Nature based Solutions (NbS) for enhancing Ecosystem Services and Human Well-Being

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Talk Outline

To underscore the importance and potential of ecosystems in solving local, national and regional challenges and seek collaboration to sustainably management them

Key Points will be to:

1. Introduce integrated and interactive nature-human interaction and it's strengths and weaknesses;
2. Understand the Issues and limitations of NbS and Community based Solutions (CbS);
3. Exploring the opportunities and challenges of Community empowered NbS for building resilient socio-ecological ecosystems.

Innovative approaches, case studies and success stories shared from few ecosystems that provide overview on integrated application of NbS and CBA

My Expectations while I deliver this talk

- **To influence and endorse the knowledge base on complex issues related to NbS that also addresses ecosystem conservation and efforts to create healthy ecosystems by understanding the importance and judicious application of NbS.**

- **To provide overview on advanced and emerging knowledge with reference to increasing the resilience of ecosystems using NbS and Indigenous and Traditional Knowledge (ILK) based CBA available with indigenous and local communities.**

- **To provide you details on key requirements in implementing NbS;**

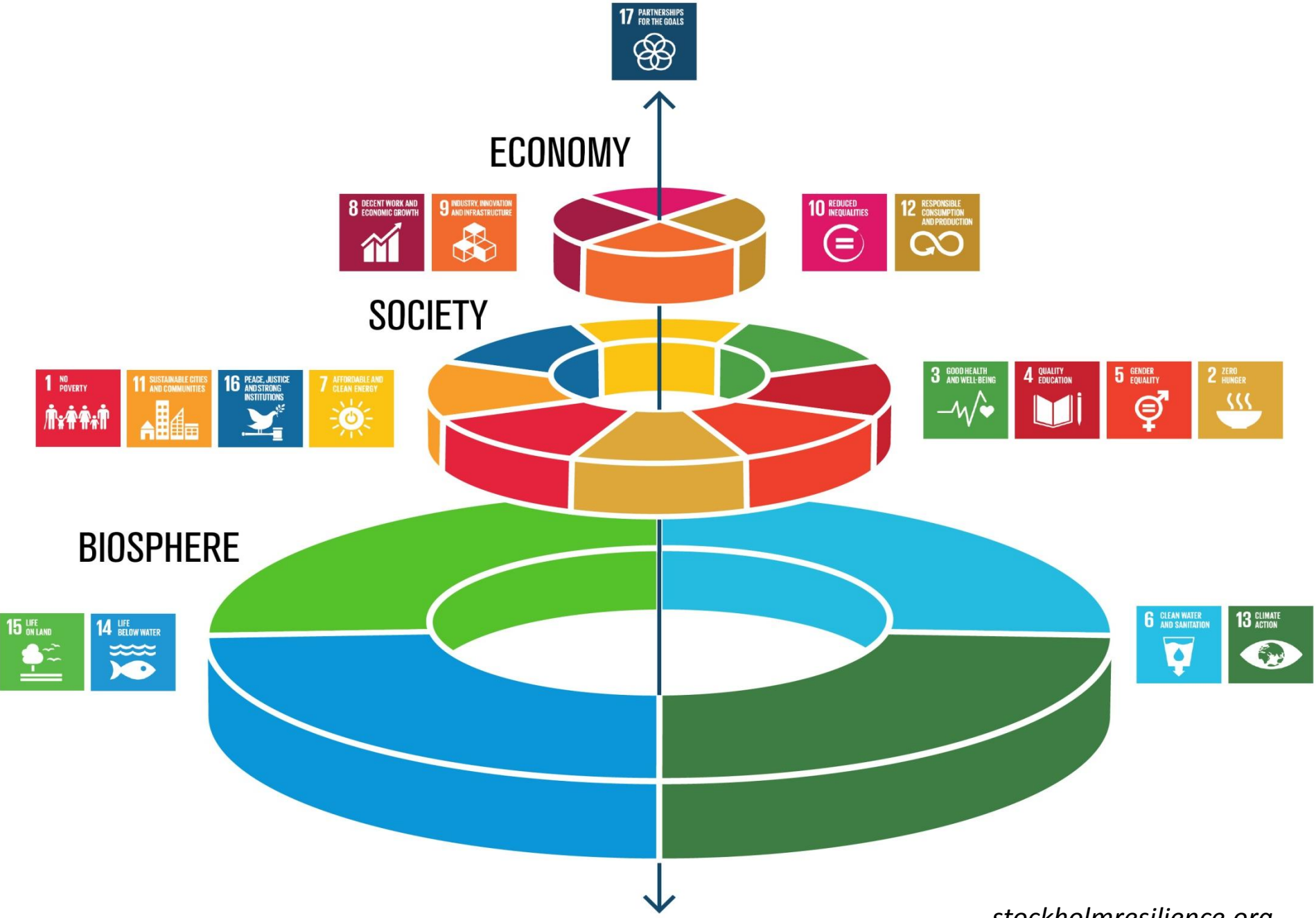
- **Seeking your comments and contributions that can help for vertical and horizontal scaling up of NbS approach from local to landscape to ecosystem level**

