



Training Manual **Green Growth and Resource Efficiency for DRR** Towards Green Economy and Resilient Development



Resilient India - Disaster free India

National Institute of Disaster Management
(Ministry of Home Affairs, Government of India)



Towards Green Economy and Resilient Development

National Institute of Disaster Management

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Training Manual on Green Growth and Resource Efficiency for DRR: Towards Green Economy and Resilient Development

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MESSAGE

Climate change implications are grave as witnessed by more frequent extreme weather events and intense disasters, hampering life, growth and development globally. The paradigm shift in disaster management from a response and relief-centric approach to a mitigation and prevention-centric approach may have helped in reducing the loss of lives, however, we struggle in reducing the associated loss and damages.

Green Growth promotes economic growth and development while ensuring that our natural assets remain healthy and provide us with the resources and services, thus green growth holds tremendous potential for disaster risk reduction. Green growth pathways are circular, inclusive and promote resource efficiency in systems and processes. Effective planning and promotion of green growth strategies can aid in achieving India's commitments to the global developmental targets and goals of the Paris Climate Agreement, Sustainable Development Goals, Sendai Framework for Disaster Risk Reduction and Nationally Determined Contributions.

This training manual on *"Green Growth and Resource Efficiency for DRR"* has highlighted some of the important green growth approaches and tools including urban green growth, green industries and nature-based solutions which will help in transitioning towards a green economy and a more resilient future. This manual will act as a guidance and knowledge document for developing the understanding of sustainable development, and carbon neutrality guidelines for the pathways to achieve Green Growth in all sectors of development.

(Akhilesh Gupta)



FOREWORD

Green Growth has gained recognition in the recent years due to its ability to bring in economic growth, social well-being, and development while at the same time focusing on conserving the environment and natural resources. Climate change implications are being witnessed in multiple forms including increased hazards, extreme events, and hydro-metrological disasters. The current UN report suggests that by 2040 disasters will increase by 40%. It is therefore, imperative to build so it is thus imperative to build upon capacities and work on effective adaptation and risk mitigation strategies to reduce risk vulnerability.

The National Institute of Disaster Management (NIDM) is an apex institution under the Government of India performing the crucial role of bringing disaster risk reduction to the forefront of national agenda. It is mandated to develop knowledge products, development of capacity development and training documents and manuals. CAP-RES caters to the knowledge gaps and capacity-building needs in terms of climate change and related extreme events. The five themes under CAP-RES provide value addition to the sub-thematic areas of the National Mission on Strategic Knowledge for Climate Change through knowledge-sharing documents. This manual has been developed to highlight the regional priority areas for climate and ecosystem-specific needs and possibilities for Green Growth and promote knowledge sharing around the themes and approaches of Green Growth.

I hope that the training manual will serve as a vital reference document for researchers, practitioners and academic fraternities.

(Taj Hassan)

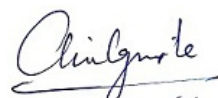


PREFACE

The concept of green growth encourages the basic idea of sustainable economic growth wherein development and ecological sustainability reinforce each other. The idea fosters Nature Based Solution (NbS), i.e. investments in ecological assets that can play vital role in climate change mitigation and disaster risk reduction. Economic efficiency and Environmental protection are two mainstays of green growth. It promotes resource-efficient, sustainable, cleaner and more resilient growth processes while fostering economic growth and development which could be materialized through internalizing ecological cost, maximizing resource efficiency and minimizing pollution. Green growth is expected to switch the current carbon-based economy to an ecological-based green economy.

The training manual on “*Green Growth and Resource Efficiency for DRR*” tries to understand the knowledge gaps and needs to build capacity in the sub-thematic area of Green Growth and Disaster Risk Reduction. The focus of the module is to promote preparedness through adaptive. Management of urban and rural ecosystems through resource-efficient, low carbon, socio-economically inclusive and holistic approaches as key drivers to attain the priority areas of SDGs.

This manual will provide an insight to the trainees for a basic understanding of the themes, approaches and pathways of green growth and its application in disaster risk reduction.



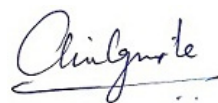
(Anil K. Gupta)

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I sincerely acknowledge Shri Taj Hassan (IPS), Executive Director, NIDM for his constant support and encouragement in undertaking the study and ensuring its smooth functioning. The preparation of this training manual has been expedited with the help of Dr Shweta Baidya Das (Consultant, NIDM), Ms Pritha Acharya (Research Associate, CAP-RES NIDM), Ms Mahak Agrawal (Development and Outreach Lead, INACTUS) and Ms Shruti Bansal (Karo Sambhav). A special lot of thanks to Ms Pritha Acharya, for designing and coordinating the printing of the manual. I am also thankful to Mr Nilesh Maiti for providing us with the cover photograph.

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Prof. Anil K Gupta
Project Director
CAP-RES Project

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About the Training Manual

Training Design and Training Brief

Climate change is no more a myth, with the several warnings from Intergovernmental Panel on Climate Change, we need to reduce 45% of the present global CO₂ emission to reach the level by below 2010 level by 2030 and an ambitious goal to achieve Net Zero by 2050 to arrest the temperature within 1.5°C by the end of this Century (IPCC, 2018). Excess Green house gas emission has forced a 0.7°C increase in average temperature of India. Future estimates for India shows that the this might even increase to 2.7°C and 4.4°C by the end of 2099 and the Century respectively (MoEs, 2020). India has an ambitious goal of turning into a US\$ 5 Trillion economy for which India should promote Climate proofing of Economy and resilient Development across all sectors. Therefore, Strategic policy intervention and investment is required to achieve Sustainable Development Goals in terms of Economic, Social and Environmental aspects.

Cities are the most influencing factor towards climate change. Even though cities incorporates < 2 % of the Earth Surface, it produces 60% of the total green house gas by using 78% of the total global energy (WHO, 2018). This situation is even going to become worse by 2050 when ~68% of the total global population will start residing in urban areas (UNDESA, 2019) and in India 50% of the total population will live in urban areas (Tewari et al. 2016). But unfortunate many of the Indian cities are experiencing rapid decline in blue green infrastructure due to rapid urbanization (Ramachandra et al. 2017). The idea of Blue Green infrastructure is new in India, We should include this idea in the policy intrevention to successfully implement this all over India to safeguard ourselves from disasters (Rajput 2020, Mankikar, 2021).

Green growth is fostering economic growth and development while ensuring that the natural assets continue to provide resources and environmental services. There is a significant opportunity to integrate green growth strategies for disaster risk management and adaptation benefits in urban, rural, infrastructure, industrial and business settings. Keeping this in mind five modules are included in this manual. The manual provides a distinctive platform for integrating the various aspects of green growth including green industry, green economy, urban green growth and the use of effective strategies like NbS to promote climate resilience and sustainability.

The training manual has been developed as a part of the project Climate Adaptive Planning for Resilience and Sustainable Development in Multi-hazard Environment (CAP-RES) being implemented by the National Institute of Disaster Management (NIDM) with the support of the Department of Science and Technology (DST), GoI. The project supports the National Knowledge Mission on Climate Change (NKMCC) through developing a series of knowledge products including a toolkit for training capacity building including training strategies and designs, training modules, instruction manual, reference readings, using the outcome of capacity gap analysis and knowledge-based compendium. This training manual is It is an outcome of CAP-RES's 'International Symposium on Disaster Resilience and Green Growth for Sustainable Development' and brought out as part of one of the five themes of CAP-RES i.e. Green Growth and DRR.



It is designed to build capacity, improve the existing knowledge and create awareness among officials, researchers, academicians, students and practitioners at national, state and district/local levels across multiple sectors including water, urban planning, disaster management, climate change, health, energy, agriculture etc. regarding the Green Growth and its practices. The manual will also act as a guidance and knowledge document for developing the understanding of sustainable development, and carbon neutrality guidelines for the pathways to achieve Green Growth in all sectors of development. The manual was developed after carrying out training need analysis (TNA) to understand the opportunities, capacity needs, strategies & tools, policy priorities etc. related to green growth for sustainable development.

The training manual has been designed with an aim to address the capacity gaps around two central needs

- 1** What are the priorities for regional, climate and ecosystem-specific needs and possibilities for Green Growth? *A detailed situational analysis was done to identify the existing developmental needs and gaps at regional and local levels.*
- 2** What are the suitable pathways, approaches and entry-points for resilience building towards a greener system? *A focus on promoting preparedness through adaptive management of urban and rural ecosystems through resource-efficient, low carbon, socio-economically inclusive and holistic approaches as key drivers to attain the priority areas of the SDGs.*

Aim of the Training Manual

This training manual aims to strengthen the understanding of all government officials at the national, state and local (panchayat, urban and district) levels, institutions, private sectors, policy-makers, NGOs, CSOs, practitioners, academicians, researchers, students regarding the concept of Green Growth, Sustainable Development, Carbon Neutrality, Circular Economy, Green Industries and Nature-Based Solutions (NbS). The manual will build the capacity of the target groups to implement understanding and concepts of green growth for societal development.

Training Objectives

At the end of the training the participants should be able to:

- Identify and analyse the potential risks and vulnerabilities of the environment and local ecosystem.
- Impart an understanding of the concept and importance of green economy and green industry and urban green growth.
- Analyze and understand the social implications of Green Growth, carbon Neutrality, Nature-Based Solutions (NbS) and Ecosystem Services.

- Impart an understanding of the value of ecosystem services and Nature-Based Solutions (NbS) and their benefits in green growth.
- Assess the value of a green economy, scope and opportunities in a sustainable future.
- Identify and enlist key sectors for expanding and accelerating the transition to a green economy model.
- Identify the need and challenges for developing and implementing green industries.
- To enumerate the pathways and opportunities and identify strategic planning and management framework to address challenges in green growth.

Target Groups/Audience

The training manual has been developed keeping in mind the performance gaps and the knowledge needs of the following group of participants:

- Senior to middle-level officials from the state and local level bodies [district bodies/Upper-Level Bodies (ULBs) and Panchayats] from line departments: Ministry of Health & Family Welfare (MoHFW), Ministry of Home Affairs (MHA), Ministry of Housing and Urban Affairs (MoHUA), MoUD, Ministry of Environment Forest and Climate Change (MoEFCC), Ministry of Rural Development (MoRD), Ministry of Corporate Affairs (MoCA), Department of Water Resources, Department of Information Technology & Telecommunication, Ministry of Road, Transport & Highways, Ministry of Jal Shakti etc.
- Executives/professionals from other Government agencies/boards, programmes/schemes, including public sector undertakings: India Meteorological Department (IMD), CWCs, ISRP, DOT, CPWD, SDMAs, DDMAAs, SPCB, CPCB, NDRF, MCDs, EMR, National Centre for Disease Control (NCDC), State Health Departments, CMO, CGHS etc.
- Members/representatives of non-governmental and community organizations engaged in activities related to assessment, planning, implementation or monitoring of any aspect of disaster risk and management, public health development, occupational health and safety etc.

- Faculty members/professionals from training, education and research institutes and other master trainers related to public health, planning/development, environment, climate change, housing, disaster management, finance and insurance sector etc.
- Private Sector (CSR): Officials/professionals involved in water supply, sanitation, environmental/occupational health, waste management, power, industries, communication, risk management, etc. in cities.
- Local communities/community workers and others: NGOs, CSOs, RWA, Panchayats, Volunteer organizations, Bilateral etc.

Structure of the Modules

This training manual offers a training tool along with course guidelines which will enable participants to develop a holistic view of hazards and vulnerabilities associated with climate change-related disasters and uncontrolled and unplanned developmental infrastructure. The manual will also provide an understanding of the appropriate mitigation and preparedness measures to deal with those risks and vulnerabilities concerning climate change related disasters and knowledge about building **“Green Resilience”**. The module provides a good mix of theoretical and practical exercises developed from various literature available on the subject across a range of sources.

The training manual consists of five modules and has been designed for a five-day course with interesting learning activities, case studies and tools to support the overall framework of the manual. The five modules are as below:

Module 1		Module 3		Module 5
Understanding and Scoping Green Growth	Module 2	Green Industry	Module 4	Nature Based Solutions (NbS)
	Green Economy		Urban Green Growth	

Learning Units

The details of the learning units under the training modules are as follows:

Module 1: Understanding and Scoping Green Growth

LU-1.1: Concept and Importance of Green Growth

LU-1.2: Approaches and Strategies of Green Growth

LU-1.3: Green Energy Opportunities

LU-1.4: Green Business and Green Skills

LU-1.5: Identifying the pathways and entry points of Green Growth

Module 2: Green Economy

LU-2.1: Principles and Strategies for a green economy

LU-2.2: Circular Economy & resource efficiency

LU-2.3: Green Finance: Tools & Mechanism

LU-2.4: Exploring Green Economy Opportunities

Module 3: Green Industry

LU-3.1: Green Industries: Concept and Scope

LU-3.2: Green and Clean technology

LU-3.3: Industrial Ecology: Potential and benefits

LU-3.4: Greening Industrial Areas: Entry Points and Pathways

Group Exercise: Interactive Discussion Scenario Based Studies

Module 4: Urban Green Growth

LU-4.1: Urban Green Growth: Concept, Scope and Opportunities

LU-4.2: Urban Green Growth Pathways and Entry points

LU-4.3: Mapping Opportunities for Urban Green Growth

Group Exercise: Cost-Benefit Analysis for Urban Green Growth

Module 5: Nature-Based Solutions

LU-5.1: Overview of Nature-Based Solutions (NbS)

LU-5.2: Nature-Based Solutions (NbS) and Ecosystem- Based Approaches (EbA)

LU-5.3: Understanding NbS and Green Growth Benefits

LU-5.4: Entry points and Pathways for NbS Mainstreaming

Group Exercise: Appreciating Nature-Based Solution: Value-Based Exercise

Selection of Trainees

The participants selected for the training programme will be based on the following criteria:

Target Level of Trainees	As specified under target group/ audience (Senior to middle-level officials/professionals/agency representatives).
Nature of the Group	Heterogeneous (from various departments, agencies and academic institutions), with representation of women colleagues.
Qualification	At least graduation and preferably post-graduation, having written and spoken ability in English/Hindi. Computer knowledge is desirable.
Medium of Instructions	Mainly English with blend of Hindi/regional language.

Pre-requisite for the Trainer/Course Faculty

The training team should consist of a minimum of three trainers, of which one shall be from the region where training is being conducted or planned. Other criteria for the course trainer are as follows:

Eligibility

Interdisciplinary expert with knowledge on climate change impacts, vulnerability and resilience, disaster risk reduction, green growth, carbon neutrality, resource management, urban planning, circular economy, ecosystem services, nature-based solution, industrial safety, planning and governance, environment and developmental planning and policy issues.

Training Approach

Friendly and informal approach and have ability to involve heterogeneous group at a single platform

Challenges to be addressed by the trainer

Motivating the participants to bring them at similar level of knowledge and experience sharing

Strategies to overcome the challenges

Provide reading materials during registration (or preferably can be mailed in advance).

Involve the participants through group exercise, video clippings and quiz sessions, etc.

Tips for using the Training Manual

Each learning unit of this training module has been developed to enhance knowledge and skills (developing capacity) through active discussions, presentations and engagement of trainees in an interactive and learning environment. To make learning easy and interesting and more participatory the following techniques can be used:

- Question-Answer/Quiz Sessions: will help in assessing and evaluating the general understanding of the concepts of green growth, carbon neutral, resource-efficient, value chain management, climate and disaster risk reduction, adaptations, strategic tools, ecosystem and nature-based solutions, sustainability, resilience etc.

- Group activities like group work and discussions: an essential component to facilitate knowledge on developing skills related to analysis, planning and formulating strategies.
- Presentations using Multimedia tools: should be included after every group work to motivate the participants for knowledge gasping, participation and sharing.
- Table Top/ Class Room Exercises: will enhance the ability of focused discussions.
- Field Visit: to be organized for group reality and situational analysis and to facilitate understanding of data collection.
- Case Studies: will provide connections with real-life situations, and success stories and establish a connection of knowledge with ground reality.

Expected Benefits:

- ✓ Capacity enhancement of the officials/professionals engaged in planning, designing, executing and/or governing various services and systems, disaster management authorities, developmental planning and actions in National, State and Local levels its sectors/departments and allied activities.
- ✓ The overall capacity enhancement of administration, academic institutions and non-governmental organizations for identification, assessment of hazards and vulnerabilities occurring from climate change, unplanned urbanization and proliferation of Peri-Urban areas, Unsustainable resource use and for mitigation, preparedness and “Green Resilience Building” towards extreme climatic events.
- ✓ Overall sensitization of officials of the local bodies and state bodies to understand the importance of Ecosystem Services and Nature-Based Solution to achieve Sustainable Development Goals.
- ✓ Improved ability to collaborate with each other both horizontally and vertically for achieving DRR, resilient & sustainable services and systems to mitigate impacts of climate change and disasters.

How to Use this Module?

1. The module can be implemented at the local, project, municipality or state level (also at the National or State/UT level with suitable modifications utilizing its flexibility). For example, at a national level, courses may be organized by concerned Ministries, Institutes/Universities and leading NGOs, whereas at the state and district level the course may be organized by SDMAs, ATIs, Public Health Institutions, Centre for Disaster Management, Climate Change Cell, etc.
2. Learning shall be facilitated by a trained trainer in a relevant subject and preferably in a Training of Trainers (ToT) course on this Manual. Appropriate resource persons shall be selected and invited as speakers/moderators for taking up the case studies and field surveys-based technical sessions. It is advisable to conduct Training of Trainers (ToT) courses in every State in order to build their capacities in conducting training programs at the sub-national level.
3. Each learning unit includes case studies, group work etc. The course facilitator shall ensure that the Manual has been taught in light befitting the target group's background, time and resources available.
4. The entire Manual is designed in a way to complete it within the given duration of about 5 days, depending upon the field visit exercise.
5. At the end of the training, a feedback session shall be conducted by the facilitators in order to understand the opportunities and shortcomings of the Manual. The session shall be complied with and appropriately included in future training programs.

Action Plan/ Post Training Assignment

It is well understood that training has more impact on the ground if a mechanism for follow-up is in place. During the first activity in this module, participants review the gaps identified throughout the training in order to identify the changes they might be able to make in their own departmental work. Working as a group, they will:

- Identify areas for future action.
- Develop criteria for prioritizing future actions.
- Prioritize these actions according to the criteria.

- Create an action plan (and framework for writing an assignment).
- Assignment submission guidelines.

This Manual presents an opportunity for capturing the motivation that participants have at the end of training and for them to return home with a tool – the action plan – to help them to focus on changes they want to make when faced with the day-to-day challenges of work. The action plan should help them build these changes into their routines, creating demands and eventually those of the department/organization.

Pre-Training Assessment

Context and description of the Session

The session shall consist of either written or oral question-answer/discussion round or under the perception level of the participants before at the entry level of the training course. This would be repeated at the end of the course (post training session) during valediction to understand the impact of the course by facilitation a comparison of entry and exit behaviour of the participants. A film can also be shown to trigger the expression of participants prevailing knowledge and/or perception on aspects of climate change, disaster risks and child vulnerability, with example from city environments.

Learning Objective	Methodology
1. To compare the entry and exit behavior of the trainees.	Question-answers Discussion
2. To evaluate the knowledge and skills gained from the training.	Ice-breaking games Film Show
3. To assess perceived competency of participants on disaster risks and climate resilient cities.	
4. To carry out a formal internal evaluation methodology using questionnaires.	

Guidance

1. Questionnaire based assessment of the participants' perception at the entry level (and also at the exit level) may be carried out.
2. The questions shall be identified/framed by the course director/coordination team looking into the course module's scope, participants profile and duties/background, and context of the film being screened.
3. It is advised that the course coordinator / trainers keep pre-developed notes as own tips and hints for delivering course session.
4. The resource person for this session is expected to have a broad knowledge of all aspects associated with on health issues, climate change impacts, resilience, disaster risk reduction, public health, health infrastructure and systems, planning and governance, environment and developmental planning issues. Ideally a team of two or three resource persons drawn with background of public health, climate change, disaster management, environment studies, epidemiology, urban development or planning. Prior experience of health services, disaster management and climate resilience should be desirable eligibility.

TRAINING MODULE

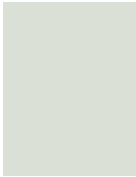
Understanding and Scoping Green Growth

1

Background and Context

The concept of Green Growth came up in the Fifth Ministerial Conference on Environment and Development (MCED) held in Seoul in March 2005.⁵² Governments and other stakeholders from Asia and the Pacific region agreed to follow the pathway of “Green Growth” to obtain a better future. A Ministerial declaration (the Seoul Initiative Network on Green Growth) and a regional implementation plan for sustainable development (UNESCAP, 2008) were adopted to achieve the goal.

Through the green growth approach, MCED sought to ensure sustained economic development by bringing in the synergies between environment and economic development. The green growth approach was fortified through various international events and steps towards the implementation of this idea. For example, the release of a National Strategy for Green Growth and the Five-Year Plan for Green Growth (which were accompanied by the enactment of a Framework Act on Low Carbon Green Growth) in 2009 by the Republic of Korea. ASEAN Leaders' Statement on Sustained Recovery and Development which includes pathways for economic resilience through promoting green growth was adopted in April 2010, at the Association of Southeast Asian Nations (ASEAN) summit in Hanoi. To elevate efforts toward green growth strategies to mitigate present and future crises, UNESCAP countries adopted the Incheon Declaration on Green Growth in May 2010. Global Green Growth Institute (GGGI) was established in June 2010, to achieve green economic growth along with poverty alleviation, job creation, social inclusion, environmental sustainability, climate change mitigation, biodiversity loss, and security to access to clean energy and potable water (Atkisson, 2012). the synergies between Green growth and the environment were recognized, at the G20 Seoul Summit in November 2010 to bring all major international organizations and think tanks and academicians together, World Bank along with UNEP, OECD and the GGGI launched a new international knowledge-sharing platform in Mexico - the Green Growth Knowledge Platform (GGKP). In India, the concept of green growth



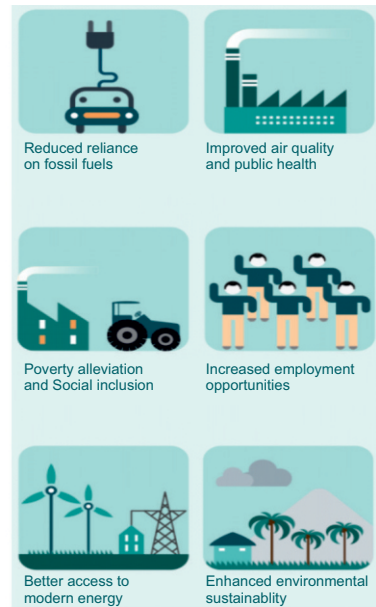
was first articulated in 2013 in the Thirteenth Finance Commission's (TFC) recommendation.

As many as 13 different definitions are identified for green growth, which includes definitions by key international organizations working in this field.

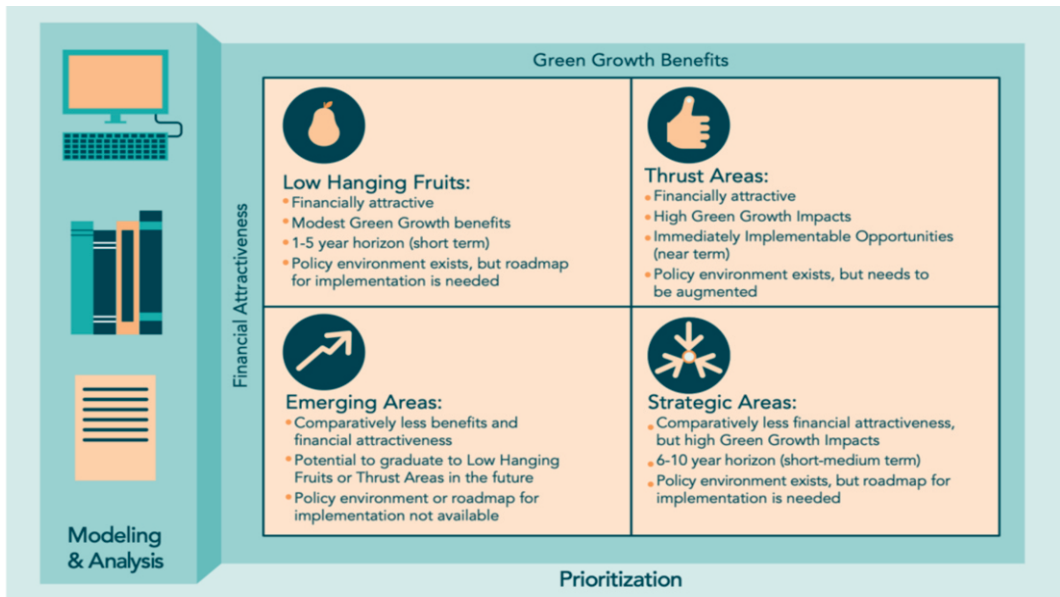
- ✓ **UNESCAP:** “growth that emphasizes environmentally sustainable economic progress to foster low-carbon, socially inclusive development.”
- ✓ **OECD:** “fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.”
- ✓ **World Bank:** “growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters.”
- ✓ **GGGI:** “green growth is the new revolutionary development paradigm that sustains economic growth while at the same time ensuring climatic and environmental sustainability. It focuses on addressing the root causes of these challenges while ensuring the creation of the necessary channels for resource distribution and access to basic commodities for the impoverished.”



Terminologies associated with Green Growth



Co-benefits of Green Growth



Criteria for Prioritization of Green Growth

Figure 1: Green Growth: Terminologies, Co-benefits and Criteria for Prioritization.
(Source: Adopted form Implementation of SAPCC: A Green Growth Approach, 2015)

Table 1: Potential Green Outcomes of Developmental Projects.
(Source: Adopted from Implementation of SAPCC:
A Green Growth Approach, 2015)

Project Goal	Environmental Benefits	Social Benefits	Economic Benefits
Agricultural and watershed development including irrigation and water conservation	1 Groundwater recharge 2 Soil moisture retention, protection and erosion control 3 Flood control (reduced risk) 4 Provisioning of irrigation for crops 5 Increased crop production 6 Carbon sequestration	1 Reduced drudgery in water collection, particularly for women 2 Increased resilience to vagaries of climate variability	1 Improved crop production and income 2 Reduced subsidies for electricity provisioning for groundwater pumping
Poverty alleviation and livelihood improvement	1 Improved tree cover if tree planting promoted	1 Community-level assets built 2 Skill building and technological upgradation of enterprises	1 Sustained income from crop production, livestock management and forestry
Land development	1 Land reclaimed for agriculture 2 Improved irrigation availability 3 Improved soil fertility 4 Desertification arrested	1 Agriculture and livelihood improvement	1 Increased income and employment
Biodiversity Conservation	1 Biodiversity conserved	1 Flow of services from biodiversity ensured	1 Sustained income from services flowing from biodiversity
Augmenting clean electricity supply	1 Enhanced access through decentralised energy sources 2 Reduced water dependence and net job benefits	1 Reduced GHG emissions through fossil-free sources	1 Higher investment costs 2 Lower fuel and operating costs 3 Energy security through reduced import dependence
Promoting efficient transportation	1 Greater affordability-enhanced access 2 Reduced air pollution 3 Reduced travel time 4 Green job gains in shifting to public transport and through electric vehicle (EV) manufacturing	1 Reduced GHG emissions	1 Higher capital and Infrastructure costs 2 Reduced oil dependence 3 Impetus to economic activity
Promoting industrial energy efficiency	1 More green jobs and sustainable livelihoods 2 Skill upgradation 3 Reduced local pollution impacts	1 Reduced GHG emissions 2 Reduced material demand	1 Industrial competitiveness 2 Reduce fossil dependence 3 Enhanced domestic demand 4 Opportunities for export promotion
Climate change mitigation and/or adaptation	1 Improved carbon sequestration 2 Reduced vulnerability of resources	1 Improved resilience of ecosystems and dependent communities	1 Vulnerability of investments reduced 2 Carbon incentives 3 Sustained flow of benefits and incomes



Figure 2: Approach for Scoping Greening Potential of Developmental Projects.
(Source: Adopted from Implementation of SAPCC: A Green Growth Approach, 2015)

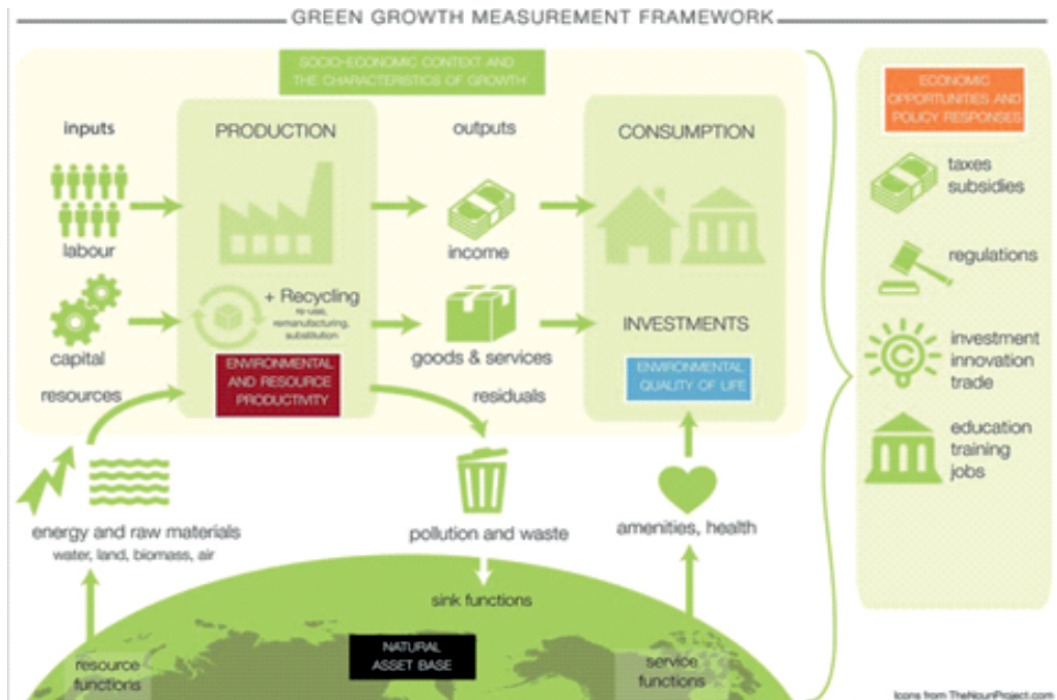


Figure 3: Green Growth Measurement Framework.
(Source: OECD Green Growth Studies, Green Growth Indicators 2017)

Training Module

This training module is on understanding and scoping green growth through adaptation to climate change and by building disaster resilience. It integrates existing and future risk factors, key sectors and future green growth opportunities towards the strategic management framework for disaster resilience. The module is developed as an overview or refresher course for sensitization aimed at increasing understanding of disaster management and resilience into the adaptation, disaster relief and recovery processes.