1. Why do ecosystems matter for developing resilient societies to disasters and climate change?

2. What are the strategies for managing uncertainties while, also addressing socio-economic development





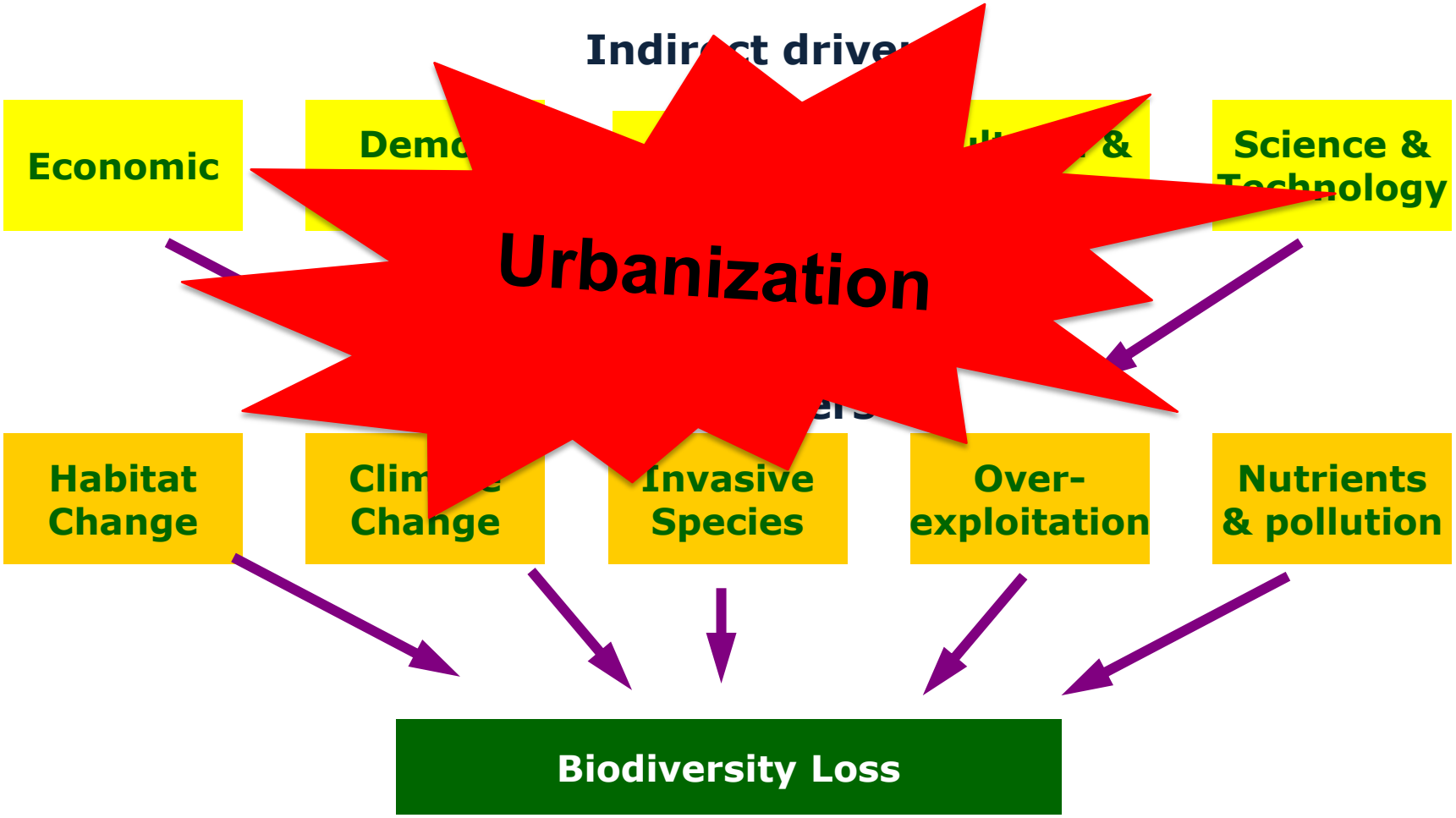



stockholmresilience.org

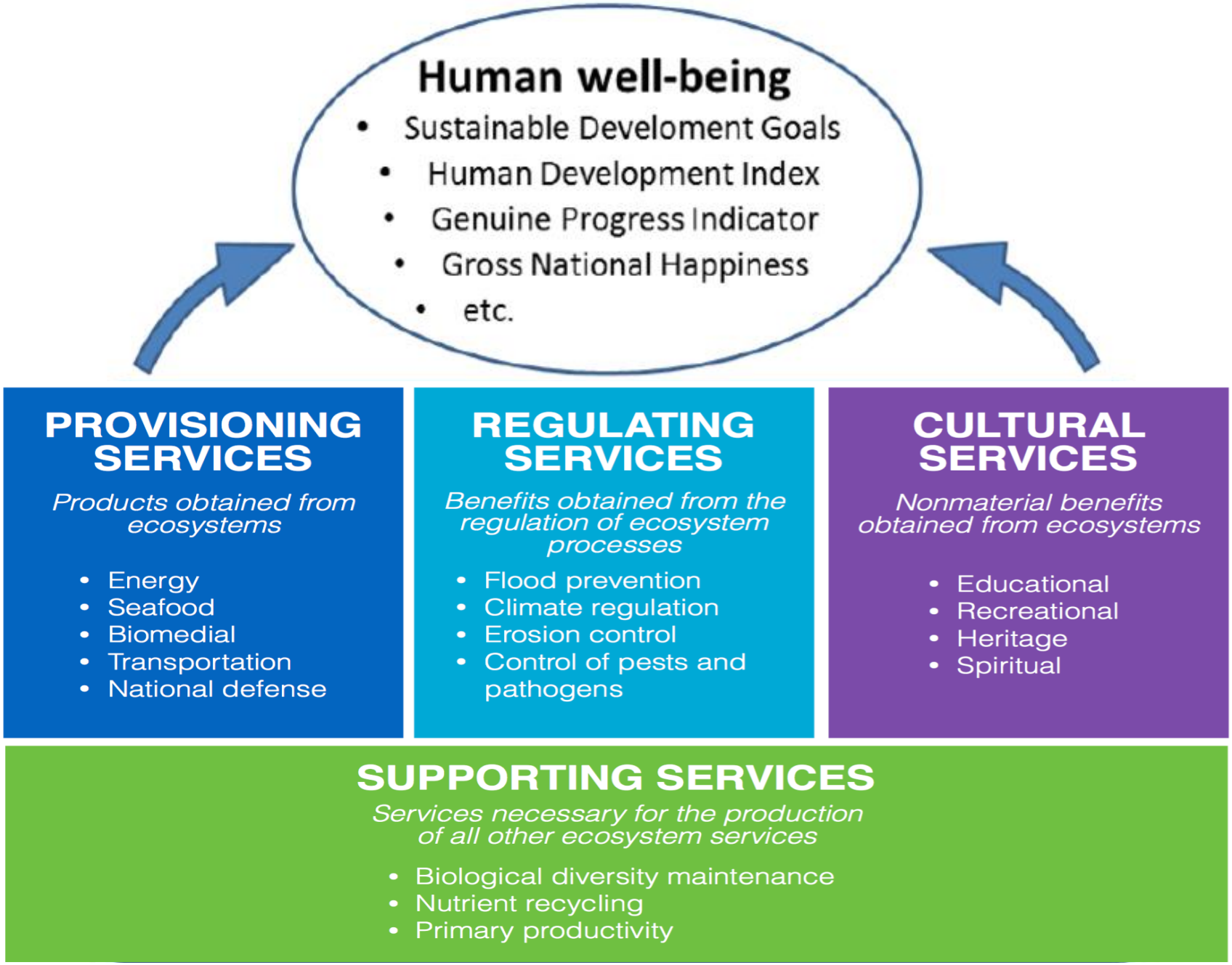
Major Environmental Challenges

- Poverty
- Deforestation, Biodiversity and Habitat Loss leading to Species extinction
- Marine pollution and coastal area degradation
- Water shortage and ground water depletion
- Sustainability and Urbanization
- Increased pollution, Poor resource management
- Non-sustainable Agriculture
- Transboundary KBA
- **CLIMATE CHANGE** as Mega Driver

Drivers of Biodiversity Loss



Source: Dhyani et al., 2017



Source: Millennium Assessment,2005

Mountain Vegetation-Landslides, Mudslides, Rockfall

Indian Himalayan Region

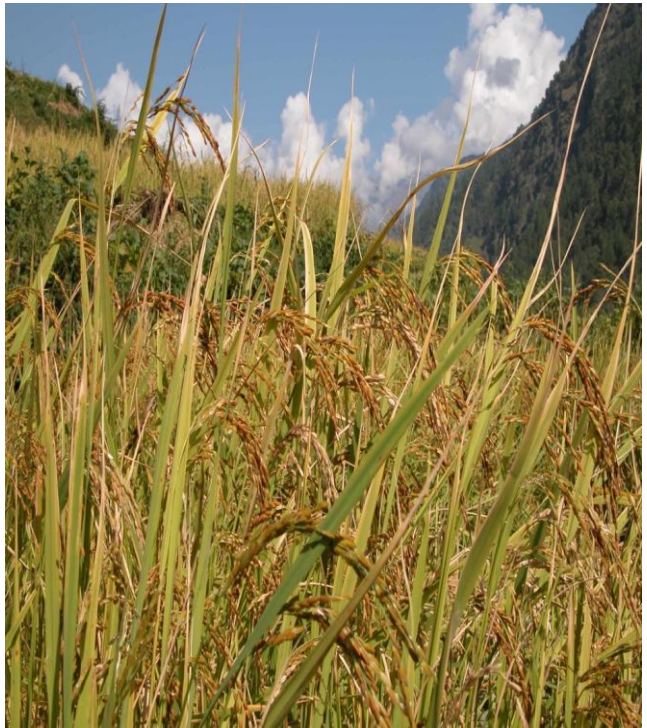
Western Ghats

Riverine and Wetlands-Flood Control

Coastal Vegetation: Coastal Hazards



Crop Diversification for drought tolerant varieties


New challenges and issues in Watershed Management across India

DEFORESTATION

BIODIVERSITY LOSS

DETERIORATION OF DRAINAGE PATTERN

UNSCIENTIFIC DEVELOPMENT

INCREASING HYDRO ELECTRIC PLANTS

INCREASE IN INFRASTRUCTURAL FACILITIES CAUSING LAND SLIDES

CLIMATE LED VULNERABILITIES

INSUFFICIENT DISASTER PREPAREDNESS (REMOTENESS)

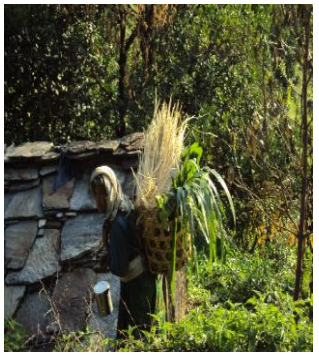
LACK OF AWARENESS AMONG LOCALS

Application of NbS

- Challenges and issues in Watershed Management and Rural development
- New opportunities in Integrated and participatory management of resources along with socio-economic development
- New approaches in the context of ensuring Food, Water, and Energy security;








INNOVATING WITH NATURE

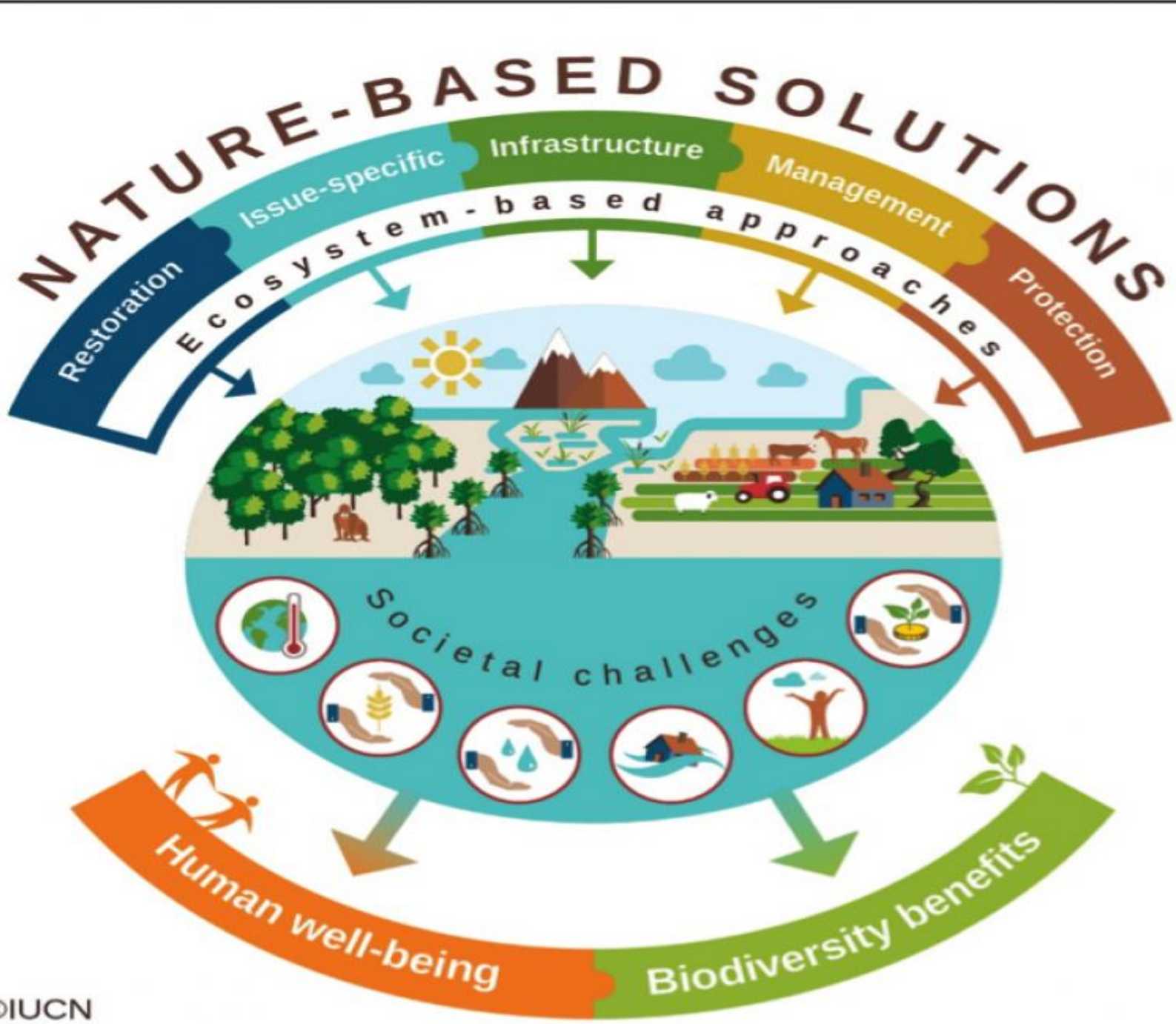
Nature-based solutions are designed to bring more nature and natural features and processes to cities, landscapes and seascapes. These innovative solutions also support economic growth, create jobs and enhance our well-being.

Nature-based Solutions (NbS)

Nature-based Solutions (NbS) are **actions to protect, sustainably manage and restore natural or modified ecosystems**, which **address societal challenges** (e.g. climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing **human well-being and biodiversity benefits**.

The NbS concept, as used in environmental sciences and nature conservation contexts, has emerged **to search for ways to work with ecosystems**-rather than relying on conventional engineering solutions

To adapt to and mitigate climate change effects, while improving **sustainable livelihoods** and protecting natural ecosystems and biodiversity.


NATURE-BASED SOLUTIONS
Restoration
Issue-specific
Infrastructure
Management
Protection
Ecosystem-based approaches
Societal challenges
Human well-being
Biodiversity benefits
©IUCN

“NbS helps sustainable management, conservation and restoration of ecosystems to reduce disaster risk, and climate uncertainities with the aim to achieve sustainable and resilient development”

Addresses risk management for climate and non climate related disasters

“NbS helps people adapt to the adverse effects of climate change.”

Addresses climate-related hazards, long term mean changes in micro-climate and future uncertainties

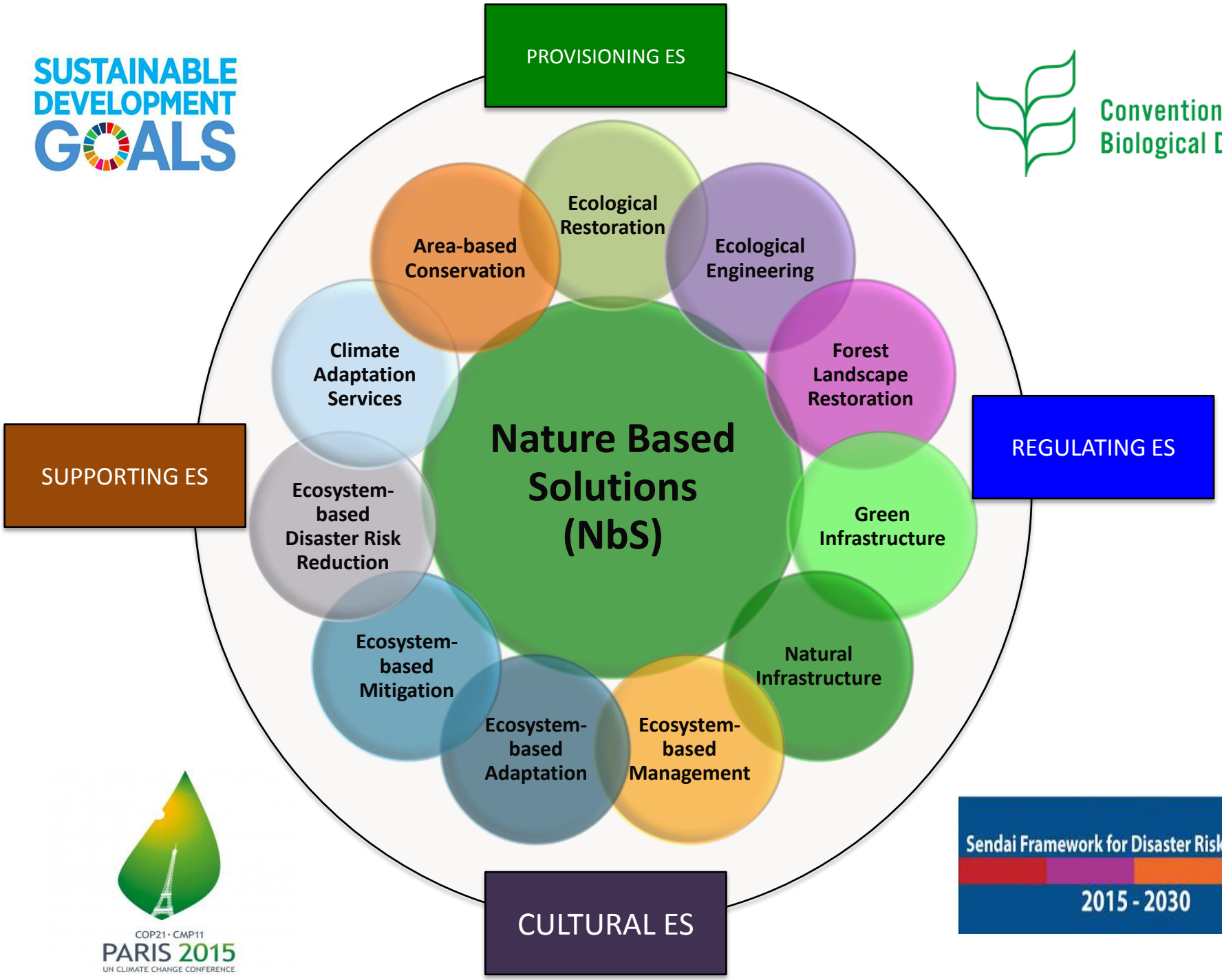
NbS concepts

ER	Ecological Restoration
EE	Ecological Engineering
FLR	Forest Landscape Restoration
GI	Green Infrastructure
NI	Natural Infrastructure
EbMgt	Ecosystem-based Management
EbA	Ecosystem-based Adaptation
EbM	Ecosystem-based Mitigation
Eco-DRR	Ecosystem-based Disaster Risk Reduction
CAS	Climate Adaptation Services
AbC	Area-based Conservation

IUCN CEM, 2016

Nature based Solutions: Ecosystem Approach

- An approach that puts people and their natural resource use practices at the center of decision making
- To seek balance between the conservation and use of biological diversity
- Relevant to professionals and practitioners active planning
- Helps to identify and understand the process of change in ecosystems and enables to plan adaptive strategies
- CBD supports application and implementation of EBA (Decision VII/11)