Four learning units are delineated under this module:

LU-1.1: Understanding and Scoping Green Growth

LU-1.2: Approaches and Strategies of Green Growth

LU-1.3: Green Energy Opportunities

LU-1.4: Green business & green skills

LU-1.5: Identifying the pathways and entry points of Green Growth

Training objectives

- Understanding the background of Green Growth.
- Discuss the scope and context of Green Growth.

Guidance

- Description of the concept and value of green growth shall be highlighted with real examples.
- Short films and case studies can be shown to illustrate the principles and benefits of Green Growth.

Methodology

- 1-2 sessions.
- Sectoral and city-specific best practices.
- Lecture and discussion.
- Question and answer.
- Experience sharing.

Resources Required

- PowerPoint presentation.
- White board.

Recommended Readings

- Implementation of SAPCC: A Green Growth Approach, A Guide for Karnataka's Policy Practitioners, 2015.
- OECD Green Growth Studies, Green Growth Indicators 2017.
- Kasztelan, A. 2017. Green Growth, Green Economy and Sustainable Development: Terminological and Relational Discourse, Prague Economic Papers 26(4):487-499. DOI:10.18267/j.pep.626.

LEARNING UNIT 1.1:

CONCEPT AND IMPORTANCE OF GREEN GROWTH

The importance of Green Growth lies in the fact that innovative aspects like green policies, innovation and investments together bring sustainable economic development. Normally Green Growth approach is taken to achieve a number of objectives towards sustainable development, by the means of no or low greenhouse gas emissions, improving resilience to extreme events or disasters and slow-onset/long-term changes by more efficient resource utilization. Sustainable and equitably-distributed increase in GDP, improved standards of living, and valuing the often economically invisible natural assets that have underpinned economic success over the centuries are important milestones of Green Growth. The proper model of green growth for India is still evolving, but with the experiences of other developed and developing countries will help shape this model (Global Green Growth Institute, 2014).

Green growth is a sustainable development model which emphasizes on strong economic growth while ensuring climatic and environmental sustainability, poverty reduction, and social inclusion. The main focus of Green Growth is to identify the root causes of the socio-economic and environmental challenges and address them through resource distribution, ensuring access to basic commodities and energy for the impoverished. Green Growth also reduces the risk of natural resource degradation and challenges posed by global climate change besides generating innovative opportunities through sustainable technologies and industries. The innovative ideas of green growth transform the way of creating economic values, the pricing of natural resources, and resource distribution with the help of smarter, greener, and more inclusive approaches and technologies.

At present time most developing countries are facing the most pressing challenges of poverty and climate change-induced extreme events. Green growth can improve livelihoods by addressing these issues. Various pathways of Green Growth can help impoverished communities increase their economic viability through harnessing and improving the value of their natural capital, and being resilient to external shocks by adopting practices that inherently improve climate outcomes (GGGI Technical Guideline No. 1, 2016).

Not only poverty reduction or climate resilience but Green Growth also can contribute positively towards increasing the Happiness index by improving the overall health condition of the people.

Therefore, the green growth “theory of change”, can be summarized as an integrated approach to sustainable economic prosperity which is characterized by:

- ✓ Enhancement of the quality and quantity of natural resources and environmental services; since the term availability of these are critical for sustainable economic growth.
- ✓ Increased natural and man-made resource productivity.
- ✓ Enhanced investment in the field of disruptive technology and innovation which opens up ways for Nature-Based Solutions.
- ✓ Catalyzed economic growth by more efficient allocation of resources as it removes the market volatility (Global Green Growth Institute, 2014).

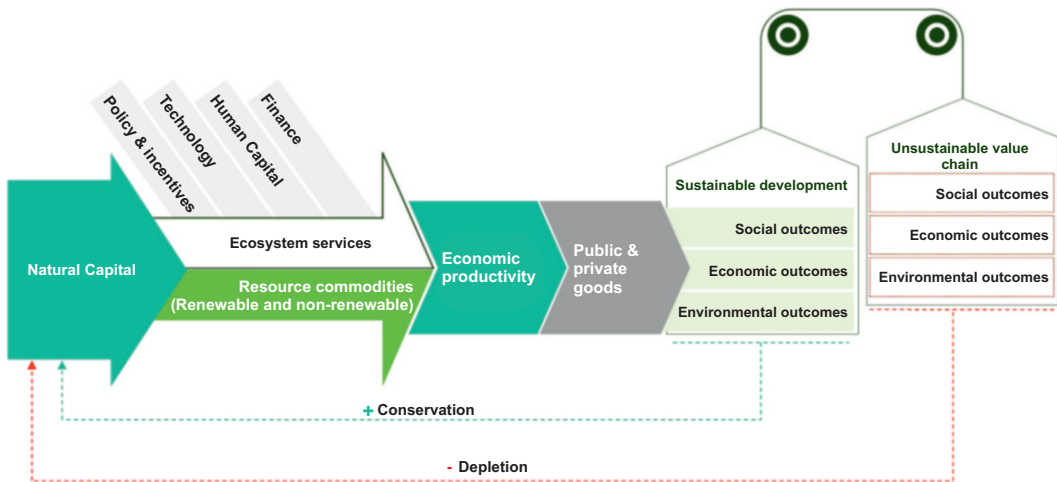


Figure 4: Green Growth Value Chain.
(Source: Global Green Growth Institute, 2014)

Learning objectives	Session(s) & methodology
● To develop the understanding of the concept of Green Growth ● To understand the importance of Green Growth	● Film or video on green economies, circular economy, green finance, resource efficiency, etc. ● Perception check questionnaire (or Q&A) ● Lecture/PowerPoint presentations ● Case study (preferably based on film) ● Group exercises ● Experience sharing ● Discussion
Guidance	Recommended readings
● Recap of prior modules' learnings and past experiences would be useful. ● Sharing of expectations from both sides - from participants as well as from the faculty/trainers and course director/coordination team is important. ● Stating the role of the participating trainees in green growth and its relevance to sustainable development would be useful in familiarization in heterogeneous background	● Global Overview, Green Growth Index 2020 ● Capasso, M.; Hanse, T.; Heiberg, J.; Klitkou, A. and Steen, M. 2019. Green growth: A synthesis of scientific findings. <i>Technological Forecasting & Social Change</i> 146. 390–402 ● Towards Green Growth, 2011. OECD - ISBN 978-92-64-094970 ● Green Growth Concepts and Definitions: Working Paper, 2014. Component 1B: Green Growth Tools: Government of Indonesia - GGGI Green Growth Program

LEARNING UNIT 1.2:

APPROACHES AND STRATEGIES OF GREEN GROWTH

Various approaches and strategies and guidelines are developed to help developing countries (Countries which are on the path of development can start the process through green, low carbon and renewable method) have a road map for green growth planning, after evaluating the lessons from other countries who have already implemented it. The already recommended or implemented operating principles provide host governments with value propositions for strategic analysis, capacity support, and stakeholder coordination.

The strategy implementation of the Green Growth process starts with a diagnosis of developmental issues for green growth, followed by a comprehensive assessment of green growth opportunities at macro and sectoral levels, prioritization and sequencing of a series of implementation actions, and building of institutional and human capacity for implementation, and, finally, progress monitoring, learning, and evaluation.

The processes aim to:

- ✓ Understand and leverage past green growth planning experiences.
- ✓ Define an empirically driven planning framework from assessment and strategy development to operationalization and implementation.
- ✓ Identify specific pathways for country-specific problems.
- ✓ Identify resources and tools for undertaking analyses and other methodologies for green growth planning.

Principles of Green Growth Planning:

- Alignment with existing and ongoing National Developmental Plans.
- Government-led process at both local and national levels.
- Broad-based engagement and coordination with stakeholders including donors, the private sector.
- and civil society.

- Space for innovation and testing.
- Political neutrality with an agenda based solely on empirical evidence and validated analysis.
- Cross-sectoral integration with institutional coordination cutting across sectors and levels.
- Flexibility depending on the specific needs of a country.

These principles would help planners and policymakers arrive at the best solution and decision. These would also balance the National, environmental, social and economic Priorities. These principles will eliminate the riskiest pathways and remain flexible with robust options for achieving green growth goals.

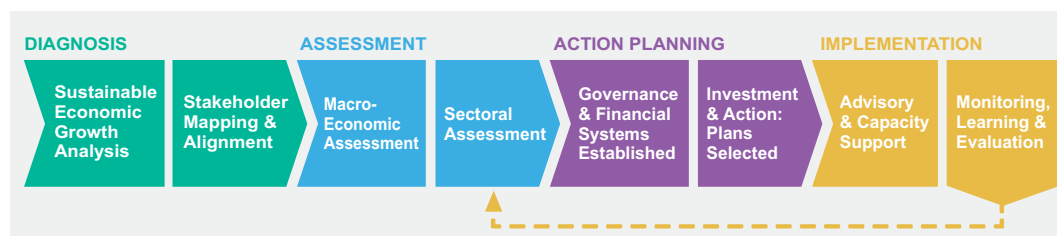


Figure 5: High-Level Planning Process.

(Source: GGGI Technical Guideline No. 1: Green Growth Planning Guidelines. Global Green Growth Institute, 2016)



Figure 6: Functions Forming Value Proposition.

(Source: GGGI Technical Guideline No. 1: Green Growth Planning Guidelines. Global Green Growth Institute, 2016)

Green Growth Planning and Implementation:

Step 1: Situation Analysis

A situation analysis is an important step in the green growth planning process, this helps in understanding the present situation of a country's economy. Through these processes all involved stakeholders, institutions governing and regulatory policies and sectors could be identified which are actively involved in economic processes. Strengths, weaknesses, opportunities, and threats analysis of partner countries can help understand the political landscape which is crucial for green growth planning. This step thus ensures that basic factors were taken care of before implementing the green growth procedures.

Step 2: Stakeholder Mapping and Political Alignment

Stakeholder involvement across sectors including various government and NGOs and institutes and alignment with existing and emerging initiatives across different geographies are important aspects of Green growth planning. Developing ownership of the stakeholders in the planning procedure, strengthens stake holder network and cooperation, and ultimately enhances knowledge sharing. Stakeholder mapping is an important beginning step of green growth planning even if the stakeholder consultation goes on throughout the process. This step is exclusively needed in developing countries to develop coordination among the stakeholders.

Step 3: Green Growth Opportunity Assessment

Green growth opportunity assessment is a step where the present scenario of the key sectors, national needs, and relevant best practices that will drive green growth forward are explored. This step involves several analyses, such as:

Global best practice and bench marking

The best practices and green growth strategies already implemented in developed countries help in policy planning and programming. Countries with similar economic condition, resource potential and governance structure can compare with each other and adopt.

National baselines

Before Green Growth Planning understanding the national baselines through the present condition of national economic, social, environmental, political, and legal conditions using green growth indicators are important for the identification of priority sectors.

Economic trends study

It is crucial to assess country's present economic condition including present development pathways, environment for economic development existing economic policies etc. to better understand the possible trajectories for future and suitable policy development.

Environmental and climate risk and vulnerability assessment

The environmental risk and vulnerability profile changes depending on the local geographic and climatic scenarios. Therefore understanding the possible ways through which the environmental and climatic hazard can paralyze the economic or social system and prepare in advance is of utmost importance.

Social development study

This step is crucial for poverty alleviation, establishing gender equality and ensure social inclusion.

Data gap assessment

Availability of genuine data is most important for above all steps. As only the quality data can ensure proper understanding of the problem areas and strategy formulation.

Step 4: Green Growth Planning Project Implementation:

This is the most important step among all. As without implementation any ideas or strategies cannot bring green development. Also, wrong strategy implementation will also not achieve the goals. Implementation stage might include formulation and implementation of a project, governance structure, or policy implementation.

Learning objectives	Session(s) & methodology
• To understand various approaches and strategies of green growth • To discuss about the principles of green growth Planning • To learn various steps of green growth planning and implementation	• 1-2 sessions • PowerPoint presentation • Sectoral and City-specific best practices • Lecture and discussion • Question and answer • Experience sharing

Enabling unit(s)

Acknowledging the value of green growth planning and implementation.

Guidance

- Brief exercise on mapping stakeholders' for green growth
- Description of the concept and value of green growth planning shall be highlighted with real examples
- Short films and case studies can be shown to illustrate the principles and benefits of Green Growth planning and implementation
- Special lectures by the representative of the country/state where green growth planning and implementation has been done

Recommended readings

- GGGI Technical Guideline No. 1
- Green Growth Planning Guidelines. Global Green Growth Institute.
- OECD Towards Green Growth: A Summary for Policy Makers
- A Framework for Assessing Green Growth Policies, OECD Economics Department Working Paper, No. 685 (2010)
- Better Policies to Support Eco innovation (2011)
- Cities and Climate Change (2010)
- Eco-Innovation in Industry: Enabling Green Growth (2010)
- Economic Policy Reforms 2010: Going for Growth (2010)
- OECD Green Growth Studies: Energy (2011, forthcoming)
- OECD Green Growth Studies: Food and Agriculture (2011, forthcoming, preliminary report)
- Resnick, D. and Thurlow, J. 2012. Green Growth: A Win-Win Approach to Sustainable Development? <https://unu.edu/publications/articles/green-growth-a-win-win-approach.html>
- Green growth strategies: a framework for the future, and the present, 2011, OECD

LEARNING UNIT 1.3:

GREEN ENERGY OPPORTUNITIES

Identifying and implementing the possible renewable energy in India is unavoidable to advance economic development, improve energy security, improve access to energy, and mitigate climate change. Sustainable development can pave through the optimal use of sustainable energy and by ensuring access to affordable, reliable, sustainable, and modern energy options for all the citizens. India has become one of the top leaders in the world's most attractive renewable energy markets due to the strong government support and the increasingly opportune economic situation led by the revolution in agricultural production and other income generation and commendable progress in technology and innovation. Indian Government have rightly designed policies, programs, and a liberal environment to attract foreign investments to ramp up the country in the renewable energy market at a truly fast pace. The renewable energy sector has immense potential to create a large number of domestic jobs in coming future.

The basic importance of Renewable energy sources lies in the fact that it play a vital role in securing sustainable energy with lower emissions (Kumar, 2016).

The use of renewable energy or green energy can dramatically reduce the carbon footprints. As generating green energy does not produce greenhouse gas thus reduces air pollution. This reduces the dependence on finite non-renewable energy sources and imported fuels. This will also create opportunities for new green jobs through manufacturing, installation and others. Green energy can either be purchased or can be directly generated from clean renewable sources. Few of the most used renewable power technologies are solar (photovoltaic, solar thermal), wind, biogas (e.g., landfill gas/wastewater treatment digester gas), geothermal, biomass, hydroelectricity, wave and tidal power etc. India has a bigger aim to attain 175 GW of renewable energy, specifically, 100 GW of solar energy, 10 GW of bio-power, 60 GW from wind power, and 5 GW from small hydro- power plants by the year 2022 (Kumar et al., 2019). Whereas the Investors are trying to achieve more than 270 GW,(in which 58 GW will be by foreign companies, 191 GW by private companies, 18 GW by private sectors, and 5 GW by the Indian Railways) which is way above the ambitious targets (Government of India, Report of the Expert Group on 175GW RE by 2022). Recent estimates show by 2047, solar potential will an

unprecedented heights of 750 GW and wind potential will be 410 GW (Sholapurkar and Mahajan, 2015; India energy Scenarios 2047, 2015).

Even if the quality and availability of renewable power sources vary, these can be used in combination with the non-renewable energy sources to reduce the pressure on the existing limited energy sources through sustainable usage. Green energy can be used in three ways:

✓ ***On-site Generation of Renewable Energy:***

Power generation at the site of use with the help of PV panels on a state building or geothermal heat pumps or biomass-fueled combined heat and power.

✓ ***Purchasing Green Power through Renewable Energy Certificates:***

Renewable Energy Certificates include Green tags, tradable renewable certificates. Purchasing power through renewable energy certificate ensures that the generated energy is from renewable sources and have used environment friendly technology.

✓ ***Purchasing Green Energy through Green Pricing or Green Marketing:***

In this system the green energy is purchased from a green pricing or green marketing programme where the buyers pay small amounts through premium for the locally produced green source electricity (United States Environmental Protection Agency, 2021).

Learning objectives	Session(s) & methodology
• To enlist and compare the green energy opportunities • To assess the feasibility of the various green opportunities	• 1-2 sessions • PowerPoint presentation • Lecture and discussion • Question and answer • Experience sharing • Case study

Enabling unit(s)

Identifying the best possible green energy sources for developing countries like India.

Guidance

- Case study-based illustrations would help map out feasibility and approaches for green energy
- Discussions and special lectures by businesses and institutions working on producing green energy would be of added value

Recommended readings

- Kumar. J and Majid Energy, 2020. Renewable energy for sustainable development in India: current status, future prospects, challenges, employment, and investment opportunities; Sustainability and Society (2020) 10:2 <https://doi.org/10.1186/s13705-019-0232-1>
- Kumar S (2016) CO₂ emission reduction potential assessment using renewable energy in India. Energy 97:273–282
- Charles Rajesh Kumar. J, Mary Arunsi. B, Jenova. R, M.A. Majid (2019) Sustainable waste management through waste to energy technologies in India—opportunities and environmental impacts .International journal of renewable energy research 9(1): 309-342.
- National Institution for Transforming India(2015), Government of India, Report of the Expert group on 175 GW RE by 2022, Available at http://niti.gov.in/writereaddata/files/writereaddata/files/document_publication/report-175-GW-RE.pdf.
- Sholapurkar RB, Mahajan YS (2015) Review of wind energy development and policy in India. Energy Technology & Policy 2:122–132
- India Energy scenarios 2047 (2015), ISGF for planning commission. Available at http://www.indiaenvironmentportal.org.in/files/file/ISGF_IES%202047%20Documentation.pdf
- <https://www.epa.gov/statelocalenergy/local-renewable-energy-benefits-and-resources>
- <https://www.iea.org/reports/renewable-energy-market-update/challenges-and-opportunities-beyond-2021>
- <https://www.investindia.gov.in/sector/renewable-energy>

LEARNING UNIT 1.4:

GREEN BUSINESS & GREEN SKILLS

Green Business

The business which practices sustainable operating procedures, green product and material sourcing, labour practices, and environment friendly shipping methods are known as Green or sustainable Business. The green business ensures the minimization of negative impact on the environment, both local and global scale depending on the size of the business. The goals of a green business also includes proactive management of waste, minimizing carbon footprint and reducing any kind of pollution that it was creating. Green business also encourages green infrastructure. Greening of business depends on the implementation of green ideas, for example.

Choosing Eco-Friendly Suppliers

Creating an eco-friendly supply chain from start to finish is important. Digital automation and implementation of AI can play important role in green supply chain management. The finished product or services by a green business also helps its customers maintain eco-friendly environment.

Creating an Efficient Office

Efficient use of resources with the help of modern technology can reduce carbon footprint. Like use of electric lighting, motion-sensor lights and use of LED and power strips, solar power, smart chargers can help reduce the energy consumption. Sunlight could be used during the daytime.

Switch to Sustainable Supplies

Swapping the daily use materials of the office to an eco-friendly option will curb office's impact on environment. For example, use of recyclable paper, both side printing, reusable water bottles and coffee mugs, eco-friendly pen made of renewable material, non-toxic cleaners and biodegradable trash bags would help reduce the carbon footprint and solid waste upto a great extent. The socially responsible business decisions can expand the idea of green business (Quick Books, 2019).

Greening Office Space

Green office space can be created using small table top plant pots or placing planter in the corners or rooftop garden. The entire building could also be designed in a smart way to reduce heating of the building. Eastgate Centre in central Harare, Zimbabwe. This shopping centre and office block is designed in a way that it is ventilated and cooled in natural way, therefore, no use of air conditioner is required.

Green Consulting

Green consulting is making business people aware of the importance of green business and suggesting them the pathways to achieve that. Green consultants would suggest the best action plan, after analyzing the individual business cases. Green consulting can expand its scope from advertising, event management to waste management.



Figure 7: Best Practices of Green Venue.
(Source: Ungerboeck, 2021)



Figure 8: Green Advertisement.
(Source: The Library of Congress, 2016)

Green Skill

Greening of economy demands for altogether a different set of skills due to the structural change of the system, new economic activity driven new occupation etc. Green skills are the combination of knowledge, values, ability and attitudes towards developing and supporting a sustainable resource efficient society. This also includes the ability for production and consumption in an environment friendly sustainable way. The Sustainable Development Goal (SDG) 9 sets a target for upgrading the existing infrastructure to a green infrastructure to make the industries green with the help of efficient use of resources and adoption of clean technologies. SDG 12 sets the goal of achieving sustainable management through efficient use of natural resources. Both the goals have to be achieved by 2030. Four important groups of tasks were identified in Green General Skill Index for green occupation viz. Engineering and technical skills, Science skills, Operation management skills and monitoring skills. Engineering and technical skills includes knowledge of eco-buildings, renewable energy design for energy saving etc. Whereas science skill encompasses knowledge about green value chain, and utility sectors like water, sewage and electricity. Operational management skills are the knowledge regarding the changing organizational structure to support increasing green activities. Monitoring skills include skills to assess technical and legal aspects of new green initiatives. Along with this four types of skills related to design, creativity, adaptability, resilience etc. is also considered important for future implementation of green growth (Arthur, 2021).

Learning objectives	Session(s) & methodology
• To learn opportunities and challenges in the field of green business and green skill my at various scales • Identify and deliberate on the pathways to tap the opportunities for including the green skills into the green businesses	• Two sessions • Lecture and discussion • Power point presentation • Experience sharing • Q&A session • Short film • Case study
Enabling unit(s)	
Exploring opportunities of green skills and green business in near future.	
Guidance	Recommended readings
• This session aims to highlight practicalities of green businesses • The session should discuss about the upcoming new opportunities of green skills • Lecture and presentation should use illustrations and practical examples.	• The LKDF and Greening: A Snapshot of the Green Skills Paper Presented at the LKDF Forum 2020, (2021). https://lkdfacility.org/news/the-lkdf-and-greening-a-snapshot-of-the-green-skills-paper-presented-at-the-lkdf-forum-2020/ • Auktor, G.V. (2020) Green Industrial Skills for a Sustainable Future, United Nations Industrial Development Organization. • Consoli, D., Marin, G., Popp, D. & Vona, F. (2015) Green Skills, VOXEU CEPR https://voxeu.org/article/green-skills • OECD Green Growth Studies, Greener Skills and Jobs, Aurther, C. 2021, What are Green Skills? United Nations Industrial Development Organization • Matthews, K. 2020. 10 Green Companies With Amazing Environmental Initiatives • https://blueandgreentomorrow.com/magazines/10-green-companies-with-amazing-environmental-initiatives/

- University of Michigan - Industrial Ecology, An Introduction <http://websites.umich.edu/~nppcpub/resources/compendia/INDEpdfs/INDEintro.pdf>US Department of Energy Smart Communities Network - Industrial Ecology
- <http://www.sustainable.doe.gov/business/indeco.shtml>
- Rockefeller University - Industrial Ecology, Some Directions for Research
- <https://phe.rockefeller.edu/publication/ie-agenda/>
- Tibbs H, 1992, Industrial Ecology: An Environmental Agenda for Industry
- <http://www.sustainable.doe.gov/articles/indecol.shtml>

LEARNING UNIT 1.5:

IDENTIFYING THE PATHWAYS AND ENTRY POINTS OF GREEN GROWTH

There are various pathways and entry points for green growth, but need to identify the proper pathways and entry points depending on the country specific or area specific problems and available resources. The stakeholder mapping and green growth opportunity assessment will help in deciding on which pathways will be appropriate for any specific area and what would be the best entry points.

Following are few examples of Green Growth Pathways: (National Council on Green Growth, Cambodia, 2013)

- ✓ Green Investment and Green Jobs Creation.
- ✓ Green Economy Management in Balance with Environment.
- ✓ Blue Economy Development with Sustainability.
- ✓ Green Environment and Natural Resources Management.
- ✓ Human Resources development and Green Education.
- ✓ Effective Green Technology Management.
- ✓ Promotion of Green Social Safety System.
- ✓ Uphold and Protection of Green Cultural Heritage and National Identity.
- ✓ Good Governance and Green Growth.



After analyzing all the existing plans and strategies, highest priority sectors for actions should be identified to achieve climate change adaptation and sustainable development. Country's climate change adaptation policies should include pathways to reduce the vulnerability in agriculture, energy, forestry, gender equality, health, infrastructure, livestock, water and disaster risk management. The National

Action Plans should include few important aspects such as decision making in various levels as per need, inclusion, access to disaster and livelihood related resources and opportunities, climate smart agriculture etc. (NAP Entry Points: Uganda, 2020). The following figure shows the priority adaptation actions as mentioned in National Adaptation Plan prepared by Govt. of Uganda (NAP Uganda).

Table 2: Priority adaptation sectors and necessary actions.
(Source: NAP Entry Points: Uganda, 2020)

Sector	Priority Adaptation Actions
Agriculture	Expand agricultural diversification, value addition, post-harvest handling and access to markets.
	Promote conservation agriculture.
	Expand extension services and support community-based adaption.
	Promote sustainable management of rangelands and pastures.
	Expand small scale water infrastructure.
	Promote highly adaptive and productive crop varieties.
	Promote highly adaptive and productive livestock breeds.
Forestry	Promote sustainable irrigation systems for agriculture.
	Promote intensified and sustained forest restoration.
	Encourage agro-forestry.
	Conserve habitats through careful use and good management practices.
	Strengthen and re-orient the conservation practice through research.
	Build on efforts to strengthen sustainable land management in fragile ecosystems.
Water	Encourage collaborative management and sustainable use of biodiversity and ecosystems.
	Promote appropriate and sustainable water harvesting, storage and utilization.
	Promote and strengthen the conservation of watersheds, catchments etc.
	Promote water harvesting and storage.
	Managing water resource systems, including wetlands, to prevent floods and conserve resources.
	Maintain current wetlands cover.

	Promote integrated water resources management.
	Promote and encourage climate resilient fishing practices.
	Promote sustainable fish farming.
	Strengthen existing national wetland policy.
	Promote and intensify wetland protection and restoration.
	Strengthen collaborative and participatory management of wetland resources.
Infrastructure, Human Settlements, Social Infrastructure, Transport Sector	Ensure land use plans and building codes for climate-resilience.
	Integrate climate change into existing infrastructure risk assessment.
Energy	Promote renewable energy and other energy sources.
	Ensure the best use of hydropower.
	Increase the efficiency in the use of biomass.
Health	Strengthen public health systems by building and supplying hospitals.
	Conduct vulnerability assessments of health sector to climate change.
	Assess the impacts of climate change on human health.
	Improve early warning systems for disease outbreaks.
	Make provision for a safe water chain and sanitation facilities.
	Improve and expand health infrastructure.
Risk Management	Improve early-warning systems and preparedness.
	Promote vulnerability risk mapping of the whole country and all sectors.
	Improve emergency related institutions and establish a contingency fund.
Tourism (not and NDC sector)	Encourage mechanisms of improving local vulnerable populations' livelihoods through tourism.
	Develop and diversify tourism products that are less sensitive to climate change.

Govt. of Uganda has also identified several entry points to implement green growth strategies for building resilience in population and ecosystem (Table 3).