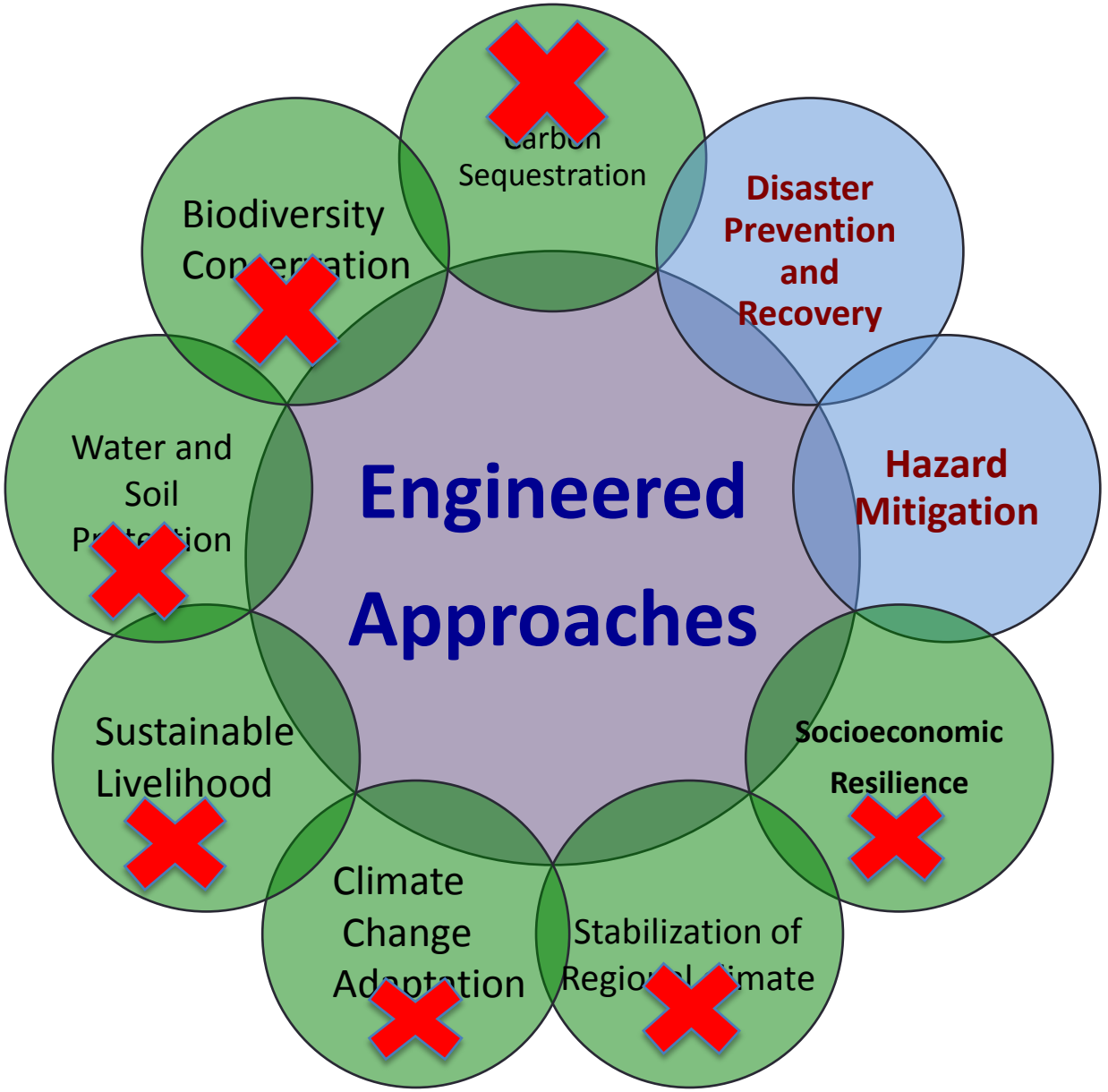


SUSTAINABLE DEVELOPMENT GOALS

Convention on Biological Diversity

COP21 · CMP11
PARIS 2015
UN CLIMATE CHANGE CONFERENCE

Sendai Framework for Disaster Risk Reduction
2015 - 2030



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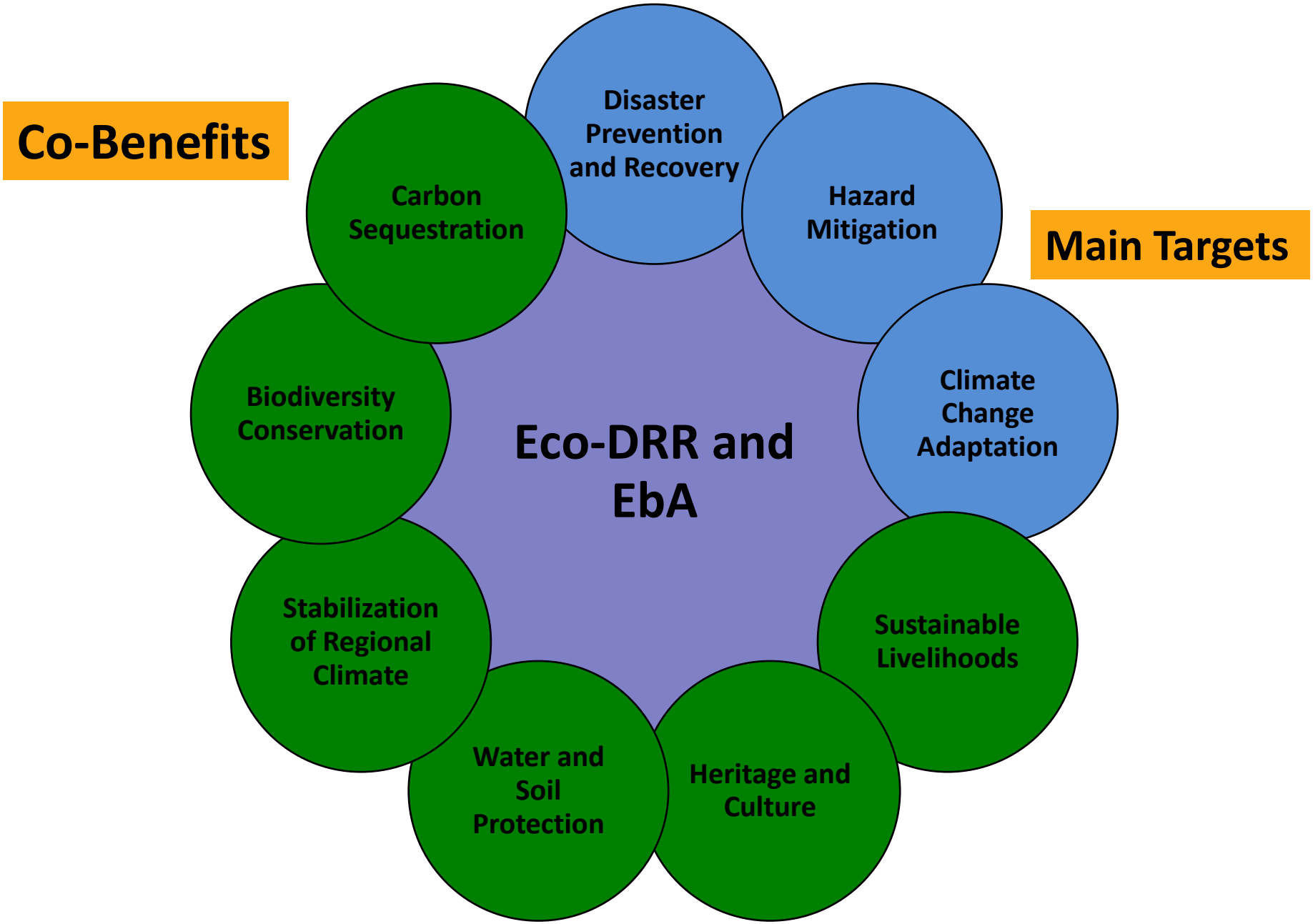

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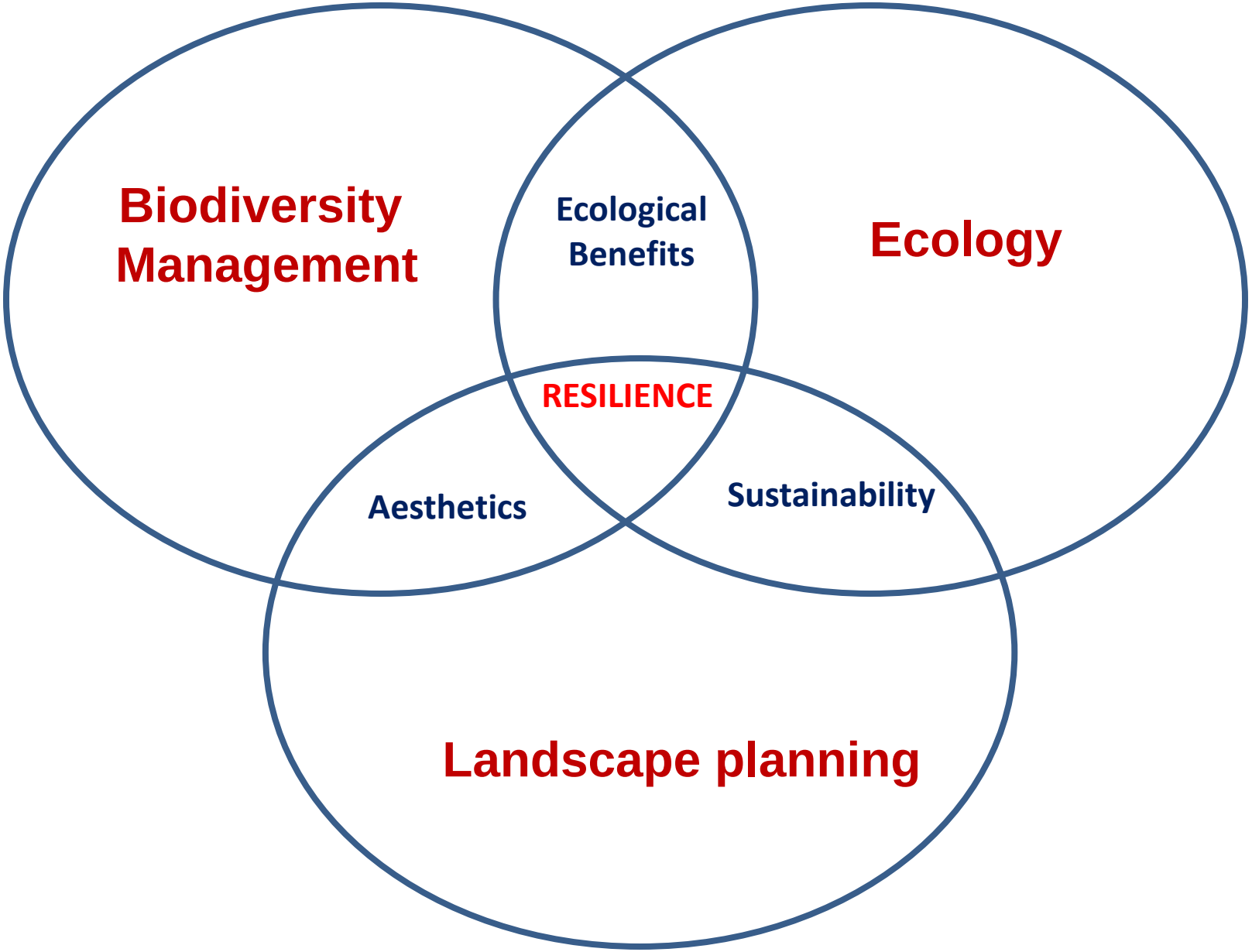


NbS: Linking Ecology, Sustainability and Aesthetics

Air pollution-Water quality-Solid Waste-Microclimatic Control-Invasive species-Ecosystem services

Conserving biodiversity- Rural planning Green networks-Habitat connectivity

BETTER ECOLOGICAL OUTCOMES

Increased flow of ecosystem Services;
Better Carbon Sinks
Improved Quality of Life and Reduced disaster risks

Table 1 Ecosystem services, values and valuation criteria managing ecosystems in Urban areas

cosystem rvices	Criteria	Probable Valuation methods	Value to property values	Value to urban dwellers in general
icroclimate gulation/reduc l heat islands	Saving energy on temperature control of buildings/annum	Assessed in kilowatt hours saved in air conditioning of buildings/year	x	x
ater eservation/har sting	Gallons of water conserved from run off	Assessed in reduction of cost to make civil structures to reduce run off and flash flood situations, amount spent in per gallon water retention	x	x
oil onservation	Tons of soil conserved/annum	Assessed in amount spent to enhance nutritional content of soil by application of fertilizers as well as costs invested in controlling leaching	x	
ultural values d recreational ospects	Landscape quality score/ square foot	Added value to property based on it's location, can be assessed in percentage increase in value of the property/square foot	x	
ater Quality	Nutrients added or Removed from water or amount spent on water treatment /annum	Circumvented cost of executing conventional water treatment plan. Assessed in amount required for per MLD of impurities removed or / liter of treated water		x
ir quality	Tons of particulate matter (PM) removed from the atmosphere/annum	Increased value of property, assessed in percentage increase of value land or property/ton/household of particulate matter (PM) removed from atmosphere		x
arbon questration	Carbon dioxide sequestered	Assessed in dollars/ carbon credit (ton carbon) sequestered in voluntary carbon markets		x

NbS: The Ecosystem based Approach

IUCN Approach for 5 Steps to implementation

Step A Defining the stakeholders and defining the ecosystem area

Determining the main stakeholders, defining the ecosystem area, and developing the relationship between them

Step B Ecosystem structure, function and management

Characterizing the structure and function of the ecosystem, and setting in

Place mechanisms to manage and monitor it

Step C Economic Issues

Identifying the important economic issues and what will affect the ecosystems and its inhabitants

Step D Adaptive management over space

Determining the likely impact of the ecosystem on adjacent ecosystems

Step E Adaptive management over time

Deciding on long term goals, and flexible ways of reaching them

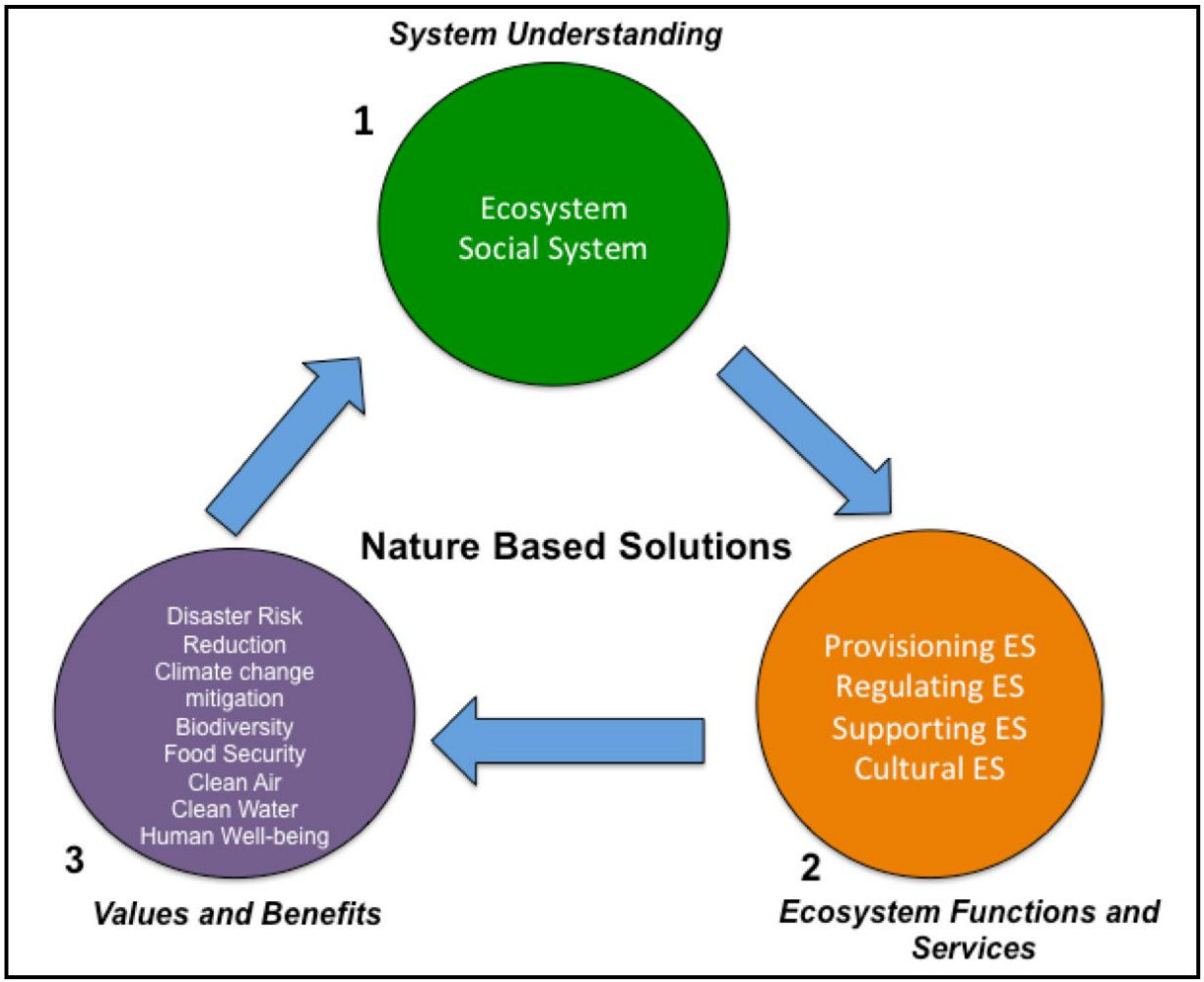


Fig. 5 Nature-based Solutions (NbS) involves system understanding for planning ective approaches that ensure restoring ecosystem functions and services for human well being though nature's benefits to people

Copyright: Dhyani et al., 2018

Key Pointers

Despites the various strength, ecosystem-based approaches/NbS are **not panacea** for all types of risk reduction.

NbS strategies must be pursued according to a **case by-case basis** in order to tackle local risks and impacts effectively.

In some cases, a **hybrid approach** that combines the functions of both hard and soft infrastructures can be more effective

There continues to be a **gap between the science and its usage in evidence-based policy-making**, this leads to unclear and sometimes contradictory information on the role of ecosystems or NbS for DRR, (quantification of ecosystem value and services to reduce vulnerability)

Furthermore, efforts to harness ecosystem services to require **strong involvement and commitment of governance actors across all levels**.

This facilitates **joint and integrated actions** for realizing the benefits of NbS.

CHOOSE WISELY….

“Just because something grows fast and yields better biomass doesn`t means it suits local environment. Either they are pioneers or exotics.

So, sense of introducing only natives should Be the agenda”

Vs

Exponential increase in the vulnerability of the society due to disasters

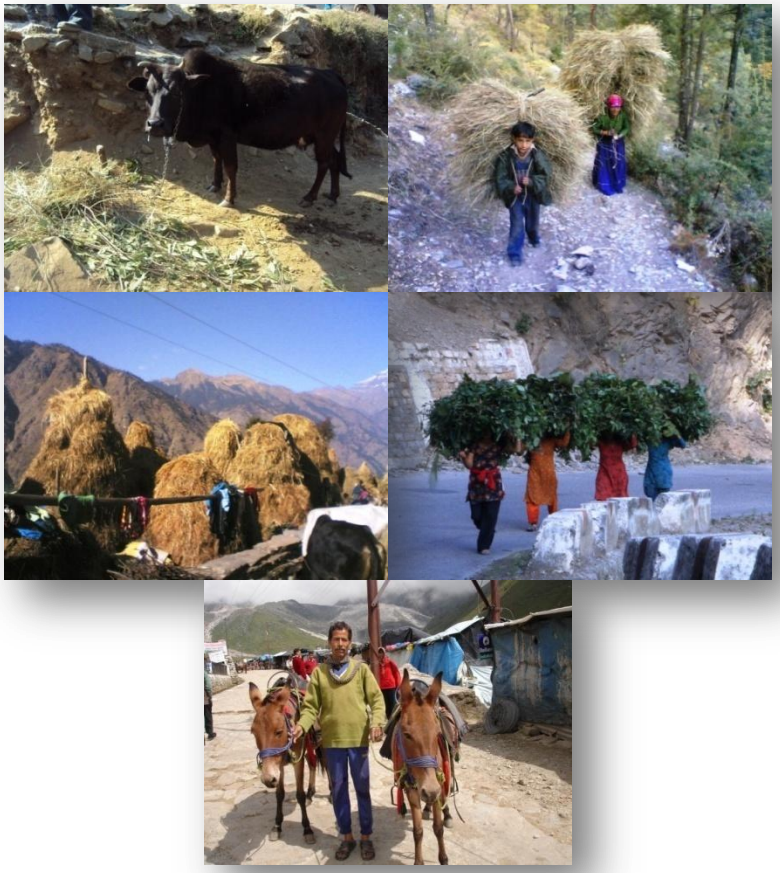
Disaster Risk Reduction has been a challenge so far

Increase in new disaster hotspots

Disasters	Causes	Economic Losses	Loss of Human lives	Long term impact
Kerala Floods and Landslides, 2018	37.5% excess rainfall in 2.5 months and degradation of forests with preparedness	≈15, 000 -Rs 20,000 crore (till Aug 20, 2018)	≈370 killed (till Aug 20, 2018)	≈10,000 km of roads washed away, 1 lakh houses damaged. Considerable wash off in topsoil and will impact land productivity in both the tea and rubber markets as well as paddy cultivation.[2]
Chennai Floods, 2015	Excessive rainfall exacerbated by very strong El Nino in the Pacific Ocean and the record-warm Indian Ocean and unplanned development choking drains and filling up wetlands with lack of preparedness	≈Rs. 10,00,000 crore	≈400 killed	Chennai floods are having worldwide economic impact, particularly in IT.
Delhi Smog, 2016	90% of the pollution in northern India is caused by farmers burning stubble to clear fields in the neighboring states of Punjab and Haryana with lack of preparedness	Direct infrastructural damage of about $21 billion. India lost more than 8.5% of its GDP in 2013 due to cost of increased welfare and lost labor due to air pollution [3,4]	5-10% of the workforce called in sick due to respiratory problems.	Lowered life expectancy of the present generation[3] Tourism season could be the worst-hit due to Delhi and NCR pollution
Jammu and Kashmir floods, 2014	Unprecedented rainfall, unplanned urbanization with lack of preparedness	≈Rs 5,400-5,700 crore	280-300 killed	2.53 lakh damaged houses
Himalayan Tsunami, 2013	More than 400% of average rainfall deforestation, and unplanned development on the banks of rivers and lack of preparedness	≈Rs 12,000 crore	4,000 killed	A total of 2,119 houses were fully damaged. 2,070 km roads and 145 bridges damaged and washed off.
Uttarkhand Forest Fires, 2016	High temperature with no atmospheric moisture, Shifting Agriculture Practice, 2015-16 El Nino, Mismanagement of the Forest Department, Pine Trees, Timber Mafias	1451 forest fire incidents leading to 4,048 hectares across 13 districts. Economic loss of forest fire is	9 killed and 17 injured	About 20% of the total forest area of the state showed indications of damage to the vegetation due to forest fire. Various ecologists and environmental

Case Study Approach to demonstrate integrated NbS and CbA: Socio-Ecological approach to effectively address Uncertainties

Natural Ecosystem: Western Himalaya



Man-made Ecosystem: Growing Urban Sprawls in India: Nagpur

Disasters have socio-ecological linkages

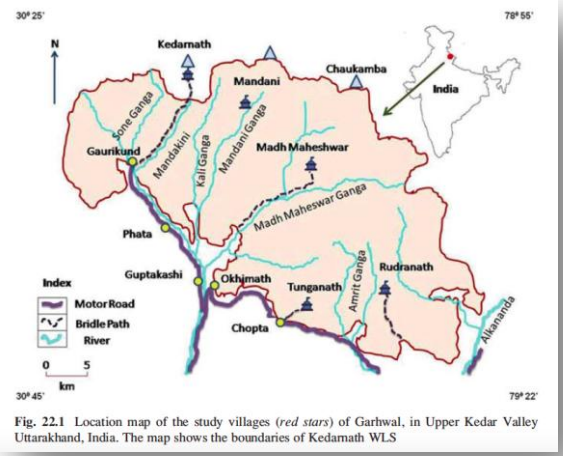


Fig. 22.1 Location map of the study villages (*red stars*) of Garhwal, in Upper Kedar Valley Uttarakhand, India. The map shows the boundaries of Kedarnath WLS