Table 3: Entry points and actions for resilient green growth.
(Source: NAP Entry Points: Uganda, 2020)

Entry Point 1: Vision 2040 and the Uganda National Development Plan	Integrate with key areas of focus in the Uganda Vision 2040 on tourism, water resources, agriculture, labor force, infrastructure, STEI, land use and management, urbanization, human resources, and peace, security, and defense.
	Take actions related to these areas into consideration to build adaptation measures on national priorities.
	Ensure that key areas of the NAP align with national development priorities.
	Align NAP with NPDIII development and priority sectors.
	Integrate NAP and UGGDS to ensure equity and social inclusiveness, low emissions and sustainable economic growth, sustainable development and environment sustainability.
Entry Point 2: Uganda Green Growth Strategy	Build on existing UGGDS activities without duplicating efforts.
	Integrate SDGs into adaptation planning parallel to their integration into development planning
	Utilize UGGDS as an entry point through inclusion of climate change adaptation as a key component, as well as other key priorities such as food and nutrition security, environment and natural resource management, livelihood enhancement as well as social inclusiveness
Entry Point 3: Roadmap for Creating an Enabling Environment for Delivering on SDGs in Uganda	Benefit from alignment of the UGGDS implementation timeline with the National Development Plan and the NDPIII to integrate NAP process
	Build on SDG Roadmap which includes integration of sustainable development, multi-stakeholder participation, strengthening of institutions, setting up data and information systems, and initiating MRV processes
	Use National Coordination Framework for SDGs as an entry point for the NAP process to mainstream climate change adaptation to government coordination structures
	Engage and extend the contribution of multi-stakeholder SDG National Taskforce to the NAP process

	Build on mandates for the Roadmap and the Framework related to SDGs actions by integrating the processes of climate change adaptation and sustainable development in Uganda
Entry Point 4: NDC Review Process	Align and integrate NDCs and NAP process through NDC update and review
	Ensure that development priorities, climate hazards and risks, and the key sectors for climate change adaptation are reflected in the NDCs
	Build on the NDC priorities for elaboration and implementation
	Facilitate Uganda to have an integrated planning process for climate change and development planning by aligning NDCs, the NAP process, and development plans
	Exploit synergies and co-benefits between the NAP process and commitments under the Paris Agreement
Entry Point 5: GCF Readiness Funding	Enhance institutional capacity of the governance system related to climate change through GCF NDA Readiness Funding
	Use activities funded under this category to enhance coordination mechanisms and processes related to multi-stakeholder input and develop a monitoring and oversight system
	Address coordination gaps of adaptation actions by integrating NAP process with NDA readiness funding components
	Utilize NAP Readiness funding to facilitate an inclusive, participatory and evidence-based NAP for Uganda
Entry Point 6: Agri-NAP	Enhance NAP activities commitments and actions in Agri-NAP areas related to crop and livestock production, fisheries management, climate information, early warning and disaster preparedness, forestry, land and natural resources management
	Align NAP process with Agri-NAP to support and strengthen stakeholder partnerships among multiple stakeholders across sectors

Case Study of Karnataka

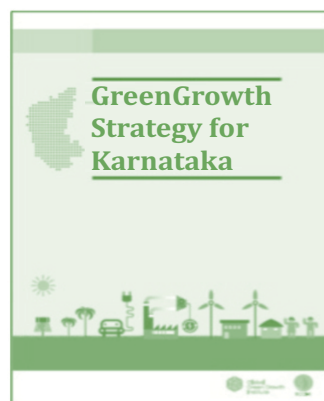
The state of Karnataka is one of India's Industrial powerhouses and a leader in the service and information technology Industries. It faces considerable sustainability challenges and seeks to become climate-resilient through green growth actions, with a particular emphasis on the energy, agriculture, forestry, and water sectors.

GGGI, in conjunction with a consortium of partners, including the Bangalore Climate Change Initiative-Karnataka, supported the state in transitioning toward sustainable growth through the project, "Mainstreaming and Implementation of Green Growth Strategies."

The initiative entailed developing a green growth strategy for Karnataka which built upon existing policies and programs, and provided a decision-making framework to policy makers. Development of the strategy included using sophisticated analytical tools and models as well as sectoral analysis focused on energy, agriculture, forestry, and water. The strategy arrived at identifying a prioritized set of green growth interventions that included electric transportation, energy efficiency, water-energy nexus in the context of the agricultural sector, and renewable energy.

As a follow-up to the strategy, GGGI also assisted the government in implementing some of the high-priority green growth opportunities, through preparing sectoral policy implementation road maps, investment projects, and capacity-building activities.

The intervention contributed to strengthening the State's Action Plan on Climate Change (SAPCC), ensuring coherence with the overarching federal National Action Plan on Climate Change, and also mainstreaming SAPCC strategies into sectoral policies and investment plans at the subnational level.



Source: GGGI, Green Growth Strategy for Karnataka (2014), http://gggi.org/wp-content/uploads/2014/12/Karnataka-GG-Report_FINAL_Web-Version.pdf

Case Study of Indonesia



The province of Central Kalimantan faces considerable challenges related to the expansion of oil palm and rubber plantations. These problems include extensive illegal deforestation, abuse of licenses, destruction of carbon-rich peatlands, encroachment into protected areas, and exacerbation of social conflicts. The incomplete spatial plan of the province complicates many of these problems, as jurisdictional boundaries and licensing authority are often unclear.

Since 2013, the Indonesia-GGGI Green Growth Program has supported the Central Kalimantan provincial government and more specifically the districts of Pulung Pisau and Murung Raya in designing and implementing green growth strategies, including mainstreaming green growth principles into their

development plans. The process is illustrated in the timetable below. The first step was to assist the district governments in assessing current plans and planning procedures and identifying entry points for green growth to support their development aims. The rubber and oil palm sectors are the biggest drivers of deforestation, but critically they are also the most important source of income for local people and the province as a whole. Therefore, green growth strategies, which identify how continuing economic growth can deliver benefits to local people while reducing environmental destruction and harmful social impacts, have targeted these sectors.

As a result of this collaboration, Murung Raya and Pulung Pisau have embraced green growth principles and practice in their development planning, and both districts have allocated funds for green growth activities. Murung Raya has earmarked IDR 52.9 billion (nearly USD 4 million) for green growth implementation in 2016, particularly the integration of green growth criteria into village development plans. The district leader has also established a green growth working group, of which GGGI is a member. Similarly, Pulang Pisau has dedicated IDR 15 million (about USD 1 million) to mainstreaming green growth in district economic development in 2016. These public investments demonstrate a real commitment by local governments to move away from destructive practices and toward a greener model of economic growth.

(Source: GGGI Technical Guideline No. 1: Green Growth Planning Guidelines. Global Green Growth Institute. 2014)

Learning objectives	Session(s) & methodology
• To identify the pathways of Green Growth • Learning the techniques and tools to identify, utilize and monitor entry points for green growth • Enumerating strategies and action plans for different vulnerabilities in varying geography	• Two sessions • Lecture and discussion • Experience sharing • Q&A session • Case study • Group exercises
Enabling unit(s)	
Evaluate and expand the pathways and entry points of green growth.	
Guidance	Recommended readings
• Brief Exercise to identify various vulnerabilities • Brief Exercise to entry points of Green Growth Implementation.	• Greening of Economic Growth Series: 1 Green growth indicators: A practical approach for Asia and the Pacific, Greening of Economic Growth Series, 4. 2013. United Nations ST/ESCAP/ 2674 • OECD (2014), Green Growth Indicators 2014, OECD Green Growth Studies, OECD Publishing. http://dx.doi.org/10.1787/9789264202030-en • GGGI Technical Guideline No. 1: Green Growth Planning Guidelines. Global Green Growth Institute. 2014 • Implementation of SAPCC: A Green Growth Approach, A Guide for Karnataka's Policy Practitioners, GGGI, 2015 • World Bank. 2012. Inclusive Green Growth : The Pathway to Sustainable Development. Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/6058 License: CC BY 3.0 IGO. • National Strategic Plan on Green Growth, 2013-2030, National Council on Green Growth, Royal Government of Cambodia, Kingdom of Cambodia Nation Religion King, 2013

TRAINING MODULE

Green Economy

2

Background and Context

There are over 95 interpretations of the Green Economy concept. It was first introduced into the scientific literature in the late 1980s via Blueprint for a Green Economy (Pearce, et al., 1989). But it was not until 2008, that the concept gained traction in international development discourse – as an approach to solve the global financial crisis and multifaceted environmental problems emerging from socio-economic systems. In 2009, the United Nations Environment Management Group established an Issue Management Group on Green Economy to prepare a report assessing how the UN system could support countries to understand and transition to a green economy. The Group identified Green Economy as an approach to achieve sustainable development – an approach that requires breaking away from resource-intensive growth models, a transformation of consumption and production into more sustainable patterns and increased value addition and reinvestment in resource-rich supplier communities in developing nations (United Nations Environment Management Group, 2011).

Defined in numerous ways by various agencies and organisations, the concept of green economy does not replace sustainability development. Rather, it amplifies the focus on economy, investment, capital and infrastructure, employment and skills for a sustainable common future. Defined as a low carbon, resource efficient and socially inclusive economy by the United Nations Environment Programme (UNEP), transitioning towards green economy calls for all hand on deck to mainstream policies, develop and implement suitable economic instruments as well as building capacities of key stakeholders – including users, implementers, regulators and industry (as indicated in Figure 9).

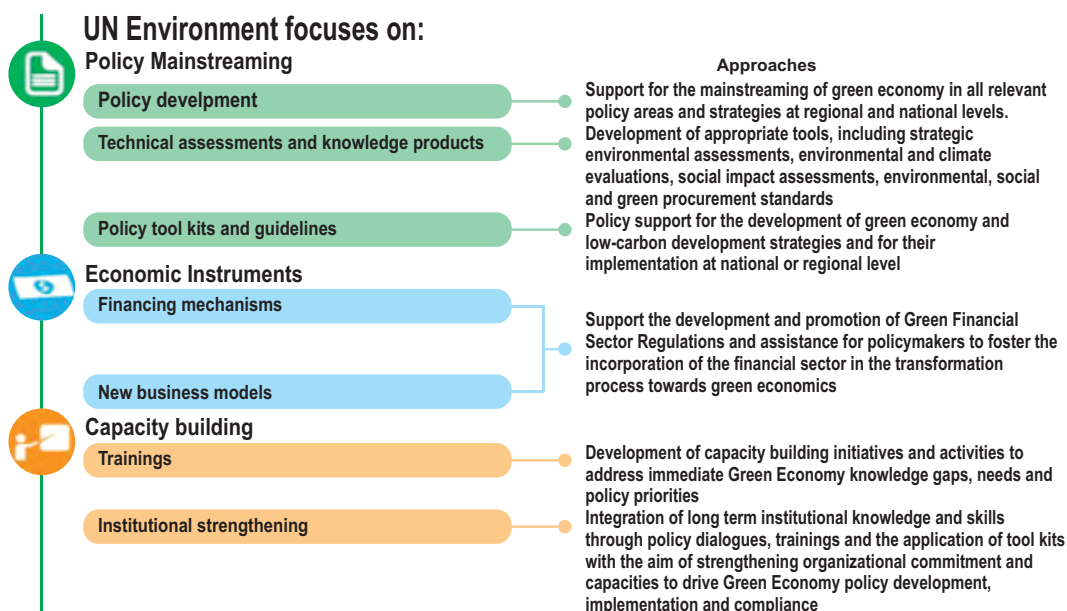


Figure 9: Focal areas of UN Environment for Green Economy.
(Source: United Nations Environment Programme, 2021)

While resource efficiency and sustainable consumption and production are critical to move towards a green economy, a circular economy envisions economies that reduce consumption of resources and generation of wastes. In addition, circular economy emphasises on reuse and recycling of wastes throughout the production, distribution and consumption processes. Together, resource efficiency and circular economy strive to close loops in use, distribution, manufacturing, extraction, innovation of products and processes (illustrated in Figure 10).

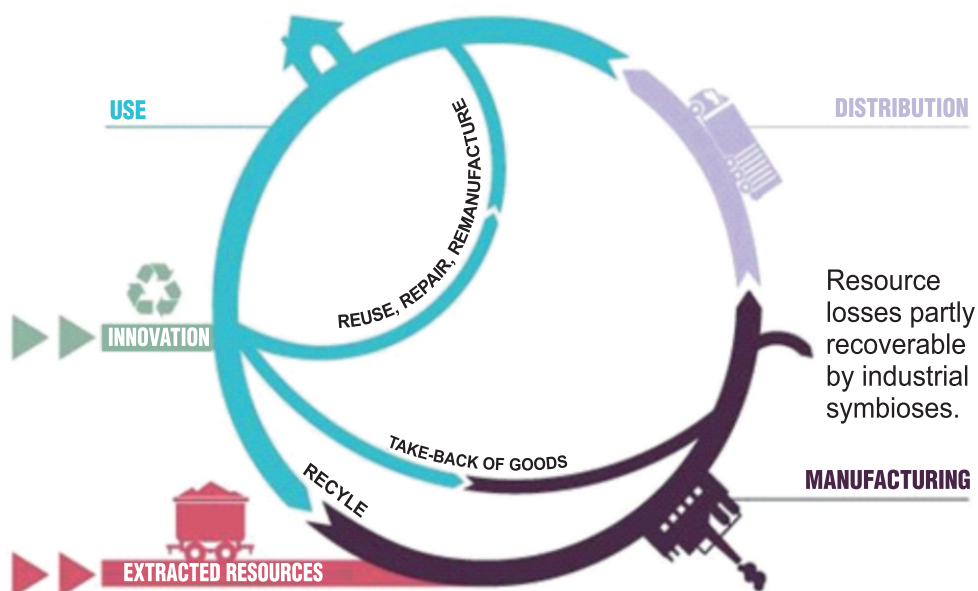


Figure 10: Circular economy allows to turn goods that are at the end of their service life into resources for others by closing loops in industrial ecosystems and minimising waste. (Source: Stahel, 24 March 2016.)

Box 2: Relationship between Circular Economy and Green Economy

Circular and green economy are two of the several global sustainability concepts, that are deliberated in public policy and academia as avenues of reconciling economic, environmental, and social pillars of sustainable future. While distinction between the two concepts is often fuzzy, operations and implementation strategies for the two differ.

Green Economy is defined as “a system of economic activities connected with the production, distribution and consumption of goods and services that results in a better human wellbeing in the long term, to avoid exposing the future generations to significant environmental risks and to the ecologic shortage”, while the circular economy represents “a development strategy that provides for the economic growth without increasing the consumption of resources and reducing the impact on the environment” Invalid source specified.

Green Economy is an umbrella concept that includes elements of the concepts of Circular Economy and Bioeconomy - such as eco-efficiency, renewables - as well as nature-based solutions. In essence, Green Economy acknowledges the critical value of all ecological processes. In contrast, Circular Economy is resource-focused. In terms of the social dimension, Green Economy is more inclusive of at local level via eco-tourism, education, etc Invalid source specified.

In closing these loops, research and innovation is needed to transform used goods into recycled atoms and new products – whilst water, energy and natural resources are extracted and enter the manufacturing processes. By renewed use of products, the need to make original products from scratch is reduced. In essence, circular economy and resource efficient models can be of two types: one, fosters reuse and extending service life; and, two, turns old goods into as-new resources by material recycling. In the green economies discourse, green finance encompasses structured financial activities that have been created or mobilised for a better environmental outcome. The European Central Bank is heavily involved in green finance, and the world's largest green bond issuing nations are the United States, China and France. In today's world striving for COVID-19 recovery, green finance is being perceived as a means to simultaneously meet the needs of environmentalism and capitalism. There is a growing international interest to raise green finance for projects on pollution prevention and control, renewable energy and energy efficiency, biodiversity conservation, circular economy initiatives, and sustainable use of natural resources and land. To sum it up, significant opportunities exist and remain untapped for green economic transition. It is imperative to identify these diverse opportunities, and further policy reforms to promote and strengthen countries around the world to reap their benefits – particularly developing countries.

Training Module

This is a basic training module on green economy and its value in our sustainable and resilient common future. It focuses on the principles of green economy, strategies and value of circular economy, resource efficiency and green financing. The module is developed as an overview or refresher course for sensitization of agencies and stakeholders working or interested to work in the domain – including authorities or officials of urban local bodies across their key departments and those dealing with developmental, disaster management, environment and climate action related professional /officials, including elected representatives, policy makers, industrial and business associations, academicians, and non-governmental organisations. There are 4 learning units in this module:

LU-2.1: Principles and Strategies for Green Economy

LU-2.2: Circular Economy and Resource Efficiency

LU-2.3: Green Finance: Tools and Mechanisms

LU-2.4: Exploring Green Economy Opportunities

Training objectives

- To assess the value of green economy, scope and opportunities in sustainable future.
- To deliberate on the key dimensions of circular economy and resource efficiency.
- To state the purpose of green finance and the role of policies and markets.
- To identify and enlist key sectors for expanding and accelerating the transition to green economy.

Guidance

- Recap of prior modules' learnings and past experiences would be useful.
- Sharing of expectations from both sides - from participants as well as from the faculty/trainers and course director/coordination team is important.
- Stating the role of the participating trainees in green economy and its relevance to sustainable development would be useful in familiarisation in heterogeneous background.

Methodology

- Film or video on green economies, circular economy, green finance, resource efficiency, etc.
- Perception check questionnaire (or Q&A).
- Lecture/PowerPoint presentations.
- Case study (preferably based on film).
- Group exercises.
- Experience sharing.
- Discussion.

Resources Required

- PowerPoint presentation.
- White board.

LEARNING UNIT 2.1:

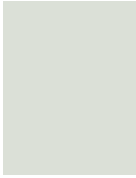
PRINCIPLES AND STRATEGIES FOR GREEN ECONOMY

Green economy is often interpreted in numerous ways. United Nations Environment Programme defined green economy as “low carbon, resource efficient and socially inclusive” economy where growth in employment and economy are driven by public as well as private investments (United Nations Environment Programme, 2021). For a green economy, these investments are geared towards economic activities, infrastructure, and assets that enable reduction in carbon emissions and pollution, enhancement of energy and resource efficiency, and preventing the loss of biodiversity and ecosystem services. Transitioning to a greener economy, thus calls for these green investments to be supported and amplified through strategic and targeted public expenditure, policy reforms, and updates to taxation and regulations. In the sustainability discourse, green economy, sustainable consumption and production, and resource efficiency play a critical role.

Sustainable consumption and production envision improvement of production processes and consumption practices to reduce resource consumption, waste generation, and emissions throughout the life cycle of products and processes. On the other end, resource efficiency includes multiple ways in which resources are used to deliver value to society. It aims to reduce the quantum of resources needed, emissions and waste generated – per unit of product or service. Green economy, however, provides a macro-economic approach to sustainable economic growth with a three-pronged focus (indicated in Figure 11).



Figure 11: Three-pronged focus of Green Economy for sustainable economic growth



Green economy requires the inclusion of the marginalized in all development processes. It also requires the reduction of gaps between developing and developed countries and regions in labour productivity and in the capacity to generate and have access to technology and scientific knowledge. Strategies need to focus on bolstering the capacity of developing countries to develop, review, and implement science, technology and innovation policies that are oriented towards green solutions to the climate, food and energy crises (United Nations Environment Management Group, 2011). Cognisant of human rights as well, tools and techniques used to formulate green economy strategies must include the principles of:

- **Principle 1:** Identifying and prioritizing action to improve the conditions of the poorest.
- **Principle 2:** Analysing the underlying power relations and the root causes of discrimination.
- **Principle 3:** Ensuring that the process and targets are consistent with international human rights standards.
- **Principle 4:** Ensuring close links between macroeconomic policy design, sectoral initiatives, governance components and principles such as transparency and accountability.
- **Principle 5:** Ensuring basic standards of civil and political rights guarantee for active, free and meaningful participation, including freedom of information, of association and access to remedies.
- **Principle 6:** Identifying indicators and setting benchmarks so that the progressive realization of socio-economic rights can clearly be monitored.

These principles and scope of action identified thereby has evolved over time (illustrated in Table 4). However, Green Economy poses a challenge to government institutions and agencies around the world – at all levels of space, time and governance – to align, converge and integrate work across the three pillars of sustainable development, i.e., economic viability, environmental protection and social equity. Significant reason for this multifaceted challenge emerges from institutional collaboration and coherence of policy approaches within national boundaries and between nations at a global scale.

Table 4: Expanding and evolving principles of green economy.
(Source: Adapted from United Nations Department of Economic and Social Affairs, 2012)

Source of Principles	Green Economy Principles
Green Economy Coalition (2012) is a group of organisations including NGOs, research institutions, UN organisations, businesses and trade working to accelerate transition to green economy.	1. Delivers sustainable development. 2. Delivers equity along the principle of justice. 3. Creates genuine prosperity and well-being for all 4. Improves the natural world. 5. Inclusive and participatory decision making. 6. Accountable. 7. Builds economic, social and environmental resilience. 8. Delivers sustainable consumption and production. 9. Invests for the future.
Earth Summit 2012 developed 15 principles for the green economy in the context of sustainable development and poverty reduction.	1. Equitable distribution of wealth. 2. Economic equity and fairness. 3. Intergenerational Equity. 4. Precautionary Approach. 5. The Right to Development. 6. Internalization of Externalities. 7. International Cooperation. 8. International liability. 9. Information, participation and accountability. 10. Sustainable Consumption and Production. 11. Strategic, coordinated and integrated planning to deliver sustainable development, the green economy and poverty alleviation. 12. Just Transition. 13. Redefine Well-being. 14. Gender Equality. 15. Safeguard biodiversity and prevent pollution of any part of the environment.

Danish 92 Group (2012) is a coalition of Danish environmental and development NGOs	1. Address systemic distortions and dis-functionalities to establish the foundation for equitable transformation and achieving sustainable development. 2. Establish clear objectives for the necessary means for action to be mobilised and defines the approach, nature and profile of these means. 3. Creates the necessary aligned framework of institutions at all levels with clearly defined roles and mandates to enable them to actively advance an equitable Green Economy. 4. Equitable Green Economy is transparent and engages all involved and affected actors, with powerful actors having clearly defined responsibilities and forms of accountability. 5. Clear timelines for action to achieve objectives, introduce new systems for measuring progression and success, and integrate the tracking of the well-being of people, places, and the planet.
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A number of countries around the world have initiated development and implementation of national green economy strategies – primarily under UNEP’s Green Economy Initiative. The latter was launched in 2008 to provide analytical and policy support for unlocking investments in green sectors, and greening of environmentally unfriendly sectors. Other agencies and organisations – such as Organisation for Economic Co-operation and Development (OECD), International Labour Organisation (ILO), Global Green Growth Institute (GGGI) – are also supporting nations in diverse capacities to further green economy policy development, strategies and actions. Five commonly used strategies for expanding and amplifying the impact of green economy include:

- **Strategy 1: Resource efficiency and green purchasing** for building green local economies. Resource efficiency and green [purchasing are two broad strategies to address consumption side of green economy, whereby purchasing power of communities is tapped to expand the efficiency of energy, water and demand for green products.
- **Strategy 2: Green economic development** strategies are adapted in green economy to build business that improves and expands environmental outcomes. Local governments, for instance, can more efficiently use resources to reduce the cost of running local government, doing

businesses, as well as lower entry barriers for new green businesses and investments.

- **Strategy 3: Local production and utilisation** creates a multiplier effect with positive impacts of local expenditures radiating throughout local economic chains.
- **Strategy 4: Waste stream management** by using innovative technologies, increasing recycling rates, and transforming waste to energy without increasing reliance on incineration.
- **Strategy 5: Green infrastructure** can be expanded in existing and new territorial systems by encouraging smart, coherent land use decisions and land budgets. Local governments can increase the quality of life of local residents and improve local business environment.

Learning objectives	Session(s) & methodology
• Stating the need and value of green economy • Enlisting and comparing strategies for mainstreaming principles of green economy into plans, policies and programmes	• 1-2 sessions • PowerPoint presentation • Case study examples at different scales of space, time and governance • Lecture and discussion • Question and answer • Experience sharing

Enabling unit(s)

Tools and technique to amplify green economy principles and strategies for our common future.

Guidance	Recommended readings
• This module includes knowledge sharing sessions on various principles and strategies for furthering green economy at various spatial and governance scales. • Tools and techniques to expand the scope and opportunities for green economy will be highlighted via practical examples or case studies. • The facilitators will have in-depth knowledge and practical experience of green economy.	• United Nations Department of Economic and Social Affairs, 2012. A guidebook to the Green Economy, Geneva, Switzerland: United Nations. • United Nations Environment Programme, 2011. Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - A Synthesis for Policy Makers, Geneva, Switzerland: United Nations Environment Programme. • United Nations Environment Management Group, 2011. Working towards a Balanced and Inclusive Green Economy: A United Nations System-wide Perspective, Geneva, Switzerland: United Nations.

LEARNING UNIT 2.2:

CIRCULAR ECONOMY AND RESOURCE EFFICIENCY

Much like the green economy – and concepts of green growth, sustainable consumption and production – circular economy is essential for realising the vision of sustainable and resilient global future. Circular economy focuses on transformation of pre-existing energy and resource intensive economies and economic functions. Distinct from resource intensive and wasteful linear economy, circular economy is restorative and resource efficient by design – urging reuse and reintroduction of materials back into the value chains instead of turning them into waste (illustrated in Figure 12). Also, circular economy approach urges shift in policy emphasis and investment priorities towards green infrastructure, emerging economic sectors and economic diversification.

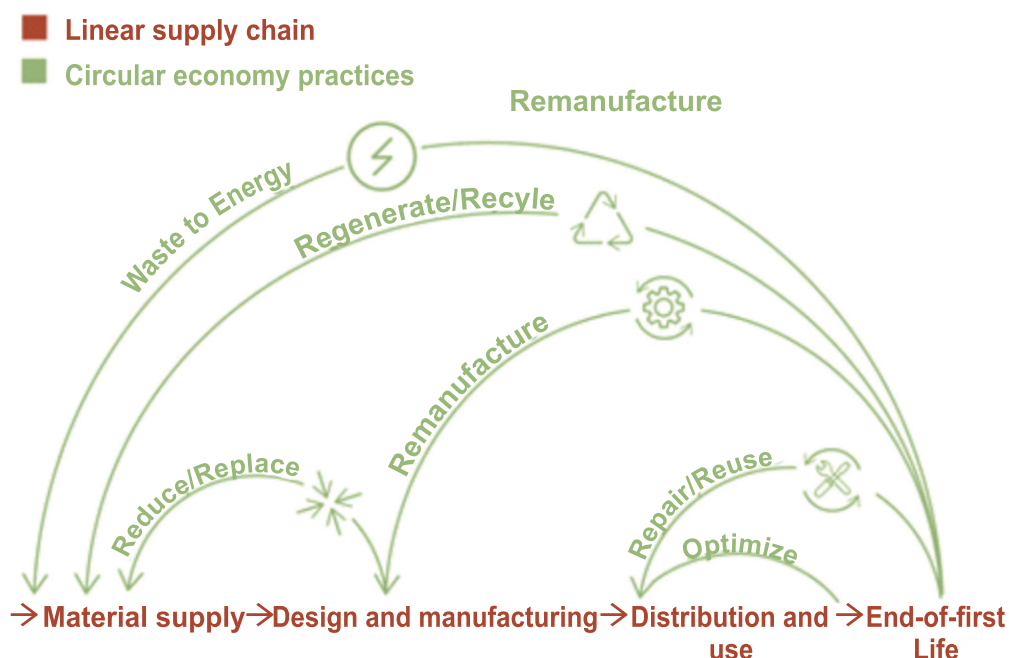
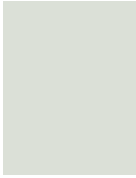


Figure 12: Difference between linear supply chains and circular economy practices.
(Source: United Nations Industrial Development Organization, 2021)



In essence, a circular economy is designed to benefit businesses, society and the environment via its systemic approach to economic development. Instead of the ‘take-make-waste’ linear model, circular economy is geared to decouple growth from consumption of finite resources – and thus, resource efficiency is critical component of this approach. There are three principles to move towards circular economy: one, design out waste and pollution; two, regenerate natural systems; and, third keeping products and materials in cyclic use (Ellen Macarthur Foundation, 2021).

With increasing market demand for sustainable investments and sustainable products, businesses around the world are presented with the opportunity to shift their operations in alignment with the circular economy principles. This shift would also help generate new profit opportunities, stronger and sustainable relationships with customers, and reduce costs due to lesser requirement of new materials. The shift is expected to benefit individuals as well – by increasing disposable incomes. But, the shift from linear to circular economy requires systemic solutions, while managing the complexities of existing systems.

Resource efficiency is geared towards using the Earth's limited resources in a sustainable manner while minimising impacts on the environment. Resource efficiency strives for creating more with less and delivering greater value with less input (European Commission, 2021). Reducing the quantity of inputs needed to produce a unit of output; helps reduce the consumption of inputs – such as raw materials, energy and water – which in turn reduces by-products including waste, wastewater, air pollution and greenhouse gases per unit of output. Resource efficiency also reduces demand on upstream supply of these inputs along with their environmental costs.

The design of consumption and production systems are central to resource efficiency outcomes; from the choice of resource inputs, to the exchange of waste material becoming feedstock for another, to recovery of materials at the end of their life. The idea of creating a ‘circular economy’ promotes the transformation of final by-products into useful inputs elsewhere by re-purposing or recycling them. Resource efficiency and pollution prevention are closely related as more efficient use of resources would typically reduce pollution risks and impacts.

Box 3: Case examples of Resource Efficiency projects in India

IGEP or Indo-German Environment Partnership (IGEP) is a joint programme of the Ministry of Environment, Forests and Climate Change, Government of India and the Federal Ministry for Economic Cooperation and Development (BMZ). Focusing on urban and industrial environmental management in India, the Deutsche Gesellschaft fuer Internationale Zusammenarbeit GmbH (GIZ) assists Government of India in managing the urban and industrial developments and transitioning towards sustainable future via resource efficiency. The programme focuses on: upscaling pilot measures for sustainable industrial and urban environmental management and climate protection; and, initiating policies and legal regulations at national, state and urban level to disseminate innovative solutions for sustainable environmental management. The programme's scope of work encompasses five thematic areas: Sustainable industrial development, sustainable urban habitat, policy for environment and climate, capacity building, climate change, and gender mainstreaming Invalid source specified..

In 2020, NITI Aayog released status paper and ways forward for achieving circular economy and resource efficiency. Cognisant of the resource efficiency ecosystem in India, the paper identified 14 priority actions and enlisted 30 recommendations, including: establishment of Bureau of Resource Efficiency (BRE); mainstreaming resource efficiency and circular economy in existing flagship missions; enabling a Modern Recycling Industry with level playing between primary and secondary producers; investing in R&D for development of scalable technologies for resource efficiency and circular economy; development and promotion of skill and capacity building programmes for informal sector; and formulation of a national policy on resource efficiency Invalid source specified..

The Resource Efficiency through Application of Life Cycle Thinking (REAL) is another project being led by the UN Environment Programme to integrate resource efficiency in global value chains. With pilot projects in India, Thailand, Guatemala, and Nicaragua, the REAL projects focus on improving the life cycle data accessibility and interoperability by facilitating global cooperation on Life Cycle Assessment (LCA) database and national LCA database improvement Invalid source specified.

Partnership for Action on Green Economy (PAGE) is another partnership project led by UN Environment Programme envisioning sustainability at the heart of economic policymaking. PAGE supports nations and regions to reframe economic policies and practices around principles and pillars of sustainability – to create income and jobs, reduce poverty and inequality, strengthen ecological foundations of economies by striving for resource efficiency Invalid source specified.

In the circular economy and resource efficiency discourse and debate, cities play a pivotal role. As energy and resource guzzlers – and producers of waste – cities also present the opportunity to effect change. Housing more than half of the global population, cities also serve as creative and innovative centres of growth. For the urban fabric, implementation of circular economy principles could foster the emergence of:

- Thriving cities in which economic productivity increases through reduced congestion, eliminated waste, and reduced costs.
- Liveable cities with improved air quality, reduced pollution, and social interactions.
- Resilient cities reducing reliance on raw materials by keeping products in use and balancing local production with global supply chains.

This transformation, however, requires an uphaul in the way urban systems are planned, designed, and financed, and how they are made, used, and repurposed.

Learning objectives	Session(s) & methodology
• Examining the importance of resource efficiency • Stating the concept of circular economy – and opportunities and challenges in an urban setting	• 1-2 sessions • PowerPoint presentation • Sectoral and City-specific best practices • Lecture and discussion • Question and answer • Experience sharing
Enabling unit(s)	
Acknowledging the value of and achieving circular economy & resource efficiency for sustainable future.	
Guidance	Recommended readings
• Description of the concept and value of circular economy and resource efficiency shall be highlighted with real examples • Short films and case studies can be shown to illustrate the principles and benefits of circular economy and resource efficiency • Brief exercise on mapping stakeholders' motivation for resource efficiency and circular economy	• Ellen Macarthur Foundation, 2021. The Circular Economy in detail. [Online] Available at: https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail. [Accessed 12 May 2021]. • Organisation for Economic Co-operation and Development, 2018. Business Models for the Circular Economy: Opportunities and Challenges from a policy perspective, Paris, France: Organisation for Economic Co-operation and Development. • Organisation for Economic Co-operation and Development, 2020. Improving resource efficiency and the circularity of economies for a greener world: Policy perspectives, Paris , France: Organisation for Economic Co-operation and Development. • United Nations Industrial Development Organization, 2021. Circular economy. [Online] Available at: https://www.unido.org/our-focus-cross-cutting-services/circular-economy [Accessed 12 May 2021].

LEARNING UNIT 2.3:

GREEN FINANCE: TOOLS AND MECHANISMS

Green finance is defined as any structured financial activity – either a product or service – that is created for better environmental outcomes. In other words, green finance includes diversity of loans, debt mechanisms, and investments to encourage the development of projects that help further sustainable development or minimise the impact on climate – or a combination of both (Fleming, 2020). For the world to transition to a low-carbon future, substantial green finance will be required for renewable energy sources, building and retrofitting energy efficient buildings, seawalls and other climate adaptive infrastructure.

To unlock public and private investments for green finance, the United Nations Environment Programme is working with countries to become compliant for green borrowing. One of the most commonly used green finance tool or instrument is the green bond – which is governed by a code of conduct (International Capital Market Association, 2018). As per the Code, a bond must adhere to criteria on the use of proceeds, have a process for project evaluation and selection, offer detailed reporting, and ensure proper management of proceeds. In 2020, the European Central Bank held nearly 20% of all Euro-dominated green bonds, and United States, China and France were reported as biggest issuers of green bonds.

Box 4: Example of Green Financing Tools and Mechanisms

Green finance, or the financial support for green growth, can be mobilised through five key sources:

1. **Retail banks** through instruments of energy equity loan, green credit card, rebates on home mortgage.
2. **Corporate banking and investments** on green property, environmental risk management, private equity and project finance. In 2021, Apple Inc. partnered with Goldman Sachs and Conservation International to invest in carbon removal initiative – Restore Fund. The \$200 million fund makes investments in forestry projects to remove carbon from the atmosphere while generating financial return for investors **Invalid source specified.**

3. **Asset management** via green indices, carbon funds, responsible investments.
4. **Insurance** such as business insurance, carbon insurance.
5. **Development banks and international financial institutions** are increasing the scope and quantum of financial support provided to nations and regions for green growth via adaptation funds, green climate fund, etc.
 - **Adaptation fund**, established under the Kyoto Protocol with an allocation of USD 778 million in 2021, gives developing countries full ownership of adaptation projects – from planning to implementation – while ensuring monitoring and transparency Invalid source specified.
 - **Green Climate Fund** invests in low-emission and climate resilient development. Established by 194 governments to limit and reduce GHG emissions in developing countries, and help vulnerable societies adapt to climate change, the GCD is mandated to contribute to the united global response to the unavoidable impacts of climate change Invalid source specified.

In essence, green finance envisions increased financial flow from public, private and not-for-profit sectors to sustainable development and for better management of environmental and social risks. Green financing can be amplified by updating regulatory frameworks, incentivising public sector funding and private sector investments for clean and green technologies, natural resource-based economies, climate smart blue economies, and other businesses striving for green economy.

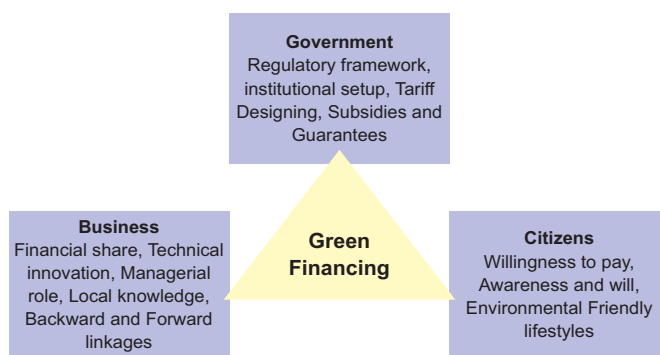


Figure 13: Focal areas for multistakeholder partnerships furthering green finance.
(Source: UN Environment Programme, 2021)

Using the approach of sustainable procurement, inclusive green economy and environmental businesses, green financing mechanisms focus on:

- Public sector support through guidelines and best practices, and interactive dialogues between private and public sector.
- Financial mechanisms such as green bonds and green insurance.
- Micro-credits for sustainable development and for pilot projects, community enterprises, etc.

To amplify and inspire green financing, multistakeholder partnerships need to include major actors operating in financial markets as well as banking institutions, investors, micro-credit institutions, insurance companies, and public companies (Figure 13). Markets and policies will need to play a fundamental role in re-aligning resource flow from high to low-carbon projects and programs. To expand green finance markets, adequate, transparent and open disclosure of information and financial risks is critical.

Learning objectives	Session(s) & methodology
• Enlisting and comparing opportunities and challenges for green financing • Assessing feasibility of different green financing tools and mechanisms	• 1-2 sessions • PowerPoint presentation • Lecture and discussion • Question and answer • Experience sharing • Case study
Enabling unit(s)	
Delineating the role and avenues of green finance in decarbonisation and sustainable future.	
Guidance	Recommended readings
• Case study-based illustrations would help map out feasibility and approaches for green financing • Discussions and special lectures by businesses and institutions working to raise or regulate green finance would be of added value	• Fleming, S., 2020. What is green finance and why is it important?. [Online] Available at: https://www.weforum.org/agenda/2020/11/what-is-green-finance. [Accessed 12 May 2021]. • UN Environment Programme, 2021. Green Financing. [Online] Available at: https://www.unep.org/regions/asia-and-pacific/regional-initiatives/supporting-resource-efficiency/green-finance [Accessed 12 May 2021].-economy [Accessed 12 May 2021].

LEARNING UNIT 2.4:

EXPLORING GREEN ECONOMY OPPORTUNITIES

Policies, research and knowledge of green economy is expanding around the world, with over 65 countries actively pursuing green economy policies and 48 of them in various stages of developing or implementing national green economy plans (United Nations Environment Programme, 2014).

Green economy opportunities are closely tied with trade at various scales of space, time and governance. Regardless of geographies and diverse backgrounds, trade influences labour rights and job generation, competitiveness, production standards of exporting countries. In essence, trade provides a rich landscape for exploration and expansion of green economy. Governments can explore how sustainability standards can help harness these opportunities for medium to long-term development and equity. It is also crucial to establish investment needs for institutional and human capital, and effective implementation.

Box 5: UAE Green Economy for Sustainable Development.
(Source: United Nations Environment Programme, 2015)

In 2012, the United Arab Emirates or UAE launched Green Growth Strategy envisioning green economy for sustainable development. The Strategy provides a national and emirate-level development plans setting course for transformation of national oil-fuelled economy to a greener economy.

In 2014, the UAE unveiled UAE State of Green Economy Report – first national reporting framework monitoring green economy transition – to inform the public about its progress in the implementation on 2012 Strategy. Emphasising on reporting and monitoring of progress on greening the economy, the UAE approach advocated for inclusive green economy and sectoral initiatives.

Nine key sectors are identified to unlock investments enabling green economy transition, including the sectors of: Oil and Gas; Transport and Logistics; Waste Management; Industry; Buildings, Construction and Real Estate; Water and Electricity; Land-use and Agriculture; Financial Services; and, Tourism and Hospitality.



Trade and non-trade opportunities for greening economy can be amplified by enhancing productivity and creating incentives for greater efficiency in the use of natural resources, reducing energy consumption, circular economy, unlocking opportunities for value creation and innovation, and strategic resource allocation to the highest value use. In addition, opening of new markets – by stimulating demand for green goods, services and technologies – and boosting investor confidence will be integral to foster strong, sustainable, and inclusive green growth.

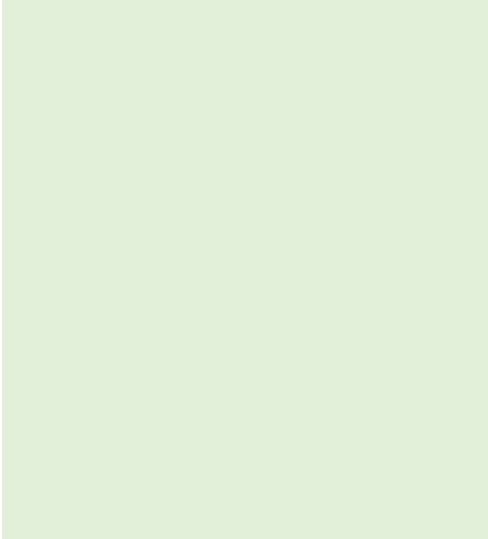
COVID-19 pandemic highlighted interconnectedness of animal health, environmental health and human health. It raised the urgency for an economic transition – a transformation that promotes sustainable well-being of individuals as well as the environment. For these multidimensional opportunities to spread far and wide – and benefit everyone in the society – governments need to clear pathways for businesses and finance to follow. The decisions policymakers, businesses and financial institutions initiate in the present will determine if the world will move and accelerate towards a more sustainable future, or not.

For instance, the UN Decade on Ecosystem Restoration is a global call for action to heal our planet. In the time frame of 2021-2030, the UN Decade on Ecosystem Restoration aims to “halt, prevent and reverse the degradation of ecosystems on every continent and in every ocean. This can help end poverty, combat climate change and prevent a mass extinction” (UN Environment Programme, 2021). In these 10 years, 10 areas of strategic action are identified including:

1. empowerment of a global movement envisioning a halt and reversal of destruction and degradation of billions of hectares of ecosystems.
2. Financing restoration on the ground.
3. Setting the right incentives for restoration – that is good for the people and the planet.
4. Celebrating leadership and momentum around restoration.
5. Shifting behaviours from local to global levels – to encourage restoration friendly consumption.
6. Investing in research to identify the best practices for restoration.
7. Capacity building of marginalised groups – including the indigenous people, women, and youth.

8. Celebrating a culture of restoration with the artists, storytellers, producers, musicians and connectors.
9. Building up the next generation of ecosystem ambassadors – to ensure that the UN Decade’s achievements outlive post-2030.
10. Listening and learning on the needs.

Learning objectives	Session(s) & methodology
• Stating opportunities and challenges in greening economy at various scales • Identify and deliberate on the pathways to tap the opportunities for green economy transition	• One session • Lecture and discussion • Experience sharing • Q&A session • Short film • Case study
Enabling unit(s)	
Exploring opportunities for green economy transition – trends, approaches, and challenges in tapping the momentum.	
Guidance	Recommended readings
• This session aims to highlight practicalities of green economy transition • The session being the final learning unit of this module should focus on discussions and experiential learning to identify approaches, risks and challenges in tapping green economy opportunities • Lecture and presentation should use illustrations and practical examples	• United Nations Department of Economic and Social Affairs, 2012. A guidebook to the Green Economy, Geneva, Switzerland: United Nations. • United Nations Environment Programme, 2011. Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - A Synthesis for Policy Makers, Geneva, Switzerland: United Nations Environment Programme. • United Nations Environment Programme, 2014. Momentum Building for a Greener and more Inclusive Economy. [Online] Available at: https://www.unep.org/news-and-stories/news/momentum-building-greener-and-more-inclusive-economy-0 [Accessed 12 May 2021].

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- United Nations Environment Programme, 2014. Trade and Green Economy Handbook and GE-TOP Projects Presented at the Green Economy Regional Forum for Latin America. [Online] Available at: <https://www.unep.org/news-and-stories/news/trade-and-green-economy-handbook-and-ge-top-projects-presented-green-economy> [Accessed 12 May 2021].
 - United Nations Environment Programme, 2015. UAE unveiled the publications of their first Green Economy report. [Online] Available at: <https://www.unep.org/news-and-stories/news/uae-unveiled-publications-their-first-green-economy-report-0> [Accessed 12 May 2021]. [Accessed 12 May 2021].

TRAINING MODULE

Green Industry : Need, Challenges and Implementation

3

Background and Context

This module of the training manual focuses on the conceptual understanding of greening existing industries and creating new green industries. The objective of this manual is to provide a broad overview of the existing industrial operations, environmental problems associated with the existing linear economy, the need of moving towards green technology, implementation of green technology in industrial areas, principals of greening the industries, challenges encountered in green industries implementation. Reader will also appreciate the idea of replicating natural ecosystem in industrial system also known by the term Industrial Ecology, principals of industrial ecology.

In some of the nations the material manufacturing and consumption is much higher than the regenerative capacity of resources. Some studies indicates (Figure 1), material consumption pattern may triple from 2008 to 2050 (BERKEL, 2012). This pattern of resource use and material consumption suggests that existing industrial operations are highly unsustainable. If this trend continues, this may lead to depletion of resources, environmental degradation and may worsen the impacts of climate change (UNIDO, Green Industry, 2011). This recommends transition towards green and sustainable industries. This will help in satisfying the demand of present generation without compromising the needs of the upcoming generation.

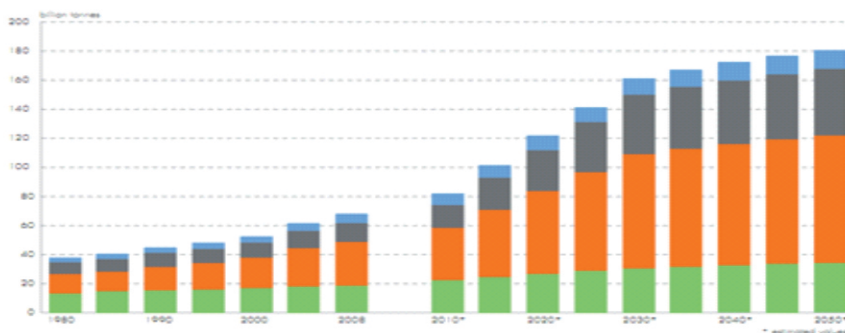


Figure 14: Global Material Consumption (Source: BERKEL, 2012)

Green Industries refer to those industries where industrial manufacturing and operation does not deteriorate environmental quality, human health and natural ecosystem functioning. Green industries considers social, environmental, climatic and health factors while designing industrial operations. Green industries are considered important for moving towards sustainable and eco-friendly development. Green industry is a two way strategy (refer figure 2) and consist of 2 components which are (i) greening the existing industries and (ii) creating new green industries (UNIDO, Green Industry, 2011).

Box 6: Green Industry.

Source: Concept prepared from (UNIDO, Green Industry, 2011)

Green Industry

1. Greening existing industries

This component is about greening all the existing industries with the intention of improving the environmental performance by minimizing the environmental impacts of industrial processes and operations. This can be done by:

- Enhancing the resource efficiency
- Improving the environmental performance
- Improving the health conditions

2. Creating new green industries

This component is about creation of industries providing environmental technologies, goods and services. This covers a broad range of services including infrastructure, installation, development and implementation of renewable energy, services in the areas related to clean technologies (e.g. clean transportation, clean energy, green buildings etc.), firms working in waste management (e.g. recycling centres, waste-to-energy centres, material recovery centres, waste collection and transportation etc.), firms working in pollution control operation (e.g. water treatment, air pollution control device etc.), environmental consultancies etc.

Green industries with its fundamental principal of environmental protection, ecosystem management and sustainable development has the potential of resolving environmental problems, mitigating climate change, adapting climate change, managing and managing the waste generated and also ensuring the green

growth of industrial sector. Development of green industries offers a wide range of benefits considering environmental, economic and social factors.

Green industries are linked with maximizing resource efficiency, utilizing clean and green technologies, minimizing waste generation etc. These factors results in lesser depletion of natural resources, less CO₂ and other GHG emissions, lesser discharge of pollutants in water bodies and into the atmosphere, minimal solid waste generation and better management waste. These all factors can considerably improve the environmental performance and with better waste management, it reduces the risk related to human health. Enhancement in resource efficiency and operation efficiency of industries, can reduce the manufacturing cost for industries. Additionally, industries complying with the environmental and sustainability standards can open up global markets for them. Industries proactively working towards improving the environmental performance of their industrial operation has better chances of adapting towards changing climatic conditions (UNIDO, Green Industry, 2011). Development of green industries, opens up new market for green business and jobs. Large section of poor population is associated with waste recycling and management services in informal sector.

Training Module

This is a basic training module explaining the concept of green industries. It covers the idea of circular economy, cleaner production, industrial ecology for developing an understanding about implementing green industries. This module is developed to provide the reader an understanding about the need of green industries, challenges and basic principals involved.

Four learning units are part of this module which are:

LU-A.1: Green Technology: Features, benefits and need for its adoption

LU-A.2: Green Industries: background, pillars, challenges and implementation

LU-A.3: Industrial Ecology: Potential and benefits

LU-A.4: Greening Industrial Areas: Entry Points and Pathways

Though implementation of green industries offers several advantages but the implementation of green industries is not as easy as it sounds. There are several challenges one has to encounter for developing green industries including lack of



infrastructure, rigidness of institutions towards accepting something new, and distorted market price of non-sustainable products (as environmental pollution cost is often ignored in non-environmental friendly goods making green products costlier).

Greening of industries is a continuous process involving collaborative efforts of multiple stakeholders including central and state government, green entrepreneurs/ industrialists, community, research institutes etc. Government as a policy making body can design policies favouring the production and manufacturing of green products by forming discharge standards of pollutants and enforcing industries to comply. Entrepreneurs working relentlessly towards optimizing the resource efficiency, improving the industrial operations designing innovative solutions towards clean technologies can be encouraged by providing some financial support or subsidies. Raising environmental awareness within the community can be helpful in generating demand for eco-friendly goods and services. Easy accessibility and sharing of information related to green technologies can bring new talent working towards contributing in implementing green technologies in industrial sector.

Training objectives

- To explain the concept of green technologies, and integration of green technologies in industrial sector.
- To describe the social, economic and environmental benefits associated with the implementation green industries.
- To enumerate key principals of implementing green industries.
- To discuss the role of industrial ecology in moving towards sustainable development.
- To enlighten the readers about the role of various stakeholders involved and their role in green industries execution.

Guidance

- Discuss expectation from the participants side helping the trainer in understanding the training deliverables with their importance.
- Discuss the profession of participants and ask them how can green technology be implemented in their working area.
- Reading material from the section 'further reading' be provided in the form of softcopy/ hardcopy.

Methodology

- Lecture and PowerPoint presentation.
- Question Answer session.
- Case study.
- Worksheet/ Group Exercise.
- Discussion.
- Experience sharing.

LEARNING UNIT 3.1:

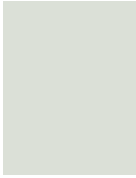
GREEN FINANCE : TOOLS AND MECHANISMS

Industrial Revolution marked the transition of agriculture and handicraft economy to the machine manufacturing. Industrial revolution is known for its tremendous benefits, few of them includes improvements in health, population growth, products affordability and better lifestyle. Not only this, it has improved the livelihood, income has risen, and more jobs are created. But the way, industries are working is highly unsustainable. Industries are working on TAKE MAKE and WASTE model currently, depleting the natural resources at a rapid rate and also generating huge amount of waste. These present practises need to be addressed with great urgency to avoid irreversible damage likely to occur on our planet.

Industrial activities are the leading cause of air, water and land pollution. The toxic chemicals industries release (sulphuric acid, nitric acid) is the leading cause of acid rain. Production in high demand is depleting the natural resources. Industries need huge of amount of water for manufacturing and processing. The water used comes in contact with variety of heavy material, toxic chemicals, sludge, radioactive waste etc. and pollute the water resources adversely.

Not only this, Industries from past several decades are harming the environment. Consider for example Bhopal Gas Tragedy of 1984, a gas leak incident that affected over 500,000 people (Encyclopaedia Britannica, 2020). The under-maintained equipment and the not so well trained staff, were identified as the leading cause of enabling the water to enter the MIC tanks. Chernobyl Nuclear Disaster of 1986, is another example of industrial disaster that happened because of human negligence.

Green technology is the generic term referring to the eco-friendly practises intended to promote sustainability, improving the environment, and to reduce the adverse impacts of human on environment. This may include reduced use of natural resources, promoting renewable energy, utilizing waste to make something new, encouraging reuse, recycling etc. Using 5 star rated appliances, electric vehicles, using recycled products, generating compost from food waste, these all comes



under green technology. Some related terminologies for green technology also include: climate smart, climate friendly, low carbon technology.

Green technology is primarily based on conservation of nature as well as humans. Better ecosystem means healthy living conditions for humans. It offers tremendous benefits not only to nature but also to humans by providing cleaner and greener environment. Let's take a look at the benefits of green technology.

Waste reduction and minimal natural resources usage is one of the prime benefits green technology provides. Post industrialization deforestation and overexploitation of forest resources is being done at an accelerated scale. Deforestation without regeneration of trees at some other suitable location can turn a green area into a desert. These natural resources are finite, extraction of these resources should be done at a rate lesser than their regeneration rate. Unfortunately, reverse is happening. Human are taking excessively more than required to maintain sustainability. The adoption of green technology can change this situation in a positive way. Green technology promotes recycling of waste, which in turn can be used to make new green products. Hence the burden on virgin natural resources extraction gets reduced. The manufactured products are designed to encourage reuse by providing easy and cheap repair options to the consumers. Recycling and reuse ultimately also helps in waste reduction.

Carbon emission is another challenge which this world is facing. Automobiles, factories, industries etc. are releasing huge volume of carbon dioxide into the air. Industries contribute to almost 30% of the global CO₂ emissions. These are also releasing dioxins, asbestos into the atmosphere. Adoption of green technology helps in reducing air pollution and carbon emissions.

Industrial processes are water intensive. Less than 1% of the earth's water is drinkable. Industries use huge amount of water, this water comes in contact with heavy metals, toxic chemicals, radioactive substances, pesticides, sludge etc. during industrial use. The resulting output water is heavily contaminated water.

At present all industrial processes (whether manufacturing, processing, transportation or packaging) are highly environmentally unfriendly. This suggest, present practices need a change, reformation and acceptance of green technology.

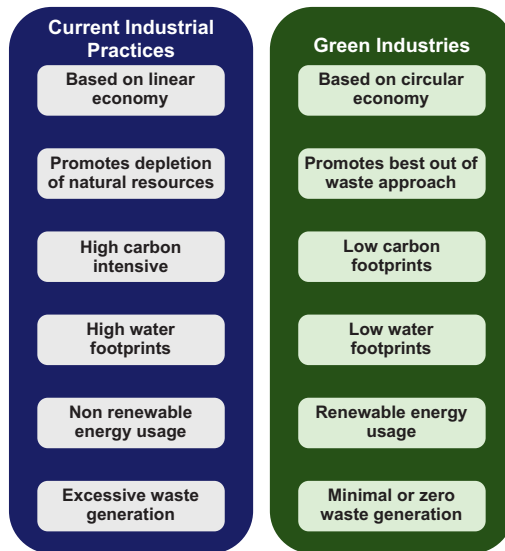


Figure 15: Features of existing and green industrial practices

Thus green industry process is the resource efficient process that increases growth and productivity in a sustainable manner, and also substantially reduces carbon footprints. The following key characteristics of green industry includes:

- Judicious/ minimal use of non-renewable natural resources.
- Renewable resource utilization at sustainable rate, which means rate of utilization should be lesser than rate of regeneration.
- Minimal waste generation based on 3R theory (i.e. Reduce, Reuse and Recycle).
- Minimal contamination to the environment.
- Cradle to cradle production.
- Clean and efficient mass.
- Control on chemical use.

Categories of green technology

Green technology is a broad area and covers a variety of technology mainly under these areas:

- **Monitoring and assessment technologies:** this involves monitoring and checking the release of harmful chemicals from anthropogenic activities deteriorating the environment.
- **Prevention technologies:** this involves adoption of technologies that are completely eco-friendly, preventing the deterioration of environment.
- **Control technology:** this involves treating the toxic substances prior to releasing in the environment.
- **Remediation and restoration:** this involves technologies that improve the environmental condition which has been degraded (UNIDO, 2021).

Departmental Integration of green technology

Agriculture

Agriculture has been supporting the mankind with innumerable resources highly desirable for the manufacturing and processing of food, clothing, furniture, medicines etc. Despite of having countless benefits, one cannot ignore the fact that agriculture is a serious threat on environment. Agriculture sector is one of the largest consumer of water and carbon footprints. Agriculture is the major source of nitrate and phosphate pollution of the water bodies. Agriculture contributes significantly to greenhouse gases emissions by emitting methane and nitrous oxide. To make agriculture sustainable and environmental friendly, integration of green technologies is highly required. Integration of clean energy for running agriculture machinery (which are currently running on fossil fuels), no-till farming, organic farming, vertical farming, optimizing the water usage for irrigation, drone use for precision farming are some of the ways for moving towards green agriculture (Taylor & Francis Group, 2003).

Energy

Production and consumption of energy substantially harms our environment. Fossil fuel consumption is the major source of energy, which is the main cause of air pollution, GHG emissions, thermal pollution etc. Petroleum handling operation deteriorates water quality, as risk of oil spillage is generally there. Mining operation



pollutes ground water as some amount of minerals may come in contact with the ground water. To avoid these damages, renewable or clean energy sources like solar, wind, geothermal, hydropower, wave and tidal power must be used. The use of clean energy is the best way to meet growing energy demand without harming the environment.

Water & Waste Management

Green technology can be applied for sustainable water and waste treatment. Green technologies can be utilized for the treatment of water, wastewater or solid waste, without generating harmful by-products. Traditional methods are costly, energy intensive, and require proper maintenance. Modern waste water technologies including bioreactor, and bio-filtration are the most accepted practices for wastewater. Sustainable waste management could be achieved by recycling the goods and products, reducing the use of waste generation, minimizing the quantity of virgin raw material for manufacturing, utilizing waste for energy generation etc.

Buildings

Building construction has significant impacts on environment, and society. Constructive activities requires huge amount of resources e.g. energy, water, construction material etc. and also emits huge quantity of waste. Construction activities contributes to about 25-40% of global carbon emissions. This sector is highly energy intensive, and consumes about 36% of world's total energy. Moreover, construction activities are the leading cause of deforestation, oil spills and habitat loss. To make buildings and construction sustainable, adoption of green technology is must. Below are some suggestions, adoption of which can be beneficial in reducing the environmental impacts of building and construction includes erosion and sedimentation control during construction, soil stabilization, strict norms of discharge of pollutants, designing zero or less energy buildings, using low emitting materials (in flooring, paint, ceilings, walls etc.), designing cool roofs, insulation, designing solar panels for energy use, water harvesting system, and using smart and energy efficient appliances (Bold Business, 2019).

Transportation

Current transportation modes are mainly based on fossil fuels consumption, which ultimately release huge amount of GHGs. Switching towards green transportation is eco-friendly and has no emission of toxic gases. Bicycle, Electric bike, Electric vehicles, Green trains, Electric motorcycles, multiple occupant vehicles, Hybrid cars

etc. are some of the examples of green mode of transportation. Because they all are in some way are reducing the environmental impact of transportation sector.

Why to adopt green technology?

Now we know, where and how to implement green technology. But for an entrepreneur or business owner the deciding factor is why to adopt it? To answer this, let's understand the strengths associated with green technology adoption:

Reduced product cost

Green technology is based on maximizing the product efficiency, with minimal resource extraction negligible waste generation, and utilizing the clean energy. On top of this recycled raw materials are used for the manufacturing, products has better durability and life.

Better product quality

Adoption of green technology helps the manufacturer in designing the products with better life expectancy and strength. The products are designed with the objective of promoting reuse, by facilitating easy repair and refurbishment.

Customer value

Eco-friendly products with lesser cost, better quality and strengths can surely improve company's competitive position. Consumers generally opt for products that are durable, has superior quality and are available at affordable pricing.