Forest Degradation → **Slope Destabilization** → **Landslides**

Reduced flow of provisioning ES → **Enhanced women drudgery** → **Affects education, health and social environment**

Dhyani et al., 2011. Biomass&Bioenergy

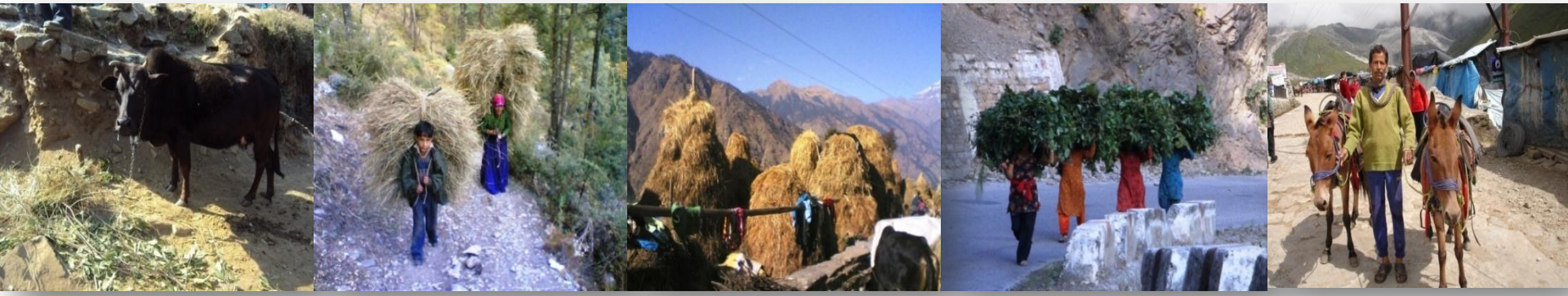
Background

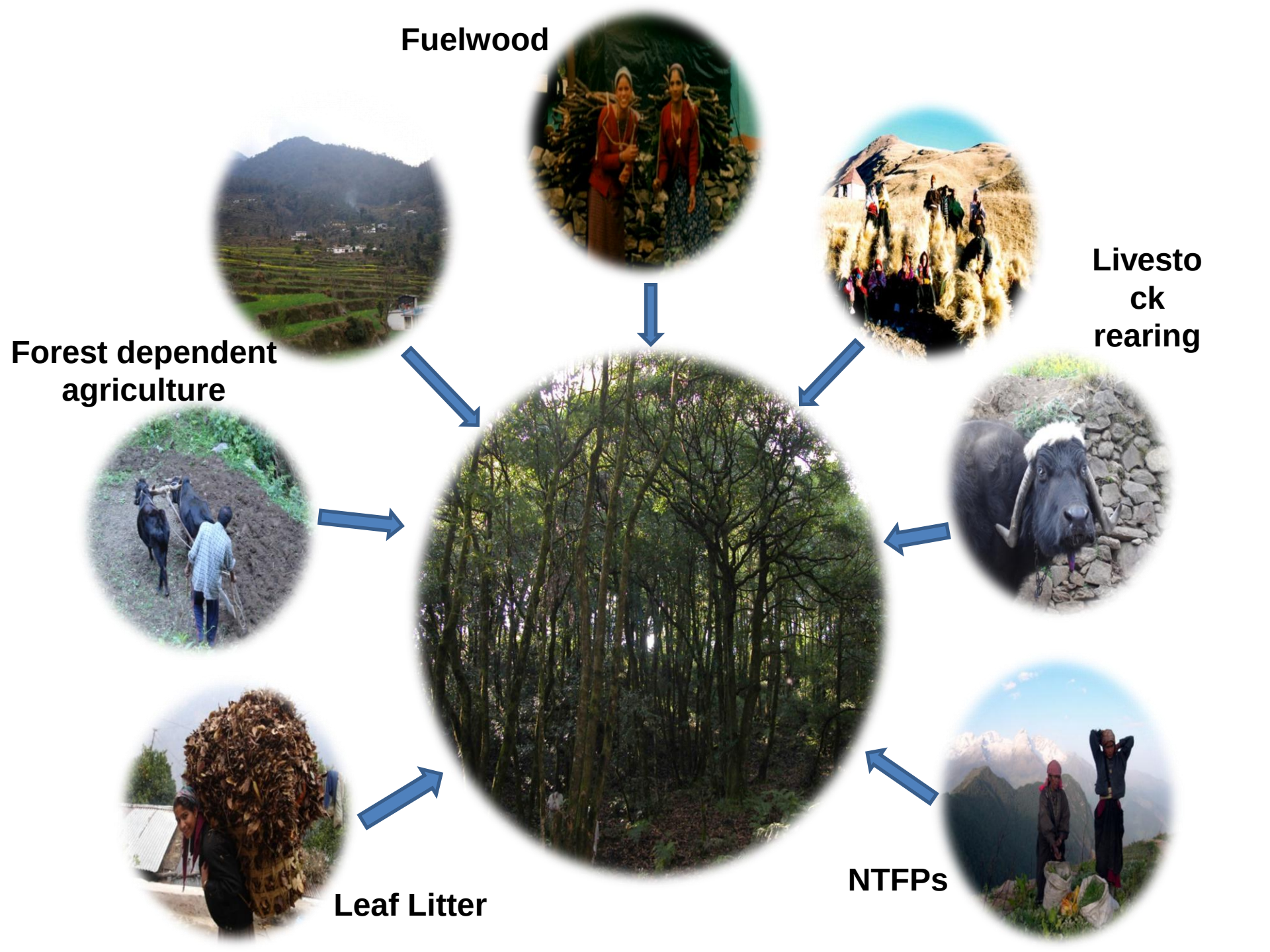
- Agriculture along with Animal husbandry is source of livelihood for over 70% of population and plays a vital role in the rural economy largely based on different land base interventions.

- Inaccessibility of most the areas and deprived socio-economic status of locals is responsible for the total dependence of the local inhabitants on nearby forest areas for their biomass demands.

- Locals of the state face a huge amount of fodder deficiency every year. The most serious problem is the unavailability of forage, particularly in winters and adds to the drudgery of local women folk.

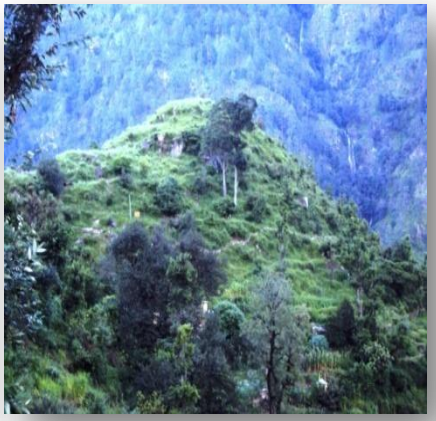
- Forests are already in a degraded stage in most of the areas and further exploitation can erode living standards as well as ecosystem stability.

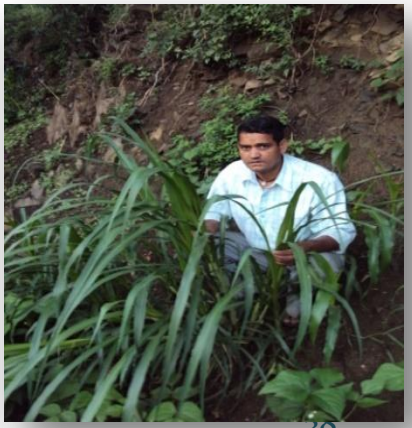



Fuelwood
Forest dependent agriculture
Livesto ck rearing
Leaf Litter
NTFPs

Work Elements

- To screen and propagate promising fodder species on community lands.
- To rehabilitate village commons with people's participation and develop a fodder based pilot model for replication.
- To build capacity for strengthening fodder resources within village ecosystems.
- To suggest a workable strategy for replication of fodder-based approach for reducing forest degradation and women drudgery.



Action Plan

- Selection of Villages to access demand, supply and shortage of fodder collected, involvement of women and their drudgery.
- Selection of community land for Fodder bank model and nursery set up.
- Identification of fast growing, high biomass yielding, nutritious (indigenous and introduced) fodder plants.
- Fodder bank and nursery site development and plantation during monsoon and spring.
- Mass propagation of some preferred and indigenous high altitude fodder trees.
- Developing local capacity




Methodology

1. Interactive data gathering tools and phyto-sociological investigation to identify preferred species, fodder collection scenario and involvement of women.

2. Participatory Rural Appraisal exercise to identify suitable land to develop fodder bank model and nursery.

3. Meeting and discussions followed by signing of MoU with locals for developing fodder bank model in village community wasteland.

4. A detailed review of literature, institute brochures and reports, discussion with scientists, expert individuals, meetings with locals to screen and propagate promising fodder species .

5. Site development on scientific lines by active community participation particularly women.

6. Mass propagation of three preferred species by vegetative propagation.

7. Capacity building by expert lectures in local language and hands on practice for right plantation techniques and mass multiplication of fast growing grass fodder.

- Fodder removal calendar was developed to reflect fodder removal pattern around the year.

- More than 48 prominent fodder species (including trees, shrubs and herbs) were listed with data on their crude protein percentage and organic matter digestibility.

- Requirement of fodder was uniform throughout the year but during winter months there was almost no availability of green fodder and livestock fed on mainly low quality straw, crop residue and dry grasses.

- Traditional stall feeding method is faulty and fodder is provided directly as a heap to livestock without removing its branches or chopping. This makes the fodder less nutritive.