Environmental image

Green technology adoption, definitely enhances a company's green reputation which is good as more and more consumers are now becoming environmentally aware. This also helps the manufacturer in meeting environmental specification, which is sometimes necessary to export the products in other countries. The implementation of green technology can help in gaining competitive advantage over others.

Worksheet

1. What according to you is green technology? Explain some of the basic examples one can follow in daily routine, as an initial step moving towards green lifestyle.
2. An entrepreneur wants to set up a hotel, and as an environmental lover you need to convince him/ her to opt for green technology during construction,

design and operation phase. Explain some of the key points, which you will be considering.

Learning objectives	Session(s) & methodology
• To explain the concept of green technologies, and integration of green technologies in industrial sector • To make the participants understand the problems associated with the existing industrial operations and need of shifting towards green technology • To discuss the categories of green technology and integration in various departments • To enlighten the readers about the benefits of adopting green technology	• Lecture and PowerPoint presentation • Question Answer session • Worksheet/ Group Exercise • Discussion • Experience sharing
Enabling unit(s)	
Overview of Green Finance Tools and Mechanisms	
Guidance	Recommended readings
• It is necessary for the trainer to give a conceptual idea about the major industrial disasters that had taken place e.g. Bhopal Gas Tragedy, Chernobyl disaster etc. • Trainer should ask the participants to answer the questions mention in the worksheet section for the proper understanding of the learning unit	• Bold Business. (2019, January 10). Building Green – Minimizing the Environmental Impact of Construction. Retrieved from Bold Business: https://www.boldbusiness.com/infrastructure/green-construction-environmental-impact/ • Encyclopaedia Britannica. (2020, November 26). Encyclopaedia Britannica. Retrieved from Bhopal disaster: https://www.britannica.com/event/Bhopal-disaster • Taylor & Francis Group. (2003). Agriculture and the environment: changing pressures, solutions and trade-offs. In J. Bruinsma, World Agriculture: Towards 2015/2030: An FAO Study. Routledge. • UNIDO. (2021). Green Industry initiative: UNIDO. Retrieved from UNIDO: https://www.unido.org/our-focus-cross-cutting-services-green-industry/green-industry-initiative • United Nations Industrial Development Organization. (2011). UNIDO Green Industry: Policies for supporting Green Industry. Vienna: UNIDO Green Industry.

LEARNING UNIT 3.2:

GREEN INDUSTRIES: BACKGROUND, PILLARS, CHALLENGES AND IMPLEMENTATION

Industrial processes are currently unsustainable. Integration of green technologies in industrial processes seems mandatory for sustainable growth. Green industries are the answer to improving the existing economic, social and environmental conditions. Green industry encourages sustainable and responsible development by optimizing production and consumption behaviour. This results in the development which is safe, less resource demanding, low carbon-intensive, generates less waste and delivers green products which does no or minimal harm to the environment. Green industries are environmentally and economically advantageous. Greening of industries maximizes resource utilization, promotes the use of clean and efficient energy, encourages the use of secondary raw material instead of the virgin, and generates less waste. These all factors reduce the operational and maintenance cost of industries and also the product cost. Going forward let's first understand the meaning of green industries. UNIDO defines green industries as "Economies striving for a more sustainable pathway of growth, by undertaking green public investments and implementing public policy initiatives that encourage environmentally responsible private investments" (UNIDO, 2021).

Aims and objectives of Green Industries

- Enhancing the efficiency of industries and supply chain.
- Creating green products.
- Creating eco-friendly consulting firms, providing guidance and expertise on developing green industries and processes.
- Providing green services.

Green industries thus promotes sustainable production and consumption. The concept of green industry cover two areas which are (i) greening of industries and (ii) creating green industries. Greening of industries cover everything which aims at improving environmental performance and resource efficiency. Broadly the areas may include optimized resource use (it may include substituting recycled raw material instead of virgin resources), minimal solid waste generation (by proper



treatment, and by following 3 R strategy which is Reduce, Reuse and Recycle), negligible release of air pollutants (by opting for green goods), choosing renewable energy instead of fossil fuels, improving health and safety of employees/ workers, extended producer responsibility for waste management etc. The second area which is creating green industries means creating such industries that delivers environmental goods and services. This may include waste management industries, water treatment firms, clean energy sectors, green consulting firms providing analytics and expertise in areas related to environmental management (DCED, 2012).

Need for Greening the Industries

Developing countries are expanding their industries unsustainably. The present-day production and consumption pattern is putting a great amount of stress on natural resources extraction. This is also leading ineffective waste management which is ultimately leading to environmental degradation. Greening the industries is the only option to promote economic development in an environmental friendly manner. The section below explains some of the amazing environmental and economic benefits associated with greening the industries.

Economic benefits:

- Resource efficiency is the core driver for greening the industries. Efficient resource management reduces the resource input and ultimately the production cost.
- Clean and green energy reduces the dependency on fossil fuel. On top of that, green industries demands lesser energy, water, and virgin raw material. This in turns reduces the overall production and operating cost.
- Greening industries has an important role in creating green jobs. Demand for green jobs in renewable sector is rising, currently about 2.3 million population is employed globally in this sector. By 2025, India could alone generate 900,000 jobs in biomass gasification (United Nations Industrial Development Organization , 2011).
- Green industries can improve the overall health conditions of the country by facilitating access to clean water, clean air, clean energy and healthy products.

- Green industries may improve industrial competitiveness, as the industries working on the principals of green technology may get reasonable advantage over brown industries in terms of government subsidy, import/export operation (many countries demand for eco-friendly goods and services) and customer choice.
- Green industries opens up new market and new business opportunities.

Social benefits

- Green industries can bring more employment by bringing more work opportunities.
- With the greening of existing industries and creating new industries, occupational health and safety conditions of workers are enhanced and improved considerably.
- New job creation and stabilizing of existing health and working condition, green industries can help in alleviating poverty.

Environmental benefits:

- Green industries can build resilience to harmful health risk arising from the solid waste by minimizing its generation.
- Minimizes resources consumption and maximizes its efficiency.
- Minimizes water and energy usage and maximizes its efficiency.
- Reduces the stress of natural resource extraction by promoting reuse and recycle.
- Green industry development is an important step towards climate change mitigation and resilience.

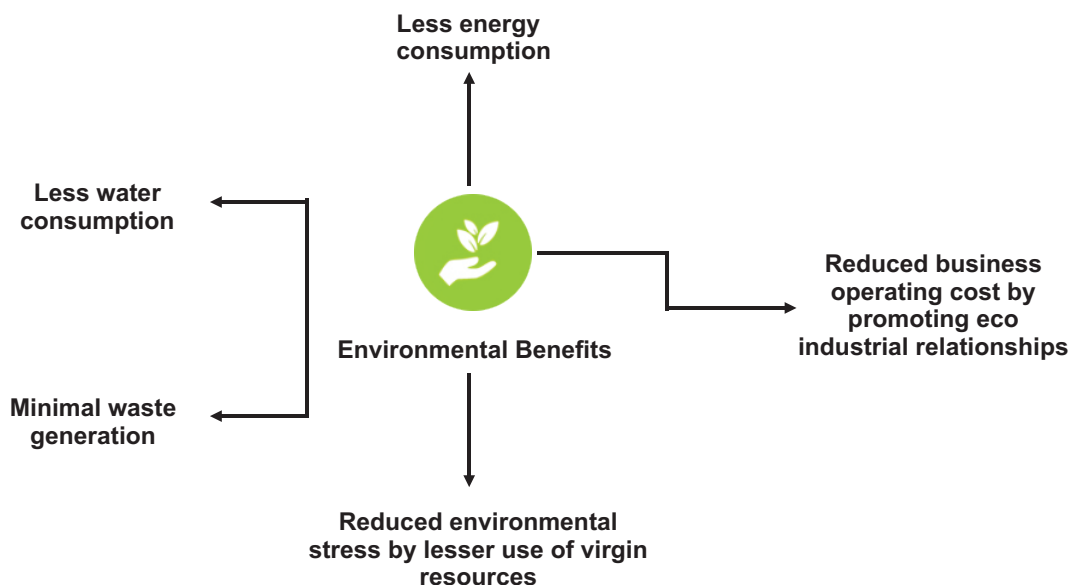


Figure 16: Environmental benefits of green industries
(Source: Authors Representation)

Greening Industries

Greening of industries requires improvement in social, economic and environmental indicators. Every industrial actions should be performed with the objective of minimizing the environmental impacts of industrial processes. This involves maximizing the resource utilization, minimizing the waste generation, utilizing clean and green energy, improving the health and safety of workers at workplace.

Developing Green Industries

This involves development of industries providing environmental goods and services. Green industries creation is a broad area that covers all such industries meant for reducing the adverse environmental impacts. It can cover green goods manufacturing, green consultancies, waste management services, pollution control device manufacturers, clean energy manufacturers, ecotourism services etc. This also includes waste recovery centres, recycling firms, energy service firms offering clean energy installation, energy saving infrastructure etc. (DCED, 2012).

Pillars of Green Industries

Circular economy

At present industries are running on linear model which is TAKE MAKE and WASTE. This means raw material are mined, processed into a product and finally discarded as waste after use.

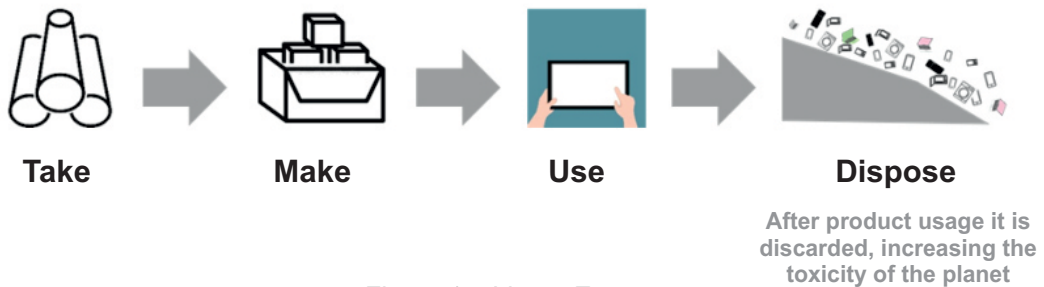


Figure 17: Linear Economy
(Source: Authors Representation)

While in circular economy we close the loop, which changes the way industrial processes are currently working. Circular economy is based on the principal of 3R which is: Reduce, Reuse, and Recycle. Based on the principal of 3R let's see how the circular economy closes the loop. The approach is simple and effective, we need to understand and tackle the major issues, which are limiting the use of raw material, generating less residual waste and using clean energy as energy resource. The approach is simple, we need to think of the waste as the resource. To manufacture new products, industries should use recycled material extracted from the discarded waste. This will certainly help in minimizing the extraction of raw material. Manufacturer should be trained to design products that are reusable. That means products should be designed in a way that they can be easily repaired. After the end of the product life, the waste should be collected in an efficient manner (using clean and green transportation), for recycling purpose. The recycled material may be used for manufacturing new products or for refurbishing the same product.



Figure 18: Illustration of Circular Economy.
(Source: Authors Representation)

Box 7: Case Study: Nike Inc.

Case study: Nike Inc.

Reuse-A-Shoe: Initiative of Nike Grind

Nike Inc., is an American based multinational industry, with its headquarter near Beaverton, Oregon. Nike is the largest supplier of athletic shoes and apparels and is one of the leading manufacturer of sports equipment.

The purpose of Nike Grind is the minimization of waste and closing the loop on Nike's product lifecycle.

Nike in 1992 came up with the idea of Nike Grind, which is the collection and recycled material from the Nike scrap, worn out shoes, and unsellable footwear. During recycling, three different material are extracted which are rubber (from the sole), foam and fabric. These separated material are then grounded into fine granules which can be reused in the manufacturing of no. of Nike products e.g. footwear, clothes, athletic ground, playground area etc. Nike grind scrap has been used successfully for the developing the sports surfaces with an area of more than 1 billion square feet globally (Chang, 2018).

Achievements

- Development of Bo Jackson Field, Nike World Headquarters by utilizing 120 Metric tons (approx.) of Nike Grind rubber.
- Manufacturing of Nike fleece sweatshirts by making use of more than 1 Million pounds of Nike Grind Textile in 2018.
- Over 3 Million pounds of Nike Grind rubber has been converted into Nike Footwear in 2020.
- Nike Grind TPU has been recycled in the form of zippers, buttons, pulls etc. and has been used in more than 500 apparels (Nike Grind, 2021).

Cleaner production (CP)

Optimizing the usage of materials, water, energy and minimizing the waste generation are the foremost requirement for green and clean production. Cleaner production involves integration of environmental strategies in industrial processes and services which results in increase in the overall efficiency and minimal negative impact on humans and environment. This pillar focusses on increasing the production efficiency, conserving the natural resources, and ensuring human safety and development. Factors to be considered in cleaner production during manufacturing involves conserving resource, minimizing energy usage, reducing the toxicity and amount of waste generation. During the stage of product usage, complete life cycle of the product is analysed and viewed for its effectiveness on environmental friendliness (El-Haggar, 2007).

Box 8: Cleaner Production by process modification
(Anbumozhi, Thangavelu, & Visvanathan, 2013)

Emission reduction by transforming conventional dyeing machine to advance dyeing machine

Conventional dyeing machines were highly resource inefficient. For one batch of processing they used

- Steam: 1480 kg
- Energy: 4191 MJ
- Water: 67 m³

- And CO₂ produced: 396 t.

While advance dyeing machine has the consumption of:

- Steam: 980 kg.
- Energy: 2794 MJ.
- Water: 30.4 m³.
- And CO₂ produced: 264 t.
- Hence, with the adoption of cleaner production in the form of process modification and equipment modification the performance was enhanced in the form of:
 - 33% reduction of steam intake.
 - 33% reduction of energy intake.
 - 55% reduction of water intake.
 - 33% reduction of CO₂ release.

Industrial ecology

Industrial Ecology is the study of flow of energy and material to understand the functioning and regulation of industrial ecosystem and its interaction with the biosphere. This is done with the objective of replicating the natural system with the industrial system to transform the industrial system into a sustainable one.

Industrial ecology aims at optimizing the management of waste and resources by promoting the interaction between multiple stakeholders. This encourages the formation of industrial ecosystem in which industries are in symbiosis similar to natural ecosystem. This is based on the principal, nothing is waste, and the waste of one can be utilized as a raw material for another.

Challenges in greening the industries

Sustainable economic growth is needed to reduce the environmental degradation led by the industrial sector. Greening of industries is advantageous but this process is challenging and complex. Greening the industries is the answer to the balanced industrial development along with environmental management. But the implementation of green industries is often hurdled by several factors. Some of them are explained below:

- Green goods and services are comparatively less profitable as compared to traditional ones. The reason could be the failure of market to truly price the goods and services considering the environmental cost.
- Existing linear economic behaviour (which is take, make and waste) is dominating over the circular one.
- Lack of technological, human and financial resources in adopting green technology.
- Environmental management and economic development are considered as separate issues. The integration of sustainability along with industrial growth is hardly reflected in any nation's development agenda.
- Resistance of entrepreneurs to invest in green industrial infrastructure considering the short-term profitability of traditional practices while ignoring the long term benefits of green technology.

Implementation of green industries

Implementation of green industries demands for long-term commitment from the government. Government should define and implement clear strategy for integrating environmental, social and economic goals in the nation's developmental agenda. The integration of sustainability and environmental management should take place both vertically (i.e. between different governmental level) and horizontally (i.e. between different governmental sectors). Financial subsidy for the green goods and services may be provided to increase their affordability. Government should organize awareness campaigns explaining the benefits of eco-friendly goods and services. Developing the skill-base is needed for sustainable economic development. Government should design educational and training programmes at every levels (i.e. primary/ secondary schools, higher education, corporates etc.) for developing the human expertise on green technology. For the monitoring and management purpose some type of policy indicators should be developed and utilized to check the effectiveness of government's initiative.

Learning objectives	Session(s) & methodology
• To explain the concept, and purpose of green industries • To describe the social, economic and environmental benefits associated with the implementation green industries • To enlighten the readers about the various challenges encountered while implementing green technologies in industrial sector	• Lecture and PowerPoint presentation • Question Answer session • Worksheet/ Group Exercise • Discussion • Experience sharing

Enabling unit(s)
Green industries background, pillars, challenges and implementation.

Guidance	Recommended readings
• Revision of green technology learning unit by recalling the key points from the participants as well as from the trainer • Trainer can enlighten the participants with the concept of circular economy, cleaner production by the providing the example mentioned as case studies	• DCED. (2012). Green Industries for Green Growth. DCED. • El-Haggar, S. M. (2007). Chapter 2 - Cleaner Production. In S. M. El-Haggar, Sustainable Industrial Design and Waste Management (pp. 21-84). Academic Press. • Tibbs, H. (1993). Industrial Ecology: An Environmental Agenda for Industries. Global Business Network. • UNIDO. (2021). Green Industry initiative: UNIDO. Retrieved from UNIDO: https://www.unido.org/our-focus-cross-cutting-services-green-industry/green-industry-initiative • United Nations Industrial Development Organization. (2011). UNIDO Green Industry: Policies for supporting Green Industry. Vienna: UNIDO Green Industry.

LEARNING UNIT 3.3:

INDUSTRIAL ECOLOGY : POTENTIALS AND BENEFITS

Industrial Ecology is a field of study focussed on study of material and energy in an Industrial Ecosystem. The idea here is to develop industrial ecosystem that work in a same way as natural ecosystem works. The objective here is to change the industrial system from linear to circular. This is done by replicating the natural ecosystem into the industrial ecosystem (Puig, 2019).

In industries the flow of energy and material can take place in any one of these form which are:

First is the linear flow, which is the currently practiced globally. Here the assumption is, there is an infinitive amount of energy and resources. This in turns generates unlimited waste, consumes huge amount of virgin resources and hence the most unsustainable economy.



Figure 19: Linear flow of resources

Second is the semi-circular flow, where one assumes, there is limited amount of energy and resources. Hence resource extraction is done at a limited rate, which in turns generates lesser waste.

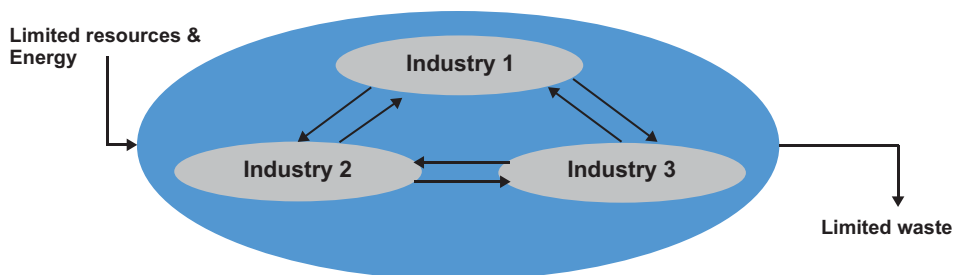


Figure 20: Semi-circular flow of resources

Last and the most ideal scenario is the circular flow, where renewable energy is utilized, no waste is generated. Manufacturing is done based on the theory 'waste-resource' that means waste of Industry 1 is utilized by 2, waste of 2 is utilized by 3 and so on.

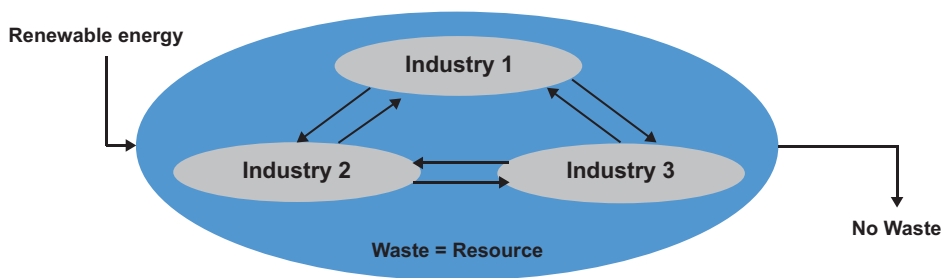


Figure 21: Circular flow of resources

Industrial symbiosis is a collective efforts of multiple organization willing to share resources and energy. Taking the reference of biological cycles, industrial ecology help companies in closing the loop, encourages the manufacturer to use natural and financial resources in a sustainable way, to minimize production, use of material and energy in order to reduce cost, to improve operational efficiency, to minimize waste, and also helps them in thinking creatively to generate alternative income by reusing and selling of waste material.

Principal of Industrial Ecology

The principle is based on six elements as very well explained by (Tibbs, 1993).

Creating the industrial ecosystem

This implies developing the industrial ecosystem in view of the natural ecosystem. This involves moving towards cyclic system and closing the loop by maximizing the product use, opting for recycling and reuse, using renewable or clean energy resources, minimizing waste generation. This also emphasis on multidimensional recycling instead of single dimensional. The concept of creating the industrial ecosystem is explained using the case of Kalundborg Eco-Industrial Park (Erkman, 2001).

Case Study: Kalundborg Eco-Industrial Park

One of the best example implementing the concept of industrial ecology is the Kalundborg in Denmark. This project was initiated to use the surface water from

Lake Tissø for an oil refinery to save ground water depletion. Kalundborg is the best example to study the functioning and working of eco-industrial park. Let's understand the various entities involved:

Table 5: Entities part of Kalundborg industrial ecological park

Companies	About them
Asnaes power station	Part of SK Power Company and the largest coal-fired plant producing electricity in Denmark.
Statoil	An oil refinery belonging to the Norwegian State oil company.
Novo Nordisk	A multi-national biotechnology company that is the largest producer of insulin and industrial enzymes.
Gyproc	A Swedish company producing plasterboard for the building industry.
Town of Kalundborg	Town receives excess heat from Asnaes for its residential district heating system.
Biotechnisk Jordrens	A soil remediation company that joined the Symbiosis in 1998.

Figure below explains how energy and material flow is taking place in Kalundborg industrial park:

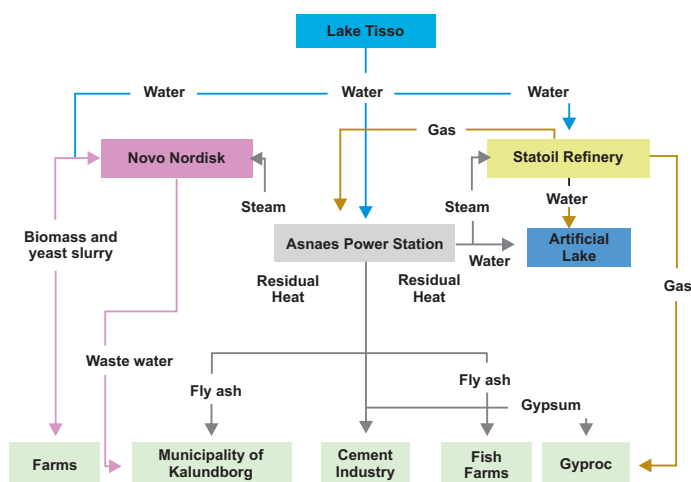


Figure 22: Material flow in Kalundborg Industrial Park (Gibbs, 2008)

Let's understand the role of various entities in material and energy flow:

Lake Tissø

This is the main source of water for the companies, part of Kalundborg Industrial Park. The use of which has reduced the consumption of ground water, by about 2 million cubic metres per year.

Statoil refinery

- Supplies it's treated and used cooling water to Asnae power station. This saves about 1 million cubic metre of water every year.
- Excess gas is treated to extract sulphur, which is sold as a raw material for manufacturing sulphuric acid.
- The clean gas is then supplied to Asnaes power station and Gyproc.

Asnaes power station

- Provides the steam to Statoil refinery and Novo Nordisk.
- In 1993, desulphurisation unit was installed to remove sulphur from its flue gases. This was utilized to produce calcium sulphate also known as gypsum. This was supplied to Gyproc, which uses it to manufacture plasterboard.
- As per research, about 190,000 tons of synthetic gypsum was produced per year.
- Residual heat is utilized for district heating system of the town.

Novo Nordisk

- Huge quantity of used biomass is produced here, which is used as a fertilizers for farming purpose.
- As per reports, about 800,000 cubic metres of liquid fertilizer and 60,000 tons of solid fertilizer is used.

<i>Reduction in consumption of resources</i>	
oil	45,000 tons/year
coal	15,000 tons/year
water	600,000 m ³ /year
<i>Reduction in waste emissions</i>	
carbon dioxide	175,000 tons/year
sulfur dioxide	10,200 tons/year
<i>Valorisation of "wastes"</i>	
sulfur	4,500 tons/year
calcium sulfate (gypsum)	90,000 tons/year
fly ash (for cement etc)	130,000 tons/year

Figure 23: Positive Impacts of Kalundborg Industrial Ecological Park (Tibbs, 1993)

Industrial Input/ Output balance

Development of industrial ecosystem demands a clear understanding of industrial input/ output and also knowing the assimilative capacity of natural ecosystem. This is important because of the fact that some amount of industrial output is released into the natural ecosystem. For this one needs to understand the current environmental condition, recovery time of natural ecosystem, effect of pollution on natural ecosystem etc. (Tibbs, 1993) This will be useful in knowing the amount of output that can be released into the natural environment, its limitations and its effect on the natural ecosystem (Srinivas, Hari, 2021).

Dematerialization

Dematerialization focusses on minimizing the use of matter and energy for the manufacturing of same products or services, ensuring the quality is not being compromised (Hond, 2001). Dematerialization can be observed in the modern computers, consuming less power with reduced weight than the earlier ones (Tibbs, 1993). Replacement of copper cable (for telecommunication) with the fibre one is another great example of dematerialization. The idea here is to generate more with lesser inputs. This will put less stress on natural resources extraction and will also generate less waste.

Improvement in industrial metabolism

Industrial ecosystems are designed to utilize all possible outputs. But in addition to this, understanding the chemical and material transformation in the industrial processes is helpful to harvest considerable environmental benefits. Industrial processes are energy demanding and generally involves high pressure and temperature. The end-product are sometimes not reused and considered as waste. Sometimes the particles are released into the air during the consumer use. The example of which is the release of fine particles from the car tyres on highways. The use of fertilizers, paints, solvents, pesticides, chemicals etc. also results in dispersion of volatile components into the atmospheres. Care must be taken to eliminate or at least in minimizing the dispersion of these harmful chemicals by adequate designing.

Industrial metabolism can be substantially improved by replicating the metabolic patterns of natural ecosystem (Tibbs, 1993). Like for example, the use of bio-mining instead of smelting has been found more economic and environmental friendly. In addition to this, product design should be done in a way it is easy to unassembled, so that the faulty part can be repaired. Other features like, better product life, easy repair, reuse and recycle should be considered while product design.

Clean energy use

Every industrial activity is energy intensive and largely the existing source is fossil fuel. Each kg of carbon in fossil releases about 3.66 kg of CO₂ (Tibbs, 1993). To make industries sustainable in a long run clean energy must be used e.g. tidal, wind, solar, nuclear etc.

Policies favouring industrial ecosystem

Government support through effective policies implementation is mandatory for promoting green industries. Green financing as a tool can be utilized for providing the environment for developing the green industries. Healthy consumer demands for green products has an important role in promoting the growth of green industries. Awareness among consumers can be created, for encouraging them to opt for sustainable products. Science and technology has an important role in developing the improved green technologies. Government can disseminate the finding of this research by organizing the workshops exhibition etc.

Learning objectives	Session(s) & methodology
• To understand the concept of industrial ecology and the underlying principles of forming an eco-industrial park • To Identify and comprehend key factors for implementation of industrial ecological parks	• Lecture and PowerPoint presentation • Question Answer session • Case study • Discussion • Experience sharing
Enabling unit(s)	
Understanding the potentials and benefits of Industrial ecology.	
Guidance	Recommended readings
• Revision of the previous learning unit green industry by recalling the key points and recollecting the importance of industrial ecology in context of green industry • It is necessary for the trainer to explain some of the famous industrial ecological park implementation • Trainer can relate industrial ecology with the natural ecological cycle by providing some examples	• Erkman, S. (2001). Industrial Ecology: a new perspective on the future of the industrial system. Geneva: Institute for Communication and Analysis of Science and Technology (ICAST). • Gibbs, D. (2008). Industrial Symbiosis and Eco-Industrial Development: An Introduction. Geography Compass, 1138–1154. • Hond, F. d. (2001). Industrial Ecology. International Encyclopedia of the Social & Behavioral Sciences, 7320-7326. • Puig, R. F. (2019). The roles of Industrial Ecology and Circular Economy: a literature review and a classroom application. UPC. • Srinivas, Hari. (2021, June 22). Industrial Ecology: Sustainable Development: Concepts. (GDRC Research Output E-008. Kobe, Japan: Global Development Research Center) Retrieved from Sustainable Development: Concepts: https://www.gdrc.org/sustdev/concepts/16-l-eco.html • Tibbs, H. (1993). Industrial Ecology: An Environmental Agenda for Industries. Global Business Network.

LEARNING UNIT 3.4:

GREENING INDUSTRIAL AREAS: ENTRY POINTS AND PATHWAYS

Industrial development is inevitable for driving economic growth in India. India aims at creating 100 million jobs via industrial sector by 2022 by forming strong manufacturing infrastructure, enhancing skill development, and providing adequate investment (Ministry of Electronics and Information Technology). The existing industrial setup is highly unsustainable. To avoid further environmental degradation and risk to humans, the industrial areas should be planned, following the concept of green industries and Eco industrial parks. Building new eco industrial parks and transforming the existing industries into green industries has huge potential of lessening the environmental degradation led by the industrial activities.

However, the development of greening industries and building Eco industrial park comes with a no. of challenges ranging from lack of appropriate technologies, financial institutions, infrastructure, inadequate interest of stakeholders, low consumer demands etc. The question now is, how one can overcome these obstacles, knowing going forward greening the industries is a challenging process? To answer these question, first we should know the potential of green industrial development:

- Advancement of nation's economic development by fostering the development of green industrial parks.
- Poverty alleviation, by generating green jobs.
- Better environmental conditions, economic growth, enhancement of human resources.
- Higher degree of eco efficiency by better utilization of resources, energy and technology.

Factors to be considered for the development of green industrial parks

Selection of urban rural fringe areas for green industrial parks

Rural urban fringe areas is the most suitable geographic location for developing green industrial areas. This is good in deriving the shortcoming of one with the

benefits of other. The urban areas has high demand of industrial goods and services with higher consumption of manufactured products. This is good considering the economic prospective for industries. But with urban areas the availability of raw material is a challenge. This can be overcome by procuring the raw materials from the rural area located nearby. The limitation with the rural areas is the less demand for industrial goods and services and less availability of human resources needed for industrial operations. This is not the case with the urban areas. Hence the urban rural fringe is the most ideal location for developing green industrial parks.

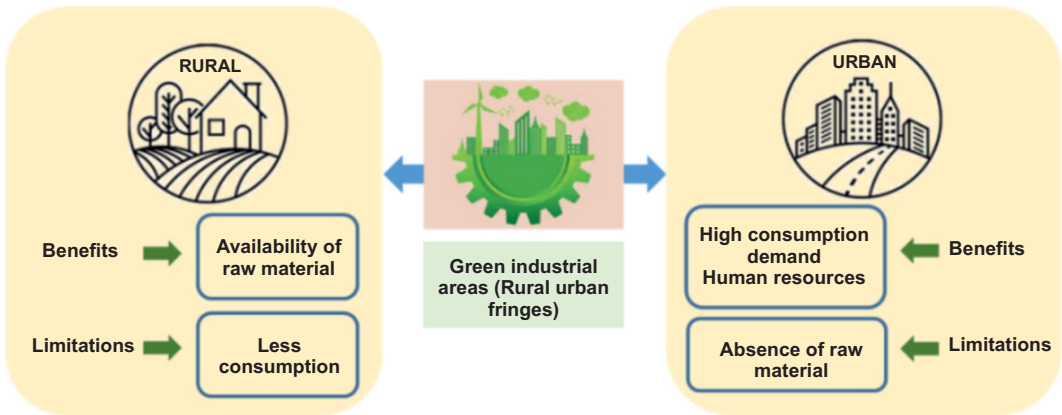


Figure 24: Rural urban fringe for green industrial park development
(Source: Authors Representation)

To explain this, an illustration of green industrial set-up on rural urban fringe has been envisaged. The primary units included in the green industrial complex includes compost plant, biomass processing plant, recycling centres, green products manufacturing, pyrolysis plant, other goods and services (e.g. hotel, café, medical, furniture, clothing etc.) and finally clean energy plant.

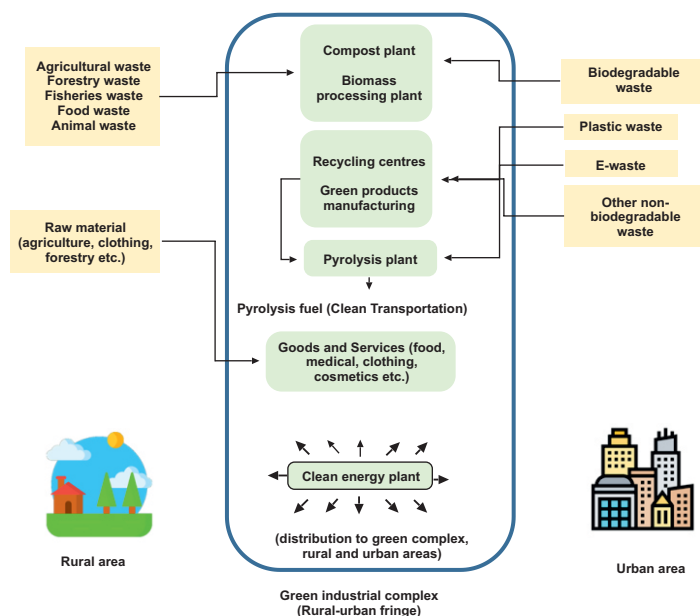


Figure 25: Envisaged working of green industrial area located near urban rural fringe (Anbumozhi, Thangavelu, & Visvanathan, 2013)

Inter-firm networks

Successful implementation of green industries highly depends on the willingness of industries to participate in inter-firm networks. This is important to reduce waste, lessen the consumption of virgin resources, generating clean energy, promoting 3R principal (reduce, reuse and recycle). Inter-firm networks promotes material flow by utilizing the waste of one as the resource for other.

Technology transfer

Technology transfer is important to make green entrepreneurs aware of the latest innovations helpful in converting waste to energy, reducing carbon footprints, manufacturing green products, treating wastewater, finding waste as alternate resources etc. (Anbumozhi, Thangavelu, & Visvanathan, 2013).

Knowledge institutes

The role of research & development centres, colleges, universities etc. is paramount in fostering innovation and advancement in greening the industries. The output of these research can then be successfully implemented by these green industries for the betterment of their processes and services.

Strategic goals for eco-industrial park development

Table 6: Components of eco industrial park with design principals
(Conticelli & Tondelli, 2014)

Goals	Design principal
Waste reduction	Elimination of waste by circulating the waste within the firms
Resource optimization	Optimum resource usage by following 3R strategy (reduce, reuse, recycle)
Understanding the natural ecosystem	• Estimate carrying capacity of the area. • Design the industrial operation within the limits of carrying capacity • Maintain the flora and fauna of the ecosystem
Industrial symbiosis	• Inter-firm connectivity is an important aspect • Waste of one firm should be utilized as the resource for other
Green design	• Optimization of energy utilization • Clean energy usage • Energy cascading meaning transferring the excess residual heat of one process to the another process demanding additional heat • Water cascading
LCA	• Minimizing the use of virgin resources by following 3R strategy (Reduce, Reuse, and Recycle). Proper disposal method of by products should be assessed by understanding the life cycle of the products.
Environmental management systems	• Maintaining the environmental quality by proper treatment of water, sewage and solid waste. • Improving the environment, health and safety of employees
Environmental improvement	• Promoting innovation and research providing better ways for waste treatment, reducing the resource extraction, clean energy etc.
Public participation and collaboration	• Encouraging the public to opt for green products and services

Stakeholders involvement and their role

Diverse group of stakeholders are involved and their role is very important for the successful implementation of green industrial park. Main players that we had considered involves Local and central government agencies, Local communities, Knowledge institutes, Green Industries members. Support of local and central government is highly influential in building green industrial park. Government can initiate actions and plans favouring the implementation of green industries. Reducing the tax burden from green entrepreneurs, financing them with initial kick-off, easy approvals, providing them with subsidies etc. are some of the ways government can help in facilitating the green industries implementation. Healthy consumer demand is needed, so that these business owners can sustain for a long run. Awareness among the local communities should be created, for encouraging them to opt green products. The role of research & development centres, colleges, universities etc. is paramount in fostering innovation and advancement in greening the industries. The output of these research can then be successfully implemented by these green industries for the betterment of their processes and services. Employees of the green industries should be properly trained, in delivery the high quality goods and services. Consumer generally prefer good quality product at a competitive price.

Role of policymakers

Policymakers can help in accelerating the development of green industries by:

- Incentivizing the industries following green practices such as:
 - o Using secondary (or used) raw materials for the manufacturing.
 - o Resource use efficiency (minimizing the virgin raw material input, exchange resources and by-products).
 - o Sharing common facilities for water and waste management.
 - o Reducing the waste generation and emitting lesser pollutants in the water and air.
- Developing required physical infrastructure promoting the development of green industries.

- Capacity development involving:
 - o Development and improvement of new scientific buildings and research institutes.
 - o Supporting and financing research on green goods and services.
 - o Sharing online knowledge materials to the stakeholders involved.
- Creating awareness by:
 - o Developing training programs and workshops for industrial entrepreneurs.
 - o Green labelling of eco-friendly products.
- Financial support
 - o Implementation of schemes for green firms like green insurance, green bonds etc.
 - o Incentives based on yearly performance based on the impacts of environmental improvement.
- Legal and regulatory policies
 - o Heavy penalization to brown firms in case emission is higher than the permissible limit.
 - o Elimination of subsidies for using fossil fuel and other natural resources.
- Development of environmental indicators for performance monitoring
 - o Development of green indicators for assessing the performance on environmental improvements.
 - o Strengthening of EIA tools and methods (Anbumozhi, Thangavelu, & Visvanathan, 2013).

Role of entrepreneurs

- Building inter-firm relationship for exchanging goods and services.
- New job opportunities should be created for local residents from urban as well as rural location. This will help the business owners in developing the diversified workforce.

- Relocating existing business operation to green industrial park, for easy availability of raw materials, minimizing the transportation cost, and easy availability of labour.
- Business owners should understand customers requirement properly for delivering quality goods and services.
- Continuous efforts in terms of minimizing the resources (e.g. raw materials, energy, water etc.).
- Minimizing emission of toxic materials into the air and water, and lessening of the solid waste generation.
- Development of business code of conduct for understanding , and delivering the goods and services meeting the customers and suppliers expectations.

Role of research institutes

- Transfer of knowledge and scientific findings from research institutes to industries.
- Easy financing of R&D activities for developing technologies related to green goods and services.
- Maintaining good relationships and cooperating with the industrial experts, other research institutes and government for developing green industries.
- Collaboration with industrial experts for adaptation of new technologies related to green goods and services.

Worksheet

- Industries are often linked with deterioration of air quality, water resources and overall environment health. In this context green industries seems to be promising solution considering the sustainable development, and balancing the economic growth along with social and environmental parameters. Support this statement with an example.
- Say for example, you need to plan for green industrial park development near your working area. Explain broadly the principals you would be considering in your design.
- Diverse group of stakeholders are involved in the successful implementation of green industries. Mention their roles with their importance.

Learning objectives	Session(s) & methodology
• To give the conceptual understanding of developing green industries and key factors to consider • To enable the trainees the understanding of potential of green industries • To identify the design criteria of developing green industries • To enlighten the readers about the role of various stakeholders involved and their role in green industries execution	• Lecture and PowerPoint presentation • Question Answer session • Case study • Discussion • Experience sharing

Enabling unit(s)
Entry points and pathways for greening industrial areas.

Guidance	Recommended readings
• Trainers should carry pre-developed notes for their hints and tips while delivering the session • Trainer can deliver the session by providing some live examples about the green industries to the participants	• Erkman, S. (2001). Industrial Ecology: a new perspective on the future of the industrial system. Geneva: Institute for Communication and Analysis of Science and Technology (ICAST),. • Gibbs, D. (2008). Industrial Symbiosis and Eco-Industrial Development: An Introduction. Geography Compass, 1138–1154. • Hond, F. d. (2001). Industrial Ecology. International Encyclopedia of the Social & Behavioral Sciences, 7320-7326. • Puig, R. F. (2019). The roles of Industrial Ecology and Circular Economy: a literature review and a classroom application. UPC. • Srinivas, Hari. (2021, June 22). Industrial Ecology: Sustainable Development: Concepts. (GDRC Research Output E-008. Kobe, Japan: Global Development Research Center) Retrieved from Sustainable Development: Concepts: https://www.gdrc.org/sustdev/concepts/16-l-eco.html • Tibbs, H. (1993). Industrial Ecology: An Environmental Agenda for Industries. Global Business Network.

TRAINING MODULE

Urban Green Growth

4

Background and Context

Cities are drivers of economic growth, accentuating negative environmental and social externalities such as air pollution, greenhouse gas emissions, segregation and crime. However, cities are also innovation hubs and their population density provides economies of scale that can, for example, help reduce environmental impacts per capita. Urban green growth is defined as “fostering economic growth and development through urban activities that reduce negative environmental externalities and the impact on natural resources and environmental services” (OECD, 2016). There are six key urban sectors for furthering green growth through policy interventions, including land-use planning, transport, buildings, energy, waste and water.

These policy interventions can be developed, planned and implemented via governmental initiatives, such as emission reduction targets, government-business agreements, spatial planning incentives for sustainable business parks or energy co-operations, tax and subsidy instruments, innovation labs, educational programs and communication tools.

Diagnosis Country needs assessment and GGGI program setup		Assessment Analysis and intervention identification		Action Planning Project, policy and institutional planning		Implementation Program operations and policy adoption	
Economic and green growth analysis	Stakeholder mapping and alignment	Macroeconomic assessment	Sectoral assessment	Governance and financial systems	Investment and action plans	Advisory and capacity support	Monitoring and evaluation
Step 1.1: Situation analysis		Step 2.1: Stakeholder input		Step 3.1: Local ownership and validation		Step 4.1: Establishment of governance units	
Step 1.2: Stakeholder mapping and political alignment		Step 2.2: Data collection and analysis		Step 3.2: Development of financial mechanisms or budgets		Step 4.2: Capacity and advisory support	
Step 1.3: Green growth opportunity assessment		Step 2.3: Identification of effective interventions		Step 3.3: Definition of actionable projects or subactivities		Step 4.3: Monitoring and reporting	
Step 1.4: GGGI program plan		Step 2.4: Green growth pathway analysis		Step 3.4: Target setting and results framework		Step 4.4: Evaluation and learning	
		Step 2.5: Prioritization and costing of interventions		Step 3.5: Political and financial approval			

Figure 26: Basic steps in planning for green growth in cities.
(Source: Global Green Growth Institute, 2016.)

In the entire process promoting urban green growth, monitoring and measuring progress – at varying government levels and for cities of different sizes – is key. This progress monitoring framework depends on the definition and indicators used by the national or local authority. Most cities collect data on economic growth and on environmental and natural resources, but they are not routinely combining the economic and environmental indicators. However, urban green growth measurements remain challenging, as both the concept and the indicators are still in nascent stage.

Table 7: Example of urban green growth strategies and policy messages

City	Policy message	Key green growth indicators
Amsterdam	Speeding up sustainability	Household waste separation rate, share of energy neutral houses
Chicago	Sustainable Chicago	Job growth in renewable energy, rate of car-free transit riders, tons of CO ₂ sequestered by urban forest
Copenhagen	Green, smart and carbon neutral city	Distance to carbon neutrality by 2025
Munich	International Sustainable United in Solidarity	Tons of CO ₂ emission prevented by waste management and sequestered by forest management, distance to eco-energy self-sufficiency by 2025
Seoul	One Less Nuclear Power Plant	Electricity self-reliance rate
Shanghai	The Sustainable Development and the Construction of Resource-saving and Environmentally Friendly Port	Overall energy consumption of total cargo handling, coastline usage efficiency
Stockholm	Stockholm: a sustainable growing city	Distance to being fossil-fuel free by 2050
Sydney	Sustainable City 2030	Distance to meeting 100 per cent of electricity demand by local electricity generation, 30 per cent of water supply by local water capture and increased canopy cover of 50 per cent by 2030; rate of city trips made by bicycle or pedestrian movement
Vancouver	Greenest City: A Renewable City	Distance to 100% of energy demand coming from renewable resources by 2050; distance to becoming a zero-waste community by 2040

Different ways have been used to incentivise cities to respond to challenges of measuring and monitoring urban green growth. Some of the ways deployed include (OECD, 2016):

- Encouraging cities to generate green growth data at the sub-national by selection for **public awards or joining prominent clubs**.
- **Outsource data collection** and analysis of urban green growth at the sub-national level to higher levels of government, international organisations, or commercial organisations.
- Using green growth indicators in the **annual budget reporting cycles** and the internal design of sustainability strategies to help advance cities' role in the green growth agenda.

Training Module

This is the fourth training module focusing on urban green growth and its relevance in sustainable development. It focuses on the concept as well as approaches, opportunities and entry points for green growth in cities. The module is developed as an orientation or sensitization course for authorities or officials of urban local bodies across their key departments and those dealing with developmental, urban planning, urban management, disaster management, environment and climate action related professionals /officials, including elected representatives, policy makers, industrial and business associations, academicians, NGOs, etc. towards the integration of green growth strategies into the urban developmental processes. There are 4 learning units in this module:

LU-D.1: Urban Green Growth: Concept, Scope and Opportunities

LU-D.2: Urban Green Growth Pathways and Entry points

LU-D.3: Opportunity Mapping of Urban Green Growth

Training objectives

- To develop an understanding of the concept of urban green growth and its importance.
- To enumerate pathways, opportunities and challenges in green growth in cities.
- To identify strategic planning and management framework addressing challenges in urban green growth.

Guidance

- Recap of prior modules' learnings and past experiences would be useful.
- Sharing of expectations from both sides - from participants as well as from the faculty/trainers and course director/coordination team is important.
- Using case examples in discussions would help the learning process.
- Stating the role of the participating trainees in urban green growth would be useful in familiarisation in heterogeneous background.

Methodology

- Film or video on urban green growth, opportunities and challenges, pathways and entry points for green growth in cities around the world.
- Perception check questionnaire (or Q&A).
- Lecture/PowerPoint presentations.
- Case study (preferably based on film).
- Group exercises.
- Experience sharing.
- Discussion.

LEARNING UNIT 4.1:

URBAN GREEN GROWTH: CONCEPT, SCOPE AND OPPORTUNITIES

Cities have often been equated to engines of economic growth. These engines or critical hubs of economic activities, job creation and innovation are home to over half of the global population. Despite their economic value, cities create complex socio-economic and environmental challenges – including unsustainable development patterns such as urban sprawl, increasing carbon emissions, degradation of air, water and soil quality, improper land and waste management – that need to be managed and responded to in a timely manner. Traditionally, expanding economic opportunities and managing environmental concerns have been perceived as opposing policy goals. However, green growth presents opportunities to realise the two together.

The concept of green growth in cities or urban green growth envisions economic growth and development through urban activities that reduce negative environmental externalities and impact on natural resources and environmental services. Conceptually, the green component extends to include public and private urban activities – such as land use management, transport, buildings, energy, waste, and water – that reduce negative environmental impact. Scope of green growth focuses on growth of gross domestic product as well as urban quality of life for all citizens.

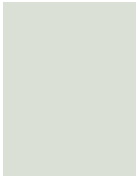
Box 9: Vietnam Urban Green Growth Action

Vietnam's experiencing significant rural to urban migration in past few decades, accompanied with economic growth and associated increase in social inequities and environmental challenges. Large urban centres in the country operate with subpar infrastructure and green growth investments.

To address multifaceted social, environmental and governance challenges – associated with increasing urbanisation and economic growth – Vietnam adopted a National Green Growth Strategy to adapt to climate change and reduce greenhouse gas emissions via investments in natural capital, infrastructure and employment.

The Strategy urges 50% of cities to attain a green urban status and expand public transportation utilisation rate to 45% by 2020. Additionally, it recommends integration of green growth into the next National Urban Development Program.

Source: CITATION Glo21 \16393 (Global Green Growth Institute, 2021)



Green growth is needed at the city level – to reconcile sustained economic growth with climate actions – for the present and projected urban dwellers. Cities around the world need to prepare themselves for the additional three billion urban dwellers expected by 2050. Cities – expanding and adding to economic growth at the cost of social and environmental integrity – need to thus play a critical role in green growth.

To recourse cities – home to over 50% of global population – on green growth path, it is imperative to realign local and national green growth objectives and monitoring frameworks. Cities can also tap the opportunities presented by global goals and mobilise private and public finance for green infrastructure, and increase inter- and intra- municipal cooperation.

Diverse opportunities for urban green growth exist in land use and transport, waste management, water resource management, energy, buildings, and green industries and services. Many of these opportunities are either untapped or inadequately explored. While geographic differences exist in extent of opportunities each of these sectors provide, land use and energy are most promising as they can support other cross-sectoral opportunities (OECD, 2016).

Learning objectives	Session(s) & methodology
• Stating the need and contexts of urban green growth • Examining the concept, scope and opportunities for urban green growth across the world	• One session • Lecture and discussion • Experience sharing • Q&A session • Short film/ poster exhibition/ Case study
Enabling unit(s)	
Re-orienting urban developing to a green growth pathway.	
Guidance	Recommended readings
• This learning unit includes knowledge sharing sessions on various international initiatives on urban green growth • The facilitators will have adequate knowledge of various institutions and agencies operating at a global and regional scale – and furthering green growth in cities Case examples of different sizes and categories of cities, sectoral and national actions in the context of urban green growth would add value to the session	• Global Green Growth Institute, 2021. Viet Nam Urban Green Growth Action, Phase II. [Online] Available at: https://gggi.org/project/viet-nam-urban-green-growth-action-phase-ii/ [Accessed 14 May 2021]. • OECD, 2016. Urban Green Growth in Dynamic Asia, OECD Green Growth Studies, Paris, France: OECD Publishing.

LEARNING UNIT 4.2:

URBAN GREEN GROWTH: PATHWAYS AND ENTRY POINTS

There are several pathways and entry points for effective urban green growth. Sustainable urban transport policies, for instance, need to be prioritised in the green growth agenda and integrated with land use planning. Policies and strategies on responsible production and consumption, and urban waste management should be embedded into municipal waste strategies. Also, industries can be incentivised and mandated to transition towards green labelling. In essence, sectoral policies offer one pathway and several entry points for green growth in cities and regions.

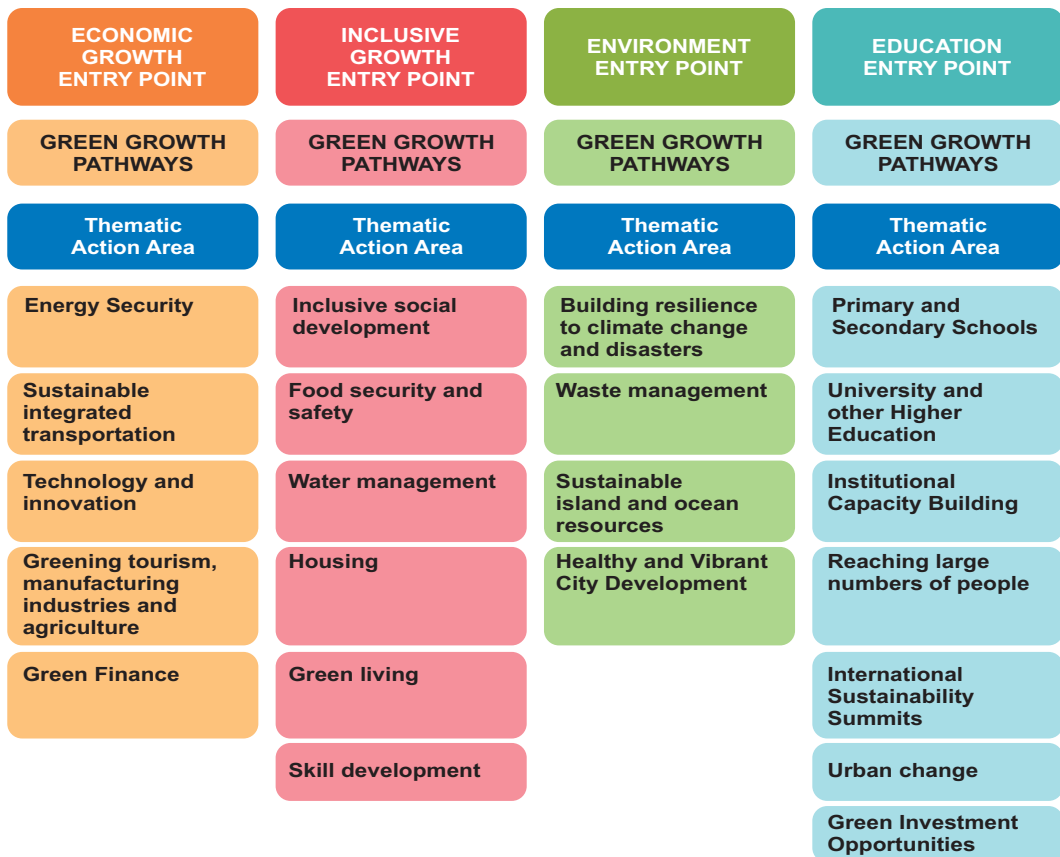
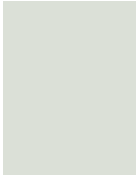


Figure 27: Key pathways and entry points for green growth in cities
(Source: Green Growth Asia Foundation, 2021)



Apart from sectoral policies, inter-sectoral policy complementarity has high potential to support and amplify the green transition (OECD, 2016). For example, waste-to-energy projects and programs can help support waste management while augmenting energy production and thence the supply. Deploying pricing mechanism is another pathway for furthering green growth in cities. Reallocating tax burdens or penalising negative environmental externalities, backed by data-informed decisions, can encourage consumers and producers to act in a more sustainable manner.

These green growth entry points envision economic growth, inclusive growth, sustainable environment, and education for sustainable development. These entry points enable pathways for strategic action and mainstreaming green growth into development policies and measures that are thence translated into programmes and projects. These Pathways also serve individually as thematic focal points to identify specific challenges and issues that require a response or intervention to be developed and implemented within an urban and community setting.

The green growth strategies are informed by the various action areas in each pathway. Each of these action areas correspond to specific challenge and corresponding set of responses. Identifying these challenges and course of action will guide the projects and programmes that need to be implemented in response.

Financing urban green growth is one of the most critical entry points supporting all pathways. Most importantly, cities need to invest in data collection, management, and monitoring systems to continually track and evaluate cities' green growth over time and space. In general, there are four categories of entry points furthering green growth in cities: one, economic growth; two, inclusive growth; three, sustainable environment; and, education for sustainable development. Several policies, legal, and financial pathways can be deployed in tandem with these entry points to mainstream green growth into development policies and measures – and implemented via programmes and projects.

Learning objectives	Session(s) & methodology
- Identifying sectoral and region-specific entry points and pathways for urban green growth - Deliberating on challenges and opportunities for urban green growth - Assessing the institutional framework and business landscape supporting green growth in cities	- Two sessions - Lecture and discussion - Experience sharing - Q&A session - Case study
Enabling unit(s)	
Strategic planning and management of cities to expand and transition towards green growth.	
Guidance	Recommended readings
Presentations may be developed using case examples of Asian cities furthering urban green growth This learning unit may include a group exercise to engage participants in developing and managing different scenarios and pressing urban challenges	- OECD, 2016. Urban Green Growth in Dynamic Asia, OECD Green Growth Studies, Paris, France: OECD Publishing. - The World Bank, 2012. Inclusive Green Growth: The Pathway to Sustainable Development. [Online] Available at: https://www.greengrowthknowledge.org/research/inclusive-green-growth-pathway-sustainable-development [Accessed 15 May 2021]. - The World Bank, 2012. Inclusive Green Growth: The Pathway to Sustainable Development, Washington DC: The World Bank.

LEARNING UNIT 4.3:

MAPPING OPPORTUNITIES FOR URBAN GREEN GROWTH

Several opportunities for urban green growth exist across variable scales of space time and governance, including: integrated water resources management, regional cooperation for water security, water stewardship, greening infrastructure, disaster risks' mitigation and adaptation, integrated land-use and transportation planning. To realise these and several other pre-existing opportunities for urban green growth, strengthening regulatory capacities is imperative. In addition, governments need to mainstream innovation and knowledge transfer, and attract private sector to unlock investment for the green growth.

Before mapping out opportunities, it is critical to map stakeholders and their political alignment. Identifying stakeholders helps understand each stakeholder's operations, investments, incentives, and needs. This assessment can develop win-win policies and solutions for urban green growth. Additionally, this can help identify potential partners with technical skills, financial resources, physical infrastructure and technology that can help develop strategies, designs and plans, or contribute to data management, policy development, and program implementations. In essence, this assessment can help guide coalitions for green growth in cities.

Box 10: Key guiding principles for realising opportunities
for urban green growth

Activity and Group exercise

Activity: Cost benefit analysis of urban green growth

Time: 1-2 hour, including discussion

Material: Flip charts, sketch pens, board and board pins

Objectives:

1. To identify the inertia and risks of realising opportunities of urban green growth
2. To map out local and immediate benefits of urban green growth
3. To state the trade-offs and identify policy solutions for realising urban green growth

Background:

Mapping and assessing opportunities for green growth is a crucial step that plugs into formulation, implementation, and monitoring of policies, plans, strategies and programs. This mapping exercise shall review key actors, national priorities, relevant best practices that can drive green growth (Global Green Growth Institute, 2016). Depending upon pre-existing data base and analytics, several layers of analysis shall be conducted. The latter could include social development study, economic trends study, data gap assessment, examination of national and city-specific baselines, benchmarking and best practices, and assessment of environmental and climate risks. In essence, the goal of mapping opportunities is to lay the foundation for in-depth urban green growth analysis that will help develop strategy design, implementation, and monitoring frameworks.

Instructions:

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

		Local and immediate benefits	
		LOWER (Trade-offs exist between short and long-term or local and global benefits)	HIGHER (Policies provide local and immediate benefits)
Inertia and/or risk of lock-in and irreversibility	LOWER (action is less urgent)	Lower-carbon, higher-cost energy supply Carbon pricing Stricter waste water regulation	Drinking water and sanitation, solid waste management Lower-carbon, lower cost energy supply Loss reduction in electricity supply Energy demand management Small-scale multipurpose water reservoirs
	HIGHER (action is urgent)	Reduced deforestation Coastal zone and natural area protection Fisheries catch management	Land use planning Public urban transport Family planning Sustainable intensification in agriculture Large-scale multipurpose water reservoirs

Learning objectives	Session(s) & methodology
• Stating and mock-implementation of techniques and tools to identify, utilise and monitor opportunities for green growth in cities • Enumerating benefits of urban green growth • Strategizing action plan and risk mitigation into policy and planning frameworks for green growth in cities.	• Two sessions • Lecture and discussion • Experience sharing • Q&A session • Group exercises • Case study
Enabling unit(s)	
Evaluating and expanding spatial-temporal distribution of opportunities for urban green growth.	
Guidance	Recommended readings
• Brief exercise on mapping stakeholders' and their motivation can be included in the training • Short films can be shown to illustrate spatial and temporal distribution of urban green growth opportunities	• OECD, 2016. Measuring urban green growth: the concept, data and adequate mechanisms for tracking progress, Paris, France: OECD. • The World Bank, 2012. Inclusive Green Growth: The Pathway to Sustainable Development, Washington DC: The World Bank. • Global Green Growth Institute, 2016. Green Growth Planning Guidelines, Seoul, Korea: Global Green Growth Institute. • ICLEI - Local Governments for Sustainability, South Asia, 2015. Urban Green Growth Strategies for Indian Cities - Volume 1, Delhi, India: ICLEI - South Asia.