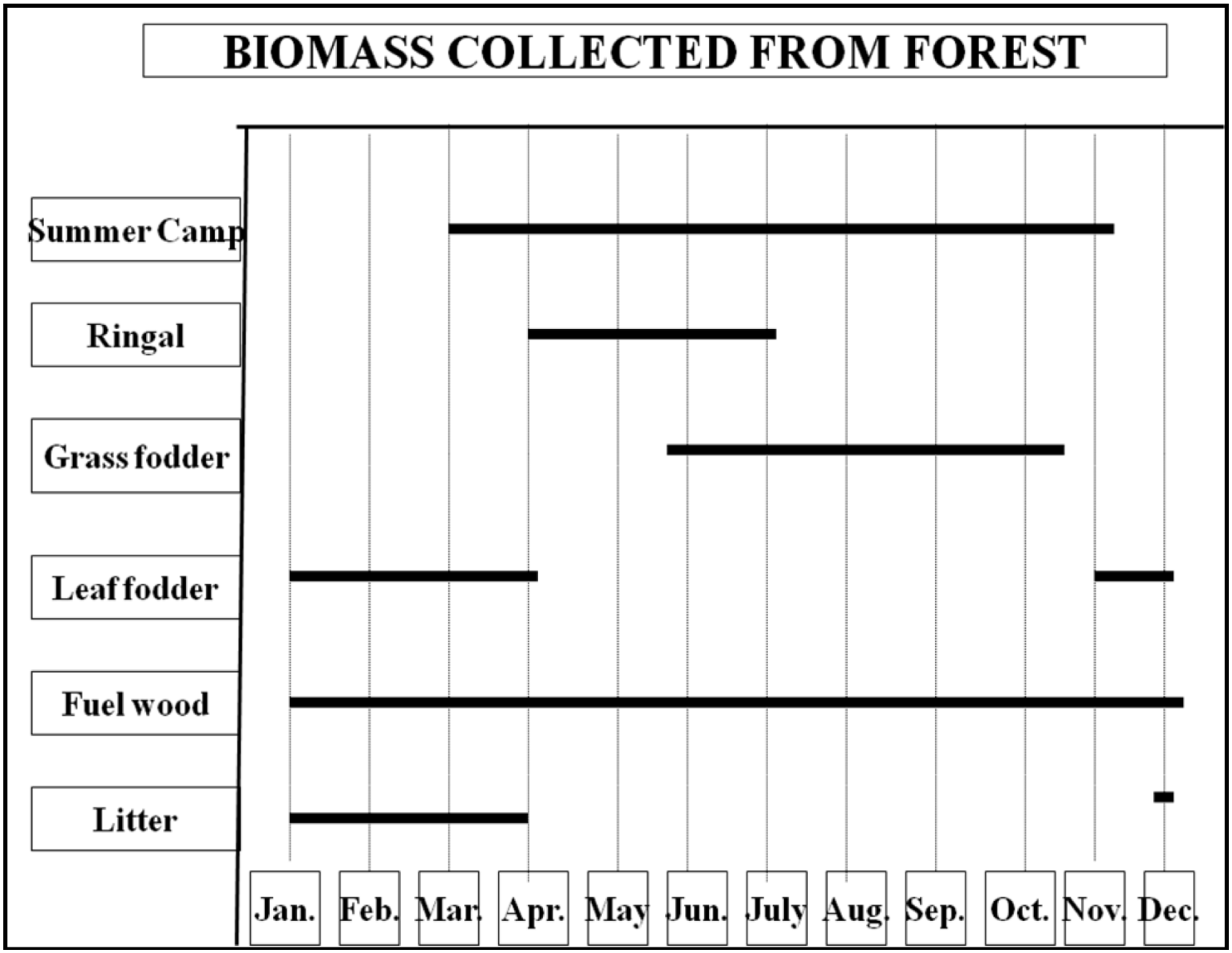


Fig. 6.1. The results of a Seasonal Calendar derived from people's consultation

Fodder removal calendar in the village ecosystems of Upper Kedar valley

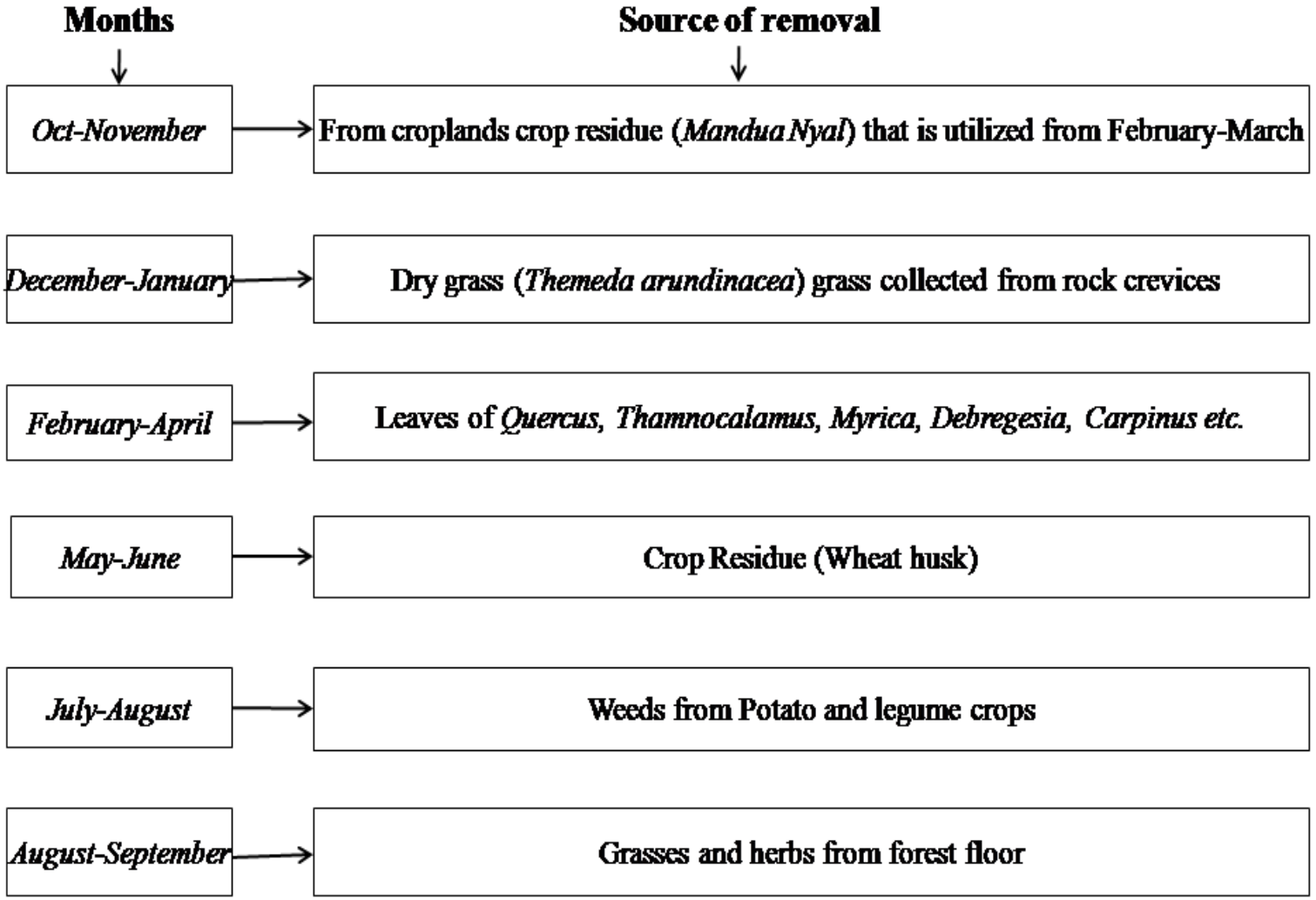


Table 1 – A general profile of the studied villages of Kedarnath Wildlife Sanctuary in Garhwal Himalaya.

Parameter	Villages of the study area					
	Shersi	Rampur	Sitapur	Triyuginarayan	Tosi	Maikhanda
Altitude (m amsl)	1800	1900	2000	2500	2750	1510
Households (number)	48	170	37	195	23	133
Population (number)	241	936	203	1125	145	715
Total agriculture land (ha)	33.35	60.64	–	66.50	9.33	57.68
Reserve forest (ha)	16.86	135.46	25.26	29.66	2.64	49.8
Community forest (ha)	150.01	7.94	–	128.57	0	9.22
Livestock (number)	302	302	288	926	749	444
Livestock unit	214.57	249.14	180.14	638.71	336.86	363.14

Table 3 – Biomass quantity and equivalent energy values (village/season) of green fodder collected during March–October in selected villages located at different altitudes of Kedarnath Wildlife Sanctuary, Uttarakhand.

Village	Quantity kg household^{-1} day^{-1}	Quantity kg household^{-1} season^{-1}	Energy^{1*} MJ HH^{-1} season^{-1}	Energy^{2*} MJ HH^{-1} season^{-1}
Tosi	83.52 ± 3.63	20,045.46	3,14,488.7	3,34,393.04
Triyuginarayan	84.0 ± 6.22	20,160	3,18,528	3,38,688
Shersi	84.0 ± 6.23	20,167	3,18,621	3,36,624
Rampur	82.6 ± 4.23	19,824	3,13,219.2	3,33,043.2
Sitapur	81.9 ± 5.32	19,656	3,10,564.8	3,30,220.8
Maikhanda	64.4 ± 3.60	15,456	2,44,204.8	2,59,660.8

Here, Energy^{1*} is according to energy value for green fodder i.e. 15.8 MJ kg^{-1} while, Energy^{2*} is according to energy value for tree and green shrubs i.e. 16.8 MJ kg^{-1} by Mitchell (1979).