TRAINING MODULE

Nature-based Solutions (NbS)

5

Background and Context

We are battling the dual challenge of climate change and biodiversity loss. The current situation is such that in the last four decades we have lost 10% of wilderness and almost 60% of more than 3000 species. Moreover, 90% of fisheries globally are either over-exploited or have altogether collapsed. Planet's important ecosystems including oceans, forests, mountains and inland waters are also facing similar impacts. Estimates suggest that by 2030, the average forest patch size will decrease to just 0.25 hectares resulting in increased demand for food, water and energy by 35%, 40% and 50% respectively. However, Nature-based solutions can help reverse these losses. For example, simple nature-based solutions like restoring ecosystems like mangroves can help avert flooding damage of USD 57 billion in countries like China, India, United States, Mexico and Vietnam (The Global Commission on Adaptation). Similarly, NbS can help achieve 37% of climate mitigation goals under the Paris Climate Accord (<https://www.iucn.org/theme/nature-based-solutions>).

Nature-based solution is a relatively new concept introduced and popularized by World Bank in 2008 to meet the global needs for biodiversity conservation for climate adaptation and mitigation. Further in COP15, 2009 NbS was promoted as a medium for “climate change mitigation & adaptation, water security, efficient energy and food supply, poverty reduction and driver for economic growth” by IUCN. The European Commission and WWF also adopted the concept of NbS, but it was restricted to urban and climate benefits.

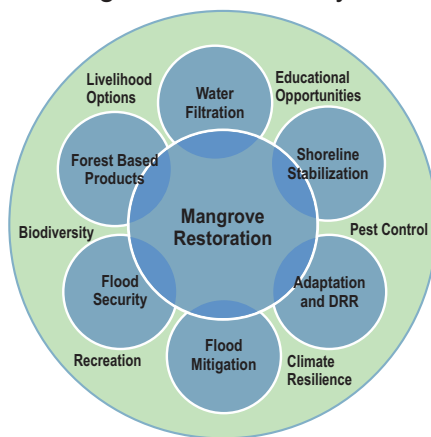


Figure 28: Benefits and Co-Benefits of Mangrove Restoration.
(Source: Authors Representation)

NbS has gained recognition globally as a potential tool for climate action and to combat biodiversity loss, but there is an ambiguity regarding the concept and precision in deployment. While the appropriate definition of NbS may vary but they capture the value, complexities and criteria of NbS viz. (i) emission cutting; (ii) ecosystem conservation and protection and; (iii) ecologically and socially responsible solutions.

Box 11: Why do we need Nature based Solutions (NbS)

Why Nature based Solutions (NbS)

Nature provides us shelter, feeds us, fuels economics growth, regulates weather patterns, and protects us from disasters. The societal challenges that we face today are due to our failed attempts to solve them. This has led to increased inequalities and human vulnerabilities, climate crises and biodiversity loss globally.

The IPCC 6th assessment report flags code red for climate crisis for the planet. Similarly, Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) in their global assessment of biodiversity and ecosystem services painted a bleak picture of biodiversity and the future of planet earth resulting in an estimated loss of 1 million plants and animals species globally.

We need to work with nature rather against it, and Nature based Solution is our safe key to improve our chances to be in a brilliant future.



Training objectives

- To understand Nature based Solutions and its benefits in green growth.
- To assess the value of ecosystem services and ecosystem based approaches in NbS.
- To deliberate on the entry-points and pathways for integrating NbS in developmental planning.
- To state the purpose of NbS in addressing societal challenges.

Guidance

- Sharing of expectations from both sides - from participants as well as from the faculty/trainers and course director/coordination team is important.
- Stating the role of the participating trainees in NbS & green economy models and its relevance to sustainable development would be useful in familiarisation in heterogeneous background.
- Films on NbS for promoting green growth through various sectors.

Methodology

- Film or video on green economies, circular economy, green finance, resource efficiency, etc.
- Perception check questionnaire (or Q&A).
- Lecture/PowerPoint presentations.
- Case study (preferably based on film).
- Group exercises.
- Experience sharing.
- Discussion.

LEARNING UNIT 5.1:

OVERVIEW OF NATURE BASED SOLUTIONS (NbS)

The European Commission used the NbS concept in their programme “Horizon 2020”¹ with an urban focus. They defined NbS as living solutions inspired by, continuously supported by and using Nature designed to address various societal challenges in a resource-efficient and adaptable manner and to provide simultaneously economic, social and environmental benefits (European Commission, 2015). International Union for Conservation of Nature (IUCN) considers NbS as an umbrella concept and defines NbS as “actions to protect, sustainably manage and restore natural or modified ecosystems that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” (IUCN, 2016).

Multiple and unclear definitions may potentially hinder development of NbS as a concept. Many instances have highlighted that misuse and over demand of NbS has resulted in greater harm than good to people and nature. Increased demand and use of NbS have led to cases of misuse of the NbS concept, where even good intentions can result in harm to nature and people.

Effective uptake and operationalising NbS on the ground, as well as policy planning, requires precise definition and a clear set of principles. The definitional framework for NbS given by IUCN and its Commission on Ecosystem Management (CEM) covers three major components viz.: (i) overarching goals for NbS; (ii) NbS definition; and (iii) principles for NbS.



Figure 29: Nature based Solutions (NbS)
(Source: IUCN, 2017)

¹ EC–European Commission. (2015). Nature-Based Solutions and Re-Naturing Cities, Final Report of the Horizon 2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities.

NbS and overarching goals: NbS supports both, the achievement of society's development goals and safeguards human well-being reflecting cultural and societal values and simultaneously enhancing ecosystem resilience. Water security, food security, human health, disaster risk, climate change, and social and economic development are some major societal challenges addressed by designed NbS interventions.

NbS Definition: Nature based Solutions are actions to protect, sustainably manage and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

NbS Principles: IUCN has proposed 8 principals to be considered in conjunction with the IUCN definition of NbS. These principles are developed to consolidate and develop a common language to understand NbS. Below are the list of 8 principles, some of these principals may be interlinked and interdependent to certain extent:

- **Principle 1: NbS embraces nature conservation norms (and principles):** Although NbS embrace nature conservation, but not all conservation action qualify as NbS actions (Watson et al., 2014). NbS also promotes biodiversity conservation but not perpetually.
- **Principle 2: NbS can be implemented alone or in an integrated manner:** Actions under NbS promotes full range of ecosystem services and are also complementary to other actions.
- **Principle 3: NbS are determined by site specific natural and cultural context that include traditional, local and scientific knowledge:** These solutions are evidence based approaches build from scientific as well as traditional & local knowledge, inclusive of locals who live and hold appropriate stake in the ecosystem.
- **Principle 4: NbS produces societal benefits in a fair and equitable way, in a manner that promotes transparency and broad participation:** Implementation of NbS focuses on involvement of diversity of stakeholders as NbS interventions provides benefits to local communities. Ensuring involvement of different categories of stakeholders and co-sharing of benefits within the entire range of affected actors right from the local communities up to national level, will avoid loss of local opportunities.

- **Principle 5: NbS maintain biological and cultural diversity and the ability of ecosystems to evolve over time:** NbS interventions should be deployed in accordant with an ecosystem's complexities and temporal dynamics. This supports cultural and biological diversity of the ecosystem and ensures the ecosystem services are sustainable and resilient.
- **Principle 6: NbS are applied at a landscape scale:** NbS can be implemented over large spatial scales, combining many ecosystems (inland water bodies, coastal, forest, agricultural etc.) For site specific NbS, wider landscape level context and consequences focusing on upscaling should be considered where appropriate.
- **Principle 7: NbS recognize and address the trade-offs between the production of a few immediate economic benefits for development, and future options for the production of the full range of ecosystem services:** While deciding among different NbS interventions, it is essential to understand thoroughly the trade-off between current and future benefits. Understanding and providing a process for fair and transparent negotiation of trade-offs are essential for ensuring successful NbS (Maginnis et al., 2004). Landscapes often contains varied groups of stakeholders with dependent livelihoods, giving way to complex and conflictual relationships. Such should be identified and negotiated.
- **Principle 8: NbS are an integral part of the overall design of policies, and measures or actions, to address a specific challenge:** Incorporating NbS in national and international policies and related actions along with practical on field implementation is imperative to have broad influence for NbS.

NbS and Societal Challenges:

Nature based Solutions offer many approaches to solve major global challenges through a range of solutions which are: (i) cost effective; (ii) sustainable; (iii) measurable; (iv) verifiable; (v) replicable; and (vi) simple. Successful implementation of NbS solutions may provide co-benefits along with addressing environmental challenges, thus they find cross-sectoral application. The table below enlists the major societal challenges which can be effectively addressed by NbS.

Table 8: Societal challenges addressed by NbS

NbS for Livelihood: NbS can act as a safety net for three billion people who depend on nature for their livelihoods through agriculture, forestry, fisheries & ecotourism.	
	Large swaths of the world's population are directly impacted by nature. Forests sustain 1.6 billion livelihoods, agriculture sustains 1.3 billion livelihoods, and oceans sustain 1.6 billion livelihoods. With this level of impact on livelihoods, nature-based solutions play a critical role in ensuring sustainable livelihoods for communities around the world.
NbS for Climate Action: NbS can help address climate crisis by sequestering carbon & other greenhouse gases.	
	Nature-based solutions, such as forest protection, restoration, and sustainable use could provide more than a third of the climate mitigation needed to meet carbon emission goals set in the Paris Agreement and manage rising temperatures. Conventional agriculture is one of the largest emitters of greenhouse gases globally, accounting for around 73% of deforestation. Livestock farming and rice production are also contributors to global warming.
NbS for Food Security: NbS can enhance food security through direct subsistence & improved income opportunities	
	Food security is the availability and adequate access to sufficient, safe, nutritious food. There are major costs associated with not prioritizing food security through sustainable agriculture. The global cost of land degradation as a result of land-use change is USD \$300 billion. Agriculture is the foundation of land-based food security and agri-biodiversity can improve the lives of 1 billion people.
NbS for Water Security: NbS yield a wide variety of benefits for water-related services and are essential for achieving water security	
	Water security is critical to sustaining livelihoods globally. Oceans supply 4.3 billion people with 15% of their annual protein. Fisheries empower women and represent 60% of the workforce in India and 80% in West Africa. Forests are the source of 75% of all drinking water. Yet, water security and quality face multiple threats. As a result of pesticide use, salinization, industrial waste, and municipal sewage, water quality is expected to decline.

NbS for Disaster Management: NbS are essential for mitigating the risk of natural disasters.



When disaster risk reduction efforts are implemented the likelihood of a natural event escalating to a disaster is drastically reduced. Wetlands, forests and coastal systems act as buffers that reduce exposure to natural hazards, therefore, serving as nature-based solutions to disasters.

NbS for Human Health: NbS can increase biodiversity & provide humans with medicine & nutrients crucial to their health.



Nature and human health are connected due to nature being the source of many medical treatments as well as the spaces we occupy that facilitate a healthy lifestyle. An estimated 4 billion people rely primarily on natural medicines as their health care. Out of all pharmaceuticals used to treat cancer, 70% are either natural products or are inspired by nature. 25% of modern drugs are derived from rainforest plants. Many zoonotic diseases, are caused by mismanaged/illegal livestock-wildlife-human interactions, habitat destruction due to deforestation increasing human & wildlife interactions, and rising temperatures expanding the range vectors are able to spread. With regard to physical health and fitness, studies have shown the positive benefits of access to green space on mental health and well-being.

Learning objectives	Session(s) & methodology
● To promote the basic understanding of NbS and overarching goals. ● To develop an understanding of the NbS principles. ● To impart an understanding of how NbS addresses various pressing challenges of the society.	● 1-2 sessions ● PowerPoint presentation/ Video representation ● Case study examples ● Lecture and discussion ● Question and answer ● Experience sharing
Enabling unit(s)	
Nature based Solution (NbS)- definition, overarching goals, principles and societal challenges addressed by NbS.	
Guidance	Recommended readings
● This module includes knowledge sharing sessions on NbS concepts including its genesis, adoption by various international organization. ● The session should take up discussion mode and promote experience and idea sharing of trainees. ● The module will promote have in-depth knowledge and practical experience of NbS and its applications in addressing societal challenges to facilitators. ● Lectures should use presentations and pictorials and easy examples to set context for the upcoming learning units.	● Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp. ● EC–European Commission. (2015). Nature-Based Solutions and Re-Naturing Cities, Final Report of the Horizon 2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities ● Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., ... & Walters, G. (2019). Core principles for successfully implementing and upscaling Nature-based Solutions. Environmental Science & Policy, 98, 20-29. ● Dhyani, S., Gupta, A. K., & Karki, M. (2020). Nature-based Solutions for Resilient Ecosystems and Societies. Springer.

LEARNING UNIT 5.2:

NATURE BASED SOLUTIONS (NbS) & ECOSYSTEM BASED APPROACHES (EbA)

Globally disasters have become predominant in the recent past. However, disasters are not always natural. Hazards tend to become disasters because of poor decisions. For example, if natural buffers are destroyed or buildings built too close to natural hazard prone areas, the conditions for disasters are enhanced. Thus, the hazard disaster dynamics works both at micro & macro levels and also at multiple levels.

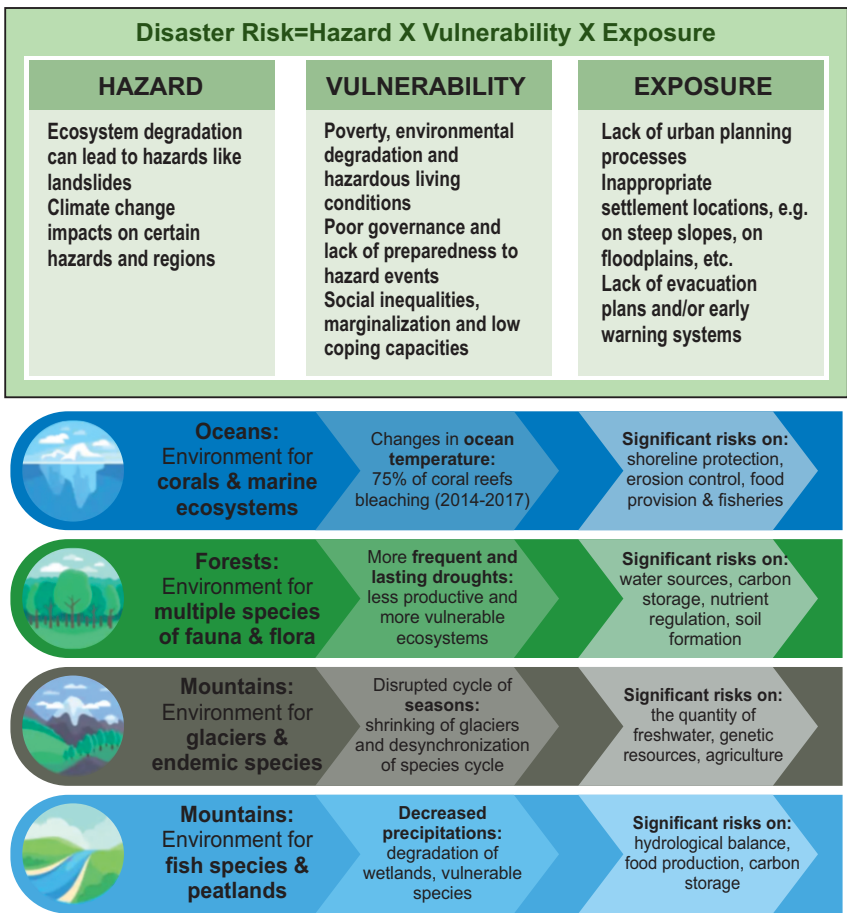
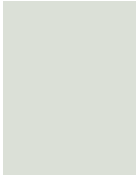


Figure 30: Concrete Examples of climate change impacts on habitat.
(Source: CBD, 2018)



As the frequency and intensity of climate-related hazards like flooding, tropical storms and droughts increase, the resultant disasters are also becoming predominant. Nature offers helpful solutions to reduce the climate crisis while at the same time keeping our society healthy.

Reducing climate crisis:

- Sequestering and storing carbon in biomass with resultant reduction in atmospheric GHG concentration.
- Protecting from hazards by as natural barriers to storm surges, slopes soil stabilization, and landslide reduction.

Keeping Societies Healthy:

- Green spaces reduce cardiovascular diseases, moderates stress, reduced urban heat island effect, controls pollution and also provides space for exercise.
- Boosts mental health and enlightens our mood.

Ecosystems are dynamic system where living and non-living beings interact together as a functional unit. Often the complex interactions within and among the ecosystems result in the structural and functional aspects to the environment around us. We depend on our surroundings for resources and also impact it through activities. The sum total of all the services we obtain from nature are collectively called ecosystem services. Ecosystem systems are predominantly of four types; provisioning services such as provision for food and water, regulating services like flood, climate and disease regulation; supporting services such as soil formation, habitats etc and cultural services like recreational and aesthetic activities.

NbS Typology

While talking about the typology of NbS applications, there main NbS types are identified.

- Type 1: NbS interventions aimed at better utilization of existing ecosystems (natural or protected).
- Type 2: NbS interventions promoting managed or restored ecosystems through effective sustainable management protocols and procedures.
- Type 3: NbS interventions for creating new ecosystems.

This typology as developed by BiodivERsA ERA-NET also categorises NbS interventions along the gradients of (i) level of engineering of ecosystems and biodiversity required and (ii) level of ecosystem service enhancements achievable by NbS. Figure below.

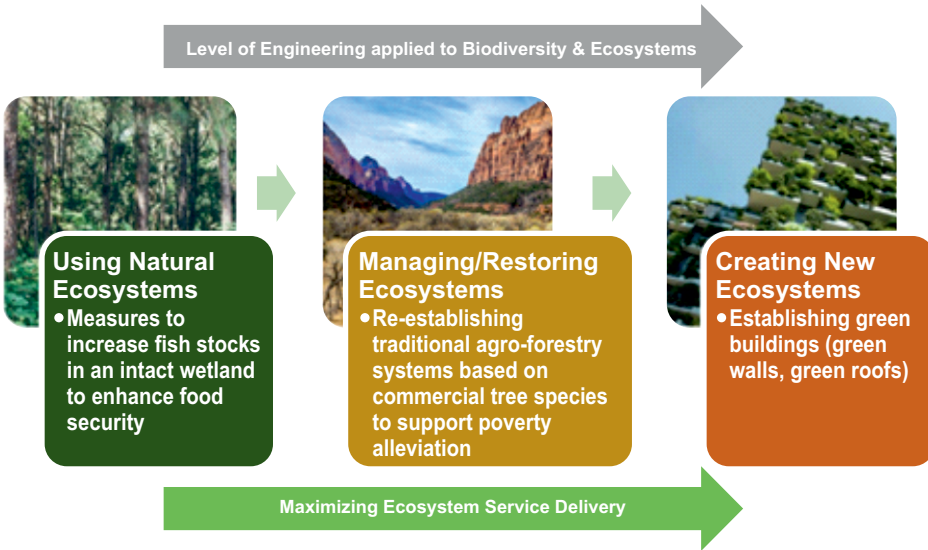


Figure 31: Nature based Solution (NbS) typology as developed by BiodivERsA ERA-NET. (Adapted from IUCN, 2016)

NbS Umbrella Concept:

Nature based Solutions should always be considered as an umbrella concept while framing NbS interventions and applications. It covers a complete range of ecosystem-related approaches that are useful in addressing societal challenges along with green growth benefits. These NbS approaches are classified under five categories. The figure 32 below shows the Ecosystem Services.

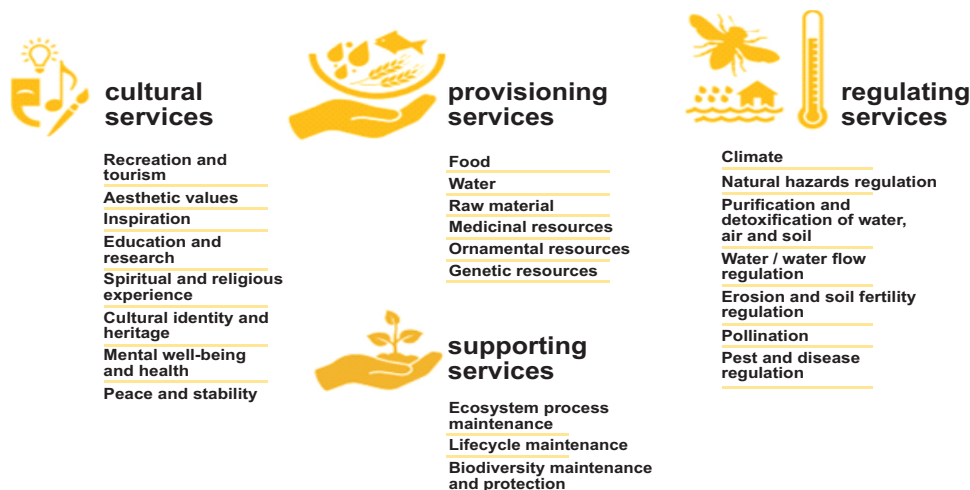


Figure 32: Ecosystem Services.
(Source: Adapted from TEEB, 2016)

It should be noted that many of these approaches are closely related to one another and share similarities in terms of offered ecosystem services and the intervention involved. For example natural infrastructure, green infrastructure, ecological engineering, ecosystem-based mitigation, ecosystem-based disaster risk reduction (Eco-DRR) and ecosystem-based adaptation (EbA). However, NbS make use of EbA and Eco-DRR for adaptation benefits to reduce climate related hazard vulnerabilities. The relationship between these three terms is illustrated in figure 33.

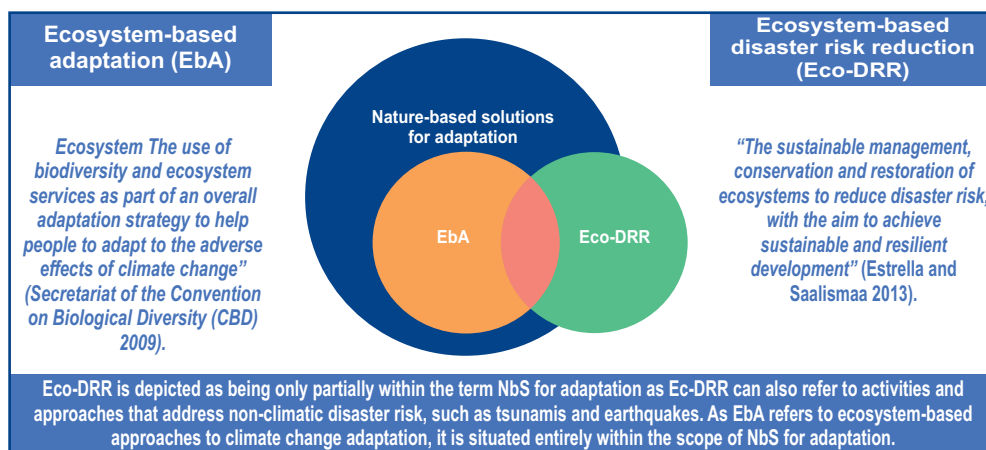


Figure 33: Relation between NbS, EbA and Eco-DRR.
(Source: Adapted from UNEP (2021) and Adaptation Gap Report 2020. Nairobi)

Hazard	NbS for adaptation	Potential additional benefits
 Coastal hazards - Sea level rise - Storm surge - Coastal erosion	- Mangrove protection and restoration to anchor sediments and dissipate wave energy - Management and restoration of coastal marshes and/or dunes to dissipate wave energy and/or complement engineered protection - Coral reef management and restoration to attenuate wave energy	- Improved fish stocks - Biodiversity conservation - Carbon sequestration and storage - Sediment accretion - Tourism and recreation and associated employment
 Intense precipitation - Flood - Soil erosion - Landslide	- Management and restoration of watershed vegetation to enhance infiltration, reduce run-off and peak flows, and stabilize slopes - Agroforestry to enhance canopy interception of rainfall and rainwater infiltration and reduce soil exposure, thereby reducing run-off and erosion - Urban watercourse restoration, and 're-naturing' to reduce assets at risk and secure riverbanks - Maintenance and restoration of urban greenspaces to improve rainwater infiltration and reduce run-off - Management and restoration of wetlands to store floodwater or slow its release and filter sediments	- Increased availability of wild-sourced food and other products - Pollination services - Carbon sequestration and storage - Improved soil fertility - Biodiversity conservation - Improved water quality - Improved physical and mental health among urban populations
 Drought	- Management and restoration of watershed vegetation to enhance infiltration, recharge groundwater stores and maintain surface water flows - Establishment of 'Green Belts' to increase water availability, improve soil quality, provide shade and windbreaks	- Increased availability of wild-sourced food and other products - Pollination services - Carbon sequestration and storage - Improved soil fertility - Biodiversity conservation
 Rising temperatures - Heat stress - Urban heat islands - Wildfire	- Agroforestry to enhance canopy cover and provide shade - Rehabilitation and restoration of rangelands to repair ecological processes and enhance fire resistance - Creation of urban green spaces to increase vegetative canopies, which provide shade and evaporative cooling	- Carbon sequestration and storage - Improved soil fertility - Biodiversity conservation - Improved physical and mental health among urban populations

Figure 34: Examples for NbS for adaptation to major climate risk.
(Source: Adapted from UNEP (2021) and Adaptation Gap Report 2020. Nairobi)

Learning objectives	Session(s) & methodology
• To develop the understanding of ecosystems and ecosystems services. • To describe the NbS typology and NbS approaches. • To conceptualize the importance of ecosystem approaches for implementing NbS interventions.	• 1 session • Power Point presentation/ Video representation • Case study examples • Lecture and discussion • Question and answer • Experience sharing
Enabling unit(s)	
Nature based Solution (NbS) and Ecosystem based Approaches – ecosystem services, NbS typology & approaches.	
Guidance	Recommended readings
• This module includes knowledge sharing sessions on NbS concepts including its genesis, adoption by various international organization. • The session should take up discussion mode and promote experience and idea sharing of trainees. • The module will promote have in-depth knowledge and practical experience of NbS and its applications in addressing societal challenges to facilitators. • Lectures should use presentations and pictorials and easy examples to set context for the upcoming learning units.	• Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp. • EC–European Commission. (2015). Nature-Based Solutions and Re-Naturing Cities, Final Report of the Horizon 2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities • Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., ... & Walters, G. (2019). Core principles for successfully implementing and upscaling Nature-based Solutions. Environmental Science & Policy, 98, 20-29. • Dhyani, S., Gupta, A. K., & Karki, M. (2020). Nature-based Solutions for Resilient Ecosystems and Societies. Springer.

LEARNING UNIT 5.3:

UNDERSTANDING NbS & GREEN GROWTH BENEFITS

Nature Based Solutions (NbS) harness nature's powers and sophistication to address enviro-socio-economic challenges and continuously provide for innovation. They offer ways to address societal challenges primarily by fostering well being of citizens, and future-proofing societies and hold the potentials to contribute substantially to green growth by enhancing business opportunities through resource-efficient, resilient and sustainable markets and supply chains.

Natural Capital is the sum total (finite stock) of all environmental assets like land, air, water, minerals, species etc., which produce ecosystem goods and service flows important to human well-being and economy. Natural capital provides a foundation for all four types of capital including financial, manufactured, social and human capital and is also complementary to them. This is particularly relevant when NbS interventions and typology are concerned. The figure explains in detail the correlation between natural capital and NbS.

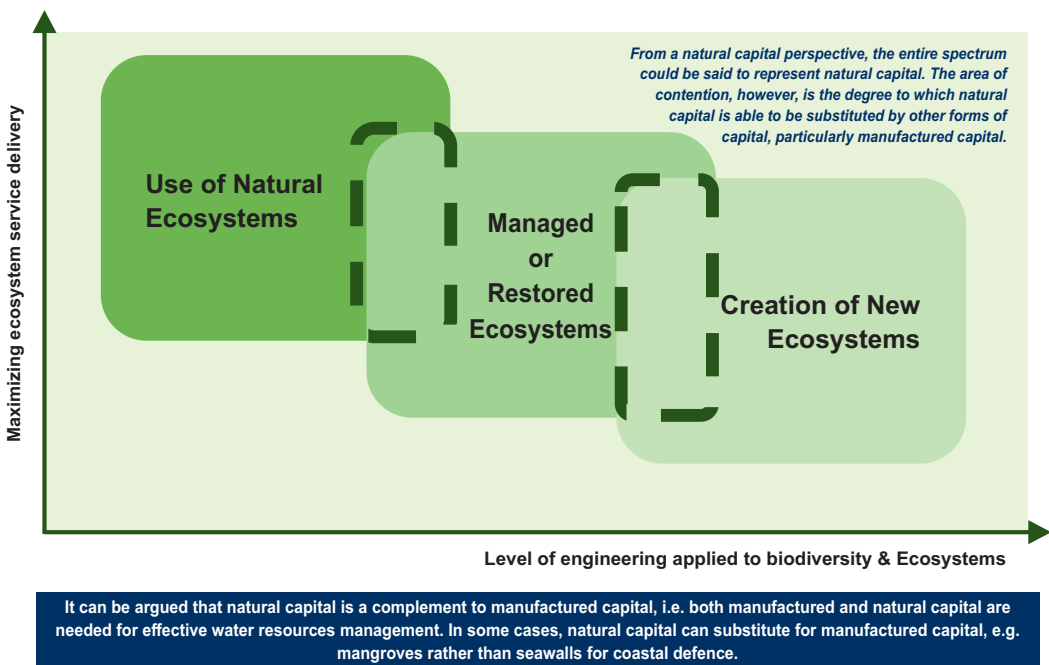


Figure 35: Relation between NbS and Natural Capital. (Adapted from IUCN, 2016)

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 (Module) NbS can be considered as an alternative to 'grey' engineering. More so, there exists a spectrum of interventions including both components (hybrid or 'grey-green' approaches). Globally many examples stand testimony to the fact that hybrid and NbS offer multiple advantages over engineered solutions especially considering low-risk and low-cost solutions to climate related hazards and disasters.

Box 12: Why to go green

Why Go Green?

Grey approaches have immediate, measurable effects on reducing specific impacts, they can be expensive and deliver few if any co-benefits. In contrast, NbS tend to be affordable and bring many co-benefits. There is also growing evidence of the economic benefits of maintaining natural habitats through avoided losses from climate change-related disasters.



For example, the presence of coastal wetlands in northeast USA protected US\$625 million worth of property from direct flood damage during Hurricane Sandy, reducing damages by 20-30% in 50% of affected areas. The greater the extent of intact wetland habitat, the greater the protection provided.

As NbS is built upon the understanding of nature and natural processes, such solutions often bring nature- its processes and features- into landscapes, seascapes and cities through interventions that are systemic, resource-efficient and can be adapted locally (European Commission).

For cities and urban centres, NbS offers several opportunities for ecosystem and urban regeneration like climate regulation, pollution control, water flow control and purification, flood and erosion control, biodiversity conservation and improvement of human health and quality of life. On the contrary, NbS provides economic benefits through the provision of social and recreational activities.

Green Infrastructure:

The European Commission defined Green Infrastructure (GI) as “a strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services” (European Commission, 2013). It includes green spaces as well as physical features in both terrestrial and coastal areas.

GI approaches inculcate conservation values and actions to land development and build infrastructure. In addition, GI also includes components of human well being in many ways and comprises a broad range of environmental features as discussed in figure 36.

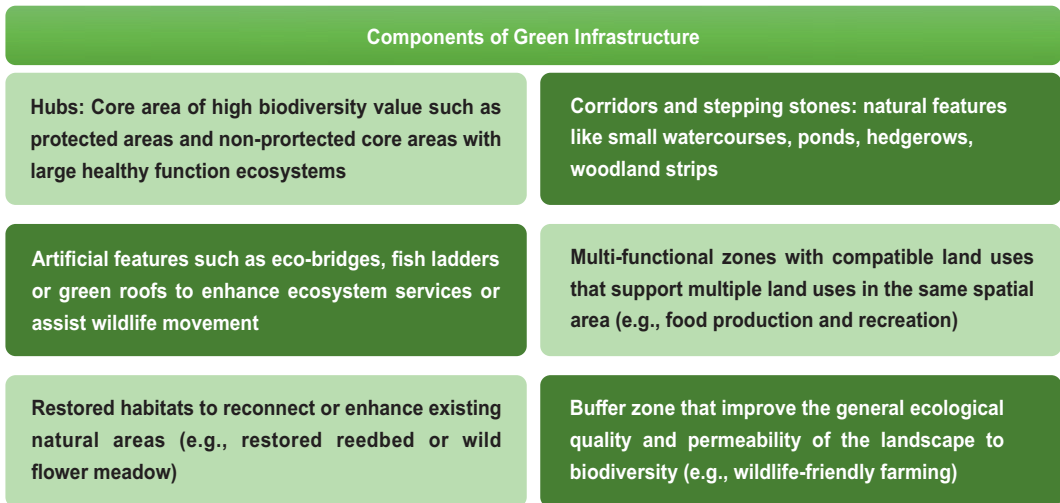


Figure 36: Components of Green Infrastructure. (Adapted from EC, 2013)

Green building materials often make use of raw and/or nature based materials (processed) for construction. Such materials are extracted from biological cycles and their production and processing causes less environmental impacts due to their nature to productively reuse resources and avoid detrimental by-products, thus ensuring a healthy working and living environment.

Box 13: Green vs Natural Infrastructure

Infrastructure: Green or Natural?

The terms green infrastructure (GI) and natural infrastructure (NI) are often used interchangeably (UNEP, 2014), though they tend to be used to refer to planning and conservation work in different contexts and at different scales. A natural infrastructure approach could be seen to be restoring structure, function and composition of ecosystems to deliver ecosystem services, whereas a green infrastructure approach would enhance these aspects of ecosystems, to deliver these services. Furthermore, while a green infrastructure approach is used at both an urban and a landscape scale, a natural infrastructure approach is used only at only a landscape scale. However, the two approaches share many of the same principles and objectives, including connectivity, multi-functionality and smart conservation (European Environment Agency, 2011). In both GI and NI approaches, hybrid solutions are commonly used, mixing hard infrastructure with ecosystem-based infrastructure.

Green building systems include components for greening of buildings like house trees, façade greenery and living walls, green roofs, building-integrated constructed wetlands (hydroponics) etc.

Green building sites are open spaces adjacent to buildings for establishing nature within cities, enhancing biodiversity, contributing towards blue-green infrastructure components and promoting cultural and social aspects. They provide multiple ecosystem services that ensure the overall well-being of the city. Some examples include pocket parks, small community parks, urban plazas, and elevated urban green promenades.

Approaches and Pathways:

In urban areas, GI as a concept and in practice is well implemented in spatial planning in comparison to EbA due to; (i) use of spatial layer and criteria for GI components and (ii) use principle-based applications in spatial planning that can be applied in spatial planning.

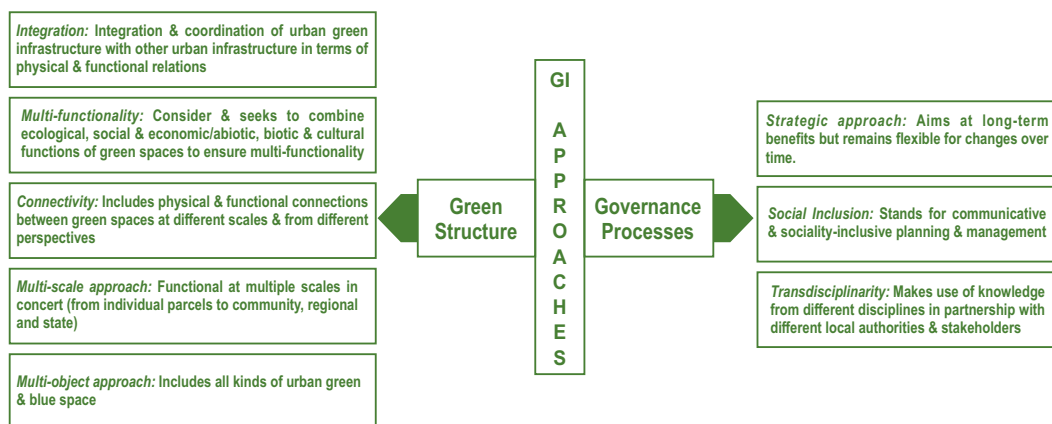


Figure 37: Pathways and approaches for Green Infrastructure to integrate it in planning. (Adapted from EU, 2020)

Growing multi-sectoral acceptance and demand for NbS- especially its implementation in urban areas and build environment- prompted Governments and other stakeholders to adopt robust plans inculcating nature based elements. They present an approach with a mix of green (nature based) and grey (engineered) solutions to acknowledge the value of existing natural systems for example hydrological systems. Figure 38 gives recommendations for integrating NbS in national plans for the water sector.

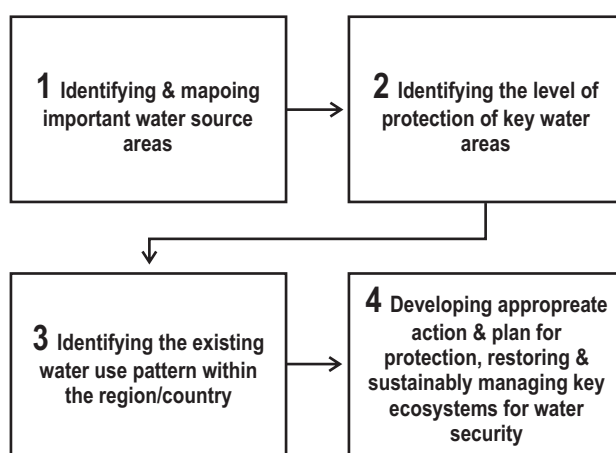


Figure 38: Step-wise guidance for integrating NbS in National Action Plans for Water Sector. (Adapted from UNDP, 2021)

Learning objectives	Session(s) & methodology
• To demonstrate the relation between Green growth and NbS. • To promote an understanding of how NbS fits in Natural Capital. • To develop an understanding of the concept of Green Infrastructure.	• 2 sessions • PowerPoint presentation/ Video representation • Case study examples • Lecture and discussion • Question and answer • Experience sharing

Enabling unit(s)
Understanding NbS and green growth solutions-natural capital, green infrastructure and approaches and pathways to adopt green infrastructure in national planning.

Guidance	Recommended readings
• This module includes knowledge sharing sessions on NbS concepts including its genesis, adoption by various international organization. • The session should take up discussion mode and promote experience and idea sharing of trainees. • The module will promote have in-depth knowledge and practical experience of NbS and its applications in addressing societal challenges to facilitators. • Lectures should use presentations and pictorials and easy examples to set context for the upcoming learning units.	• Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp. • EC–European Commission. (2015). Nature-Based Solutions and Re-Naturing Cities, Final Report of the Horizon 2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities • Cohen-Shacham, E., Andrade, A., Dalton, J., Dudley, N., Jones, M., Kumar, C., ... & Walters, G. (2019). Core principles for successfully implementing and upscaling Nature-based Solutions. Environmental Science & Policy, 98, 20-29. • Dhyani, S., Gupta, A. K., & Karki, M. (2020). Nature-based Solutions for Resilient Ecosystems and Societies. Springer.

LEARNING UNIT 5.4:

ENTRY POINTS AND PATHWAYS OF NbS MAINSTREAMING

NbS has gained momentum due to its simple and cost effective solutions which bring in environmental, economic and social co-benefits. NbS is unifying umbrella concept that stems from and brings together research on green infrastructure, ecosystem-based adaptation, urban ecosystem services, and water sensitive urban design to showcase under one term the compelling advantages these strategies bring in providing multifunctional solutions to pressing urban challenges (European Commission 2021). The case for NbS has gaining momentum in anchoring the global development agendas as being widely accepted by the policy, research communities and practitioners of urban science, climate science, sustainability science.

Need to Mainstream

The IPBES report of 2021, painted a very bleak picture assessing the current situation of biodiversity and ecosystem services. The report states that human dependence on resources have soared to a level that is beyond the capacity of nature to provide for due to proliferating biodiversity loss. Identified drivers include overexploitation, industrial agriculture and climate change as the main driver. It is very well established that NbS holds the potential to address these challenges along with providing multiple co-benefits. Apart from the SDGs, Paris Agreement and SFDRR, many other international deliberations recognized the fundamental role of natural ecosystems in reducing vulnerability to disasters, climate related extreme events and other environmental, social, economic shocks.



Figure 39: Localization and Mainstreaming of NbS.
(Source: Authors representations adopted from IPBES, 2019)

Incentivizing environmental responsibility, strengthening environmental laws and rules will advocate for uptake of NbS for green growth benefits through climate action, biodiversity conservation and societal changes. Mainstreaming through sectoral and cross-sectoral integration.

Despite global recognition, mainstreaming and localization of NbS remains a challenge. Often NbS pilots are uncoordinated and small-scaled, which substantially limits the realisation of potentials of NbS. In addition misuse of NbS increases the risk to erode and degrade the natural resources and ecosystems resulting in hampered ecosystem services. Figure 42 highlights some of the barriers to implement NbS at ground level. Localization and mainstreaming of NbS however needs to be prioritized in order to link their benefits to global development goals like the SDGs, Aichi Tatget and National Developmental Plans. Acharya et al. 2020, provided a characterization of priority based NbS mainstreaming (refer figure 41).

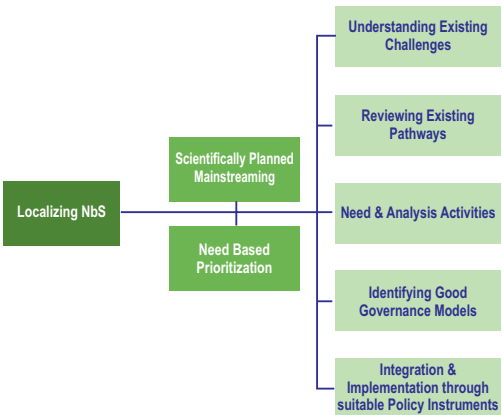


Figure 40: Priority based NbS Mainstreaming.
(Source: Acharya et al. 2020)

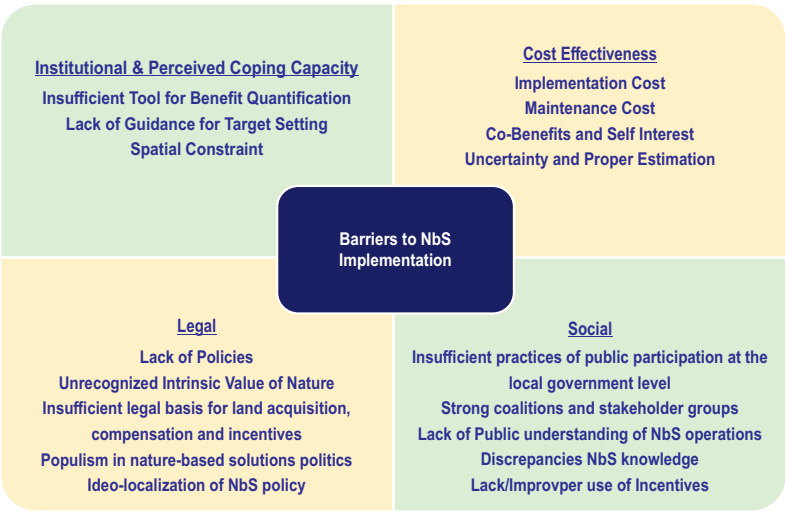


Figure 41: Barriers to on ground implementation to NbS.

Mainstreaming brings in sectoral and cross sectoral integration of nature based solutions in a systematic manner. However, it is crucial to delineate the sectoral linkages and identifying direct, indirect and transverse sectors. The figure below enlists the potential sectors and opportunities to mainstream NbS.

Table 9: Sectoral Classification and mainstreaming tools for NbS.
(Source: Authors representation, adapted from https://snrd-asia.org/wp-content/uploads/2021/11/Module-2_-Mainstreaming-NbS.pdf.)

Sectors		Mainstreaming Tools	
Direct Sectors	Agriculture	Acts	Regulatory
	Livestock	Policies	
	Forestry	Standards & Protocols	
	Fisheries	Regulations	
	Aquaculture	Strategies	
	Tourism	Laws	
Cross Sectors (Transversal)	Finance	Guidelines	Information and Education
	Sustainable Development	Programmes	
	Poverty Reduction	Practices	
	Climate Change Adaption	Information	
	Climate Change Mitigation	Certificates	
Indirect Sectors	Infrastructure	Labels	

	Energy		Audits & Assessments	
	Mining		Feedbacks	
	Health Services		Incentives	Economic and Financial
	Manufacture		Taxes	
	Processing		Tariffs	
			Subsidies	
			Grants	
Additional Sectors to NbS Mainstreaming	Food Systems	Agroecology regenerative agriculture & aquaculture, value chains		
	Investment & business sector	Economic recovery, nature positive and climate neutral economy, producers, retailers		
	Spatial planning	Integrated Land Use Planning, Integrated Water Resource Management, Integrated Coastal Zone Management, Marine Spatial planning		
	Cities & Infrastructure	Urban planning, building codes, green & blue spaces		
	Health Systems	OneHealth approach, ecosystem conservation and restoration for pandemic prevention, nature for human health and wellbeing		

However, mainstreaming NbS entails processes which require long-term institutional changes. It is critical to identify potential window of opportunity by understanding the institutional arrangements and policy processes. Collaboration (private sector participation, stakeholder and local community involvement) and institutional leadership are vital enabling factors NbS mainstreaming in policy processes. As stated in table 10 policies, programmes, strategies, practices, laws and regulations etc. are tools and vectors for maintaining NbS, however, mainstreaming requires context specific entry points. Generally different sectors offer different needs, challenges and associated opportunities and so requires separate set of policies, instruments and tools. As highlighted by **Bhardwaj et al. 2020**, the potential entry points for NbS considering policy instruments as suitable tools vary across sectors.

Nature based Solutions Standards

The global standards developed by IUCN, provides clear parameters for defining NbS and a common framework to understand progress.

Standards are also essential to prevent misuse, negative outcomes, upscale and increase NbS impacts, help funding agencies and policy makers to access effectiveness of NbS interventions.

The standards can be used by governments, NGOs, companies as a user guide & toolkit for self-assessment for:

- i. Designing new and effective NbS projects;
- ii. Identifying gaps and upscaling pilots;
- iii. Verifying past projects and future proposals.

The standards consists of 8 criterion having 28 indicators build on NbS principles and strong feedbacks from stakeholder consultations from more than 100 countries. They aim at facilitating, incentivising and enabling users and actors to implement appropriate NbS projects.



Figure 42: IUCN NbS Standards.
(Source: Adopted from IUCN, 2019)

Criterion 1 focuses on identifying the societal challenge to which the NbS is a response. Criterion 2 guides the design of the solution responding to the scale of the issue. Scale here refers to geographic scale across land and sea, as well as the economic, ecological and societal aspects of the land/seascape. Criteria 3, 4 and 5 correspond to the three pillars of sustainable development– environmentally sustainable, socially equitable and economically viable. Criterion 6 addresses the balancing of trade-offs and choices that need to be made to achieve short and long-term gains, and how to ensure that there is a transparent, equitable and inclusive process to determine such trade-offs. Criterion 7 responds to the need for adaptive management, which facilitates continuous learning about system-wide processes and adapting the NbS according to systemic changes. Criterion 8 promotes the true potential of NbS through its long-term implementation by embedding the concept and actions into policy or regulatory frameworks as well as linking to national targets or international commitments. Table 11 enlists the 8 criteria and 28 indicators.

Table 10: IUCN NbS Standards and Indicators.
(Source: IUCN 2021)

Criterion	Indicators
Criterion 1: NbS effectively address societal challenges	1.1. The most pressing societal challenge(s) for rights-holders and beneficiaries are prioritised 1.2. The societal challenge(s) addressed are clearly understood and documented 1.3. Human well-being outcomes arising from the NbS are identified, benchmarked and periodically assessed
Criterion 2: Design of NbS is informed by scale	2.1. The design of the NbS recognises and responds to interactions between the economy, society and ecosystems 2.2. The design of the NbS is integrated with other complementary interventions and seeks synergies across sectors 2.3. The design of the NbS incorporates risk identification and risk management beyond the intervention site

Criterion 3: NbS result in a net gain to biodiversity and ecosystem integrity	3.1. The NbS actions directly respond to evidence-based assessment of the current state of the ecosystem and prevailing drivers of degradation and loss 3.2. Clear and measurable biodiversity conservation outcomes are identified, benchmarked and periodically assessed 3.3. Monitoring includes periodic assessments of unintended adverse consequences on nature arising from the NbS 3.4. Opportunities to enhance ecosystem integrity and connectivity are identified and incorporated into the NbS strategy
Criterion 4: NbS are economically viable	4.1. The direct and indirect benefits and costs associated with the NbS, who pays and who benefits, are identified and documented 4.2. A cost-effectiveness study is provided to support the choice of NbS including the likely impact of any relevant regulations and subsidies 4.3. The effectiveness of the NbS design is justified against available alternative solutions, taking into account any associated externalities 4.4. NbS design considers a portfolio of resourcing options such as market-based, public sector, voluntary commitments and actions to support regulatory compliance
Criterion 5: NbS are based on inclusive, transparent and empowering governance processes	5.1. A defined and fully agreed upon feedback and grievance resolution mechanism is available to all stakeholders before an NbS intervention is initiated 5.2. Participation is based on mutual respect and equality, regardless of gender, age or social status, and upholds the right of Indigenous Peoples to Free, Prior and Informed Consent (FPIC) 5.3. Stakeholders who are directly and indirectly affected by the NbS have been identified and involved in all processes of the NbS intervention 5.4. Decision-making processes document and respond to the rights and interests of all participating and affected stakeholders 5.5. Where the scale of the NbS extends beyond jurisdictional boundaries, mechanisms are established to enable joint decision making of the stakeholders in the affected jurisdictions

Criterion 6: NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits	6.1. The potential costs and benefits of associated trade-offs of the NbS intervention are explicitly acknowledged and inform safeguards and any appropriate corrective actions 6.2. The rights, usage of and access to land and resources, along with the responsibilities of different stakeholders, are acknowledged and respected 6.3. The established safeguards are periodically reviewed to ensure that mutually-agreed trade-off limits are respected and do not destabilise the entire NbS
Criterion 7: NbS are managed adaptively, based on evidence	7.1. A NbS strategy is established and used as a basis for regular monitoring and evaluation of the intervention 7.2. A monitoring and evaluation plan is developed and implemented throughout the intervention lifecycle 7.3. A framework for iterative learning that enables adaptive management is applied throughout the intervention lifecycle
Criterion 8: NbS are sustainable and mainstreamed within an appropriate jurisdictional context	8.1. The NbS design, implementation and lessons learnt are shared to trigger transformative change 8.2. The NbS informs and enhances facilitating policy and regulation frameworks to support its uptake and mainstreaming 8.3. Where relevant, the NbS contributes to national and global targets for human well-being, climate change, biodiversity and human rights, including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP)

The IUCN standards provides an extensive framework for reporting ground level NbS interventions. Another framework developed by Wamsler et al. 2014 and discussed by Acharya et al. 2020 suggests a model for successful mainstreaming of NbS into governance and planning stages. The framework puts forward six strategies at three levels (local, institutional and inter institutional level) build around four approaches of risk reduction which are: i) reduce exposure; ii) reduce vulnerability; iii) effective response; and iv) effective recovery. Figure 44 highlights key points of this framework.

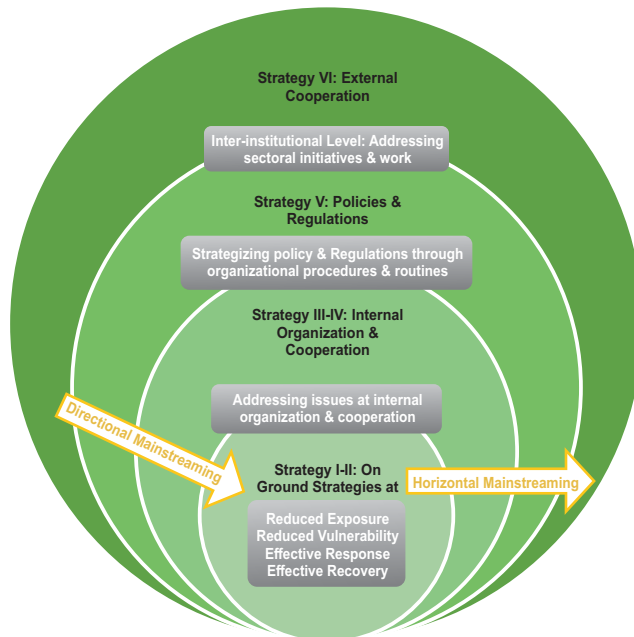


Figure 43: Framework for Mainstreaming NbS into Governance Models.
(Source: Adapted from Wamsler et al. 2014 and Acharya et al. 2020)

Learning objectives	Session(s) & methodology
● To understand the need to mainstream NbS. ● To identify the important sectors for NbS Mainstreaming. ● To deliberate upon the barriers for mainstreaming NbS intervention. ● To enumerate the standards, pathways and tools for NbS mainstreaming and localization.	● 1 sessions ● PowerPoint presentation/ Video representation ● Case study examples ● Lecture and discussion ● Question and answer ● Group Discussion
Enabling unit(s)	
Entry points and Pathways of NbS Mainstreaming- difference between localization and mainstreaming, mainstreaming needs, barriers and pathways to mainstreaming, NbS Standards, NbS framework for mainstreaming.	
Guidance	Recommended readings
● This learning unit includes knowledge sharing sessions on the needs to mainstream and localize NbS. ● The session should take up discussion on the existing barriers and drivers for uptake of NbS intervention. ● The session should discuss the sector specific policy entry points. ● Lectures should use presentations and pictorials and easy examples to set context for the upcoming learning units. ● The facilitator should have in-depth knowledge and understandings of IUCN guidelines, standards and other international and national policies.	● Frantzeskaki, N., & Mc Phearson, T. (2022). Mainstream nature-based solutions for urban climate resilience. <i>BioScience</i>, 72(2), 113-115. ● Han, S., & Kuhlicke, C. (2021). Barriers and drivers for mainstreaming nature-based solutions for flood risks: The case of South Korea. <i>International Journal of Disaster Risk Science</i>, 12(5), 661-672. ● Wamsler, C., Pauleit, S., Zölch, T., Schetke, S., & Mascarenhas, A. (2017). Mainstreaming nature-based solutions for climate change adaptation in urban governance and planning. In <i>Nature-based solutions to climate change adaptation in urban areas</i> (pp. 257-273). Springer, Cham. ● Acharya, P., Gupta, A. K., Dhyani, S., & Karki, M. (2020). New pathways for NbS to realise and achieve SDGs and post 2015 targets: Transformative approaches in resilience building. In <i>Nature-based Solutions for Resilient Ecosystems and Societies</i> (pp. 435-455). Springer, Singapore.

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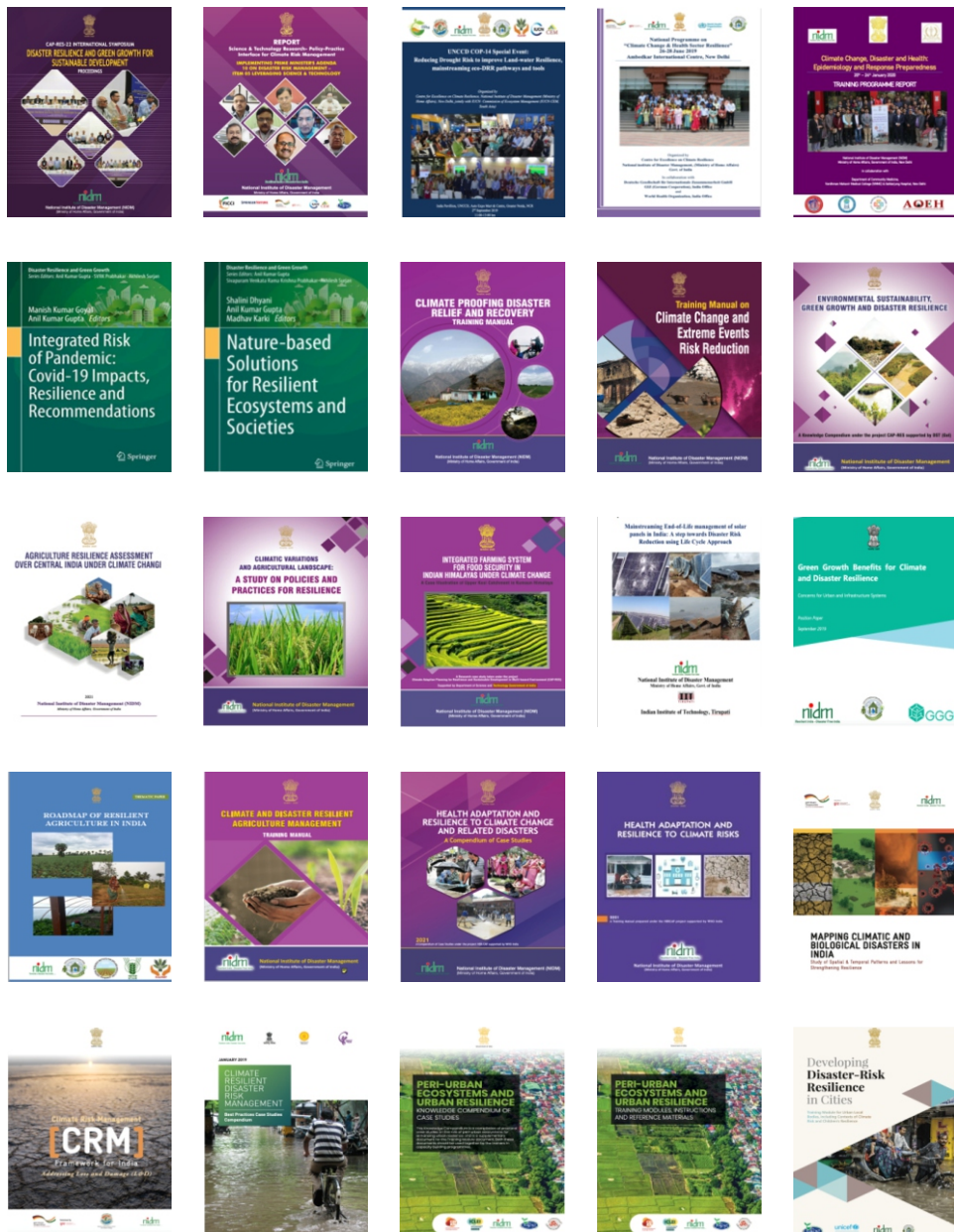
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