Inaccessibility of most the areas deprived socio-economic status of locals

Forests are already in a degraded stage

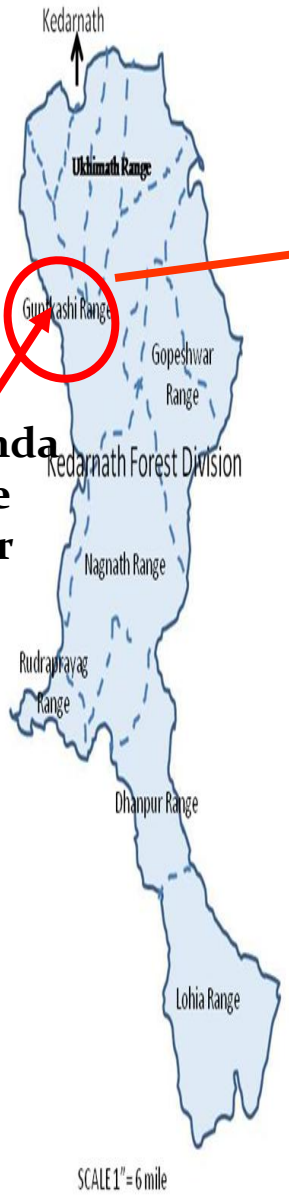
Further exploitation of natural resources is eroding living standards as well as ecosystem stability

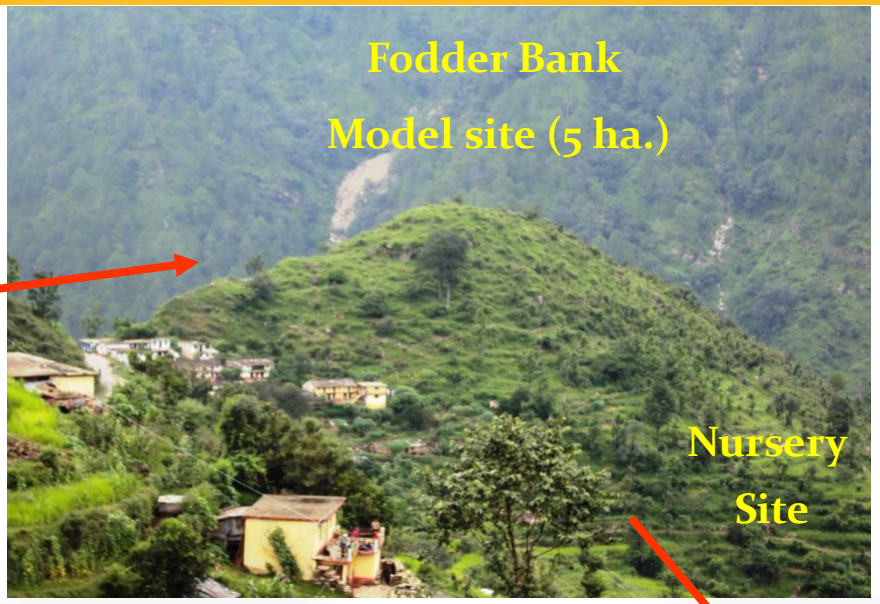
Table 2 — Some prominent fodder trees, bushes (excluding climbers), herbs and grasses found in the study villages of Garhwal Himalaya.

Botanical name	Family	Vernacular name	Crude protein* (percentage)	Organic matter digestibility* (percentage)
Fodder trees				
Acer oblongum	Aceraceae	Kamia	10.74	61.3
Acer caesium	Aceraceae	Kanchula	10.18	60.6
Aesculus indica	Sapindaceae	Pangar	9.84	54.6
Alnus nepalensis	Betulaceae	Utis	10.18	56.4
Boehmeria rugulosa	Urticaceae	Genthi	11.66	60.6
Betula alnoides	Betulaceae	Saur	9.39	54.2
Buxus wallichiana	Euphorbiaceae	Papdi	7.86	49.6
Celtis australis	Ulmaceae	Khadik	15.26	62.4
Cornus macrophylla	Cornaceae	Khagsa	10.24	57.8
Carpinus viminea	Betulaceae	Chamkhadik	10.78	53.8
Ficus palmata	Moraceae	Bedu	119.6	68.3
Ficus nemoralis	Moraceae	Thelka	12.46	72.8
Ficus roxburghii	Moraceae	Timla	12.74	66.2
Fraxinus micratha	Oleaceae	Angu	9.64	56.4
Holoptelia integrifolia	Ulmaceae	Papdi	12.26	48.7
Ilex dipyrina	Illicineae	Kanarku	11.86	65.8
Machilus odoratissima	Lauraceae	Kollain	11.65	54.6
Prunus cerasoides	Rosaceae	Paiyan	12.18	62.1
Pyrus pashia	Rosaceae	Mol	10.68	54.6
Prunus comuta	Rosaceae	Jamna	12.68	62.9
Quercus glauca	Fagaceae	Harinj	10.24	52.6
Q. leuotricophora	Fagaceae	Banj	11.56	68.7
Q. floribunda	Fagaceae	Moru	10.28	70.8
Q. semicarpifolia	Fagaceae	Khirsu	10.68	69.4
Salix tetrasperma	Salicaceae	Bains	13.82	62.4
Symplocos paniculata	Styraceae	Lodh	9.56	56.4
Ulmus wallichiana	Ulmaceae	Chamrmoa	11.83	66.8
Fodder bushes				
Bauhinia vahlii	Caesalpiniaceae	Malu	16.44	59.7
Berberis aristata	Berberidaceae	Kilmore	11.86	63.5
Cotoneaster affinis	Rosaceae	Ruins	—	—
Pyracantha crenulata	Rosaceae	Ghingaru	12.26	12.26
Debregeasia salicifolia	Urticaceae	Syanru	11.58	58.8
Deutzia staminea	Saxifragaceae	Ghugut	8.35	53.9
Princepia utilis	Rosaceae	Bhenkal	11.63	72.4
Rubes ellipticus	Rosaceae	Hinsalu	13.25	66.8
Rosa macrophylla	Rosaceae	Kundju	12.27	72.4
Strobilanthes alatus	Acanthaceae	Jana	13.87	72.8
Viburnum mullaha	Caprifoliaceae	Malyu	13.04	72.5
Herbaceous fodder				
Arundinaria falcata	Poaceae	Ringal	—	—
Asparagus curillus	Liliaceae	Jhirna	9.52	66.5
Desmodium gyrans	Papilionaceae	Chamlie	16.28	62.9
Excaecaria acerifolia	Euphorbiaceae	Dudhila	12.78	68.7
Girardinia heterophylla	Urticaceae	—	11.66	63.6
Heracleum canescens	Umbelliferae	Chatra	12.42	60.2
Indigofera heterantha	Papilionaceae	Sakina	16.67	68.4
Justicia simplex	Acanthaceae	—	10.76	53.8
Leptodermis lanceolata	Rudiaceae	Padaru	9.81	56.5
Thamnocalamus falconeri	Poaceae	Ringal	—	—
Thamnocalamus spathiflora	Poaceae	Ringal	—	—
Urtica dioica	Urticaceae	Kanali	11.96	68.7
Urtica parviflora	Urticaceae	Kanali	12.52	67.3
Valariana hardwickii	Valerianaceae	Sugandhbala	9.34	56.7

Study Area

Maikhanda village cluster





Fodder Bank Model at Maikhanda village Cluster

Fodder Bank Models to reduce deforestation and women drudgery, Kedarnath WLS (2009-2014): Now with *Mahila Mangal Dal*

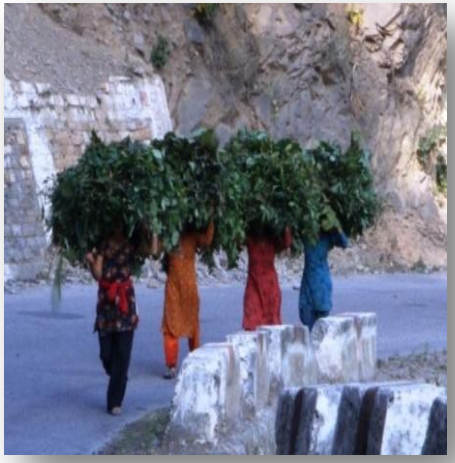
CORRESPONDENCE

Fodder banks can reduce women drudgery and anthropogenic pressure from forests of Western Himalaya

Forests meet 40% of the energy needs of India and about 30% of fodder needs of the cattle population. Agriculture along with animal husbandry is the principal occupation and source of livelihood for

the present setting, cattle are generally stall-fed, but buffaloes, sheep and goats are also left for grazing in nearby forests, alpine regions and *kharaks* or pastures. With the introduction of stall-feeding,

3000 m amsl include indigenous local *ringal* bamboo (*Chimnobambusa falcata*, *Thamnocalamus spathiflorus*, *Arundinaria* spp.), indigenous *Alnus nepalensis*, *Quercus glauca*, *Quercus leucotrico-*



- Economic costs and benefits of bioengineering approaches for slope stabilization and deforestation control while, also providing solution to local fodder shortage

- How effective are various commonly used bioengineering plants in slope stabilization and providing alternative benefits

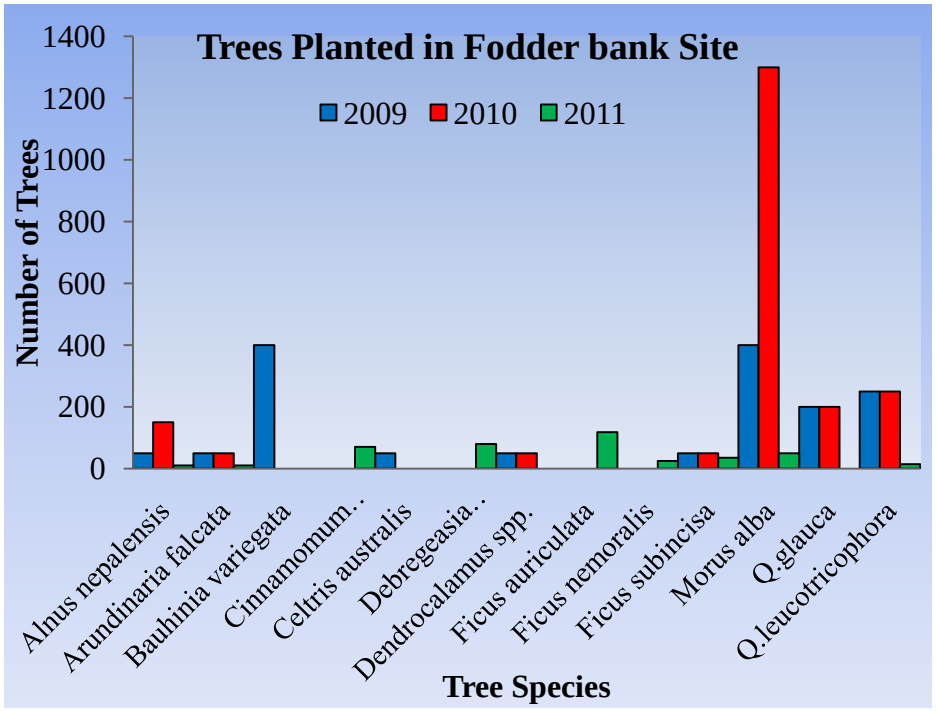
Dhyani et al., 2012 Current Science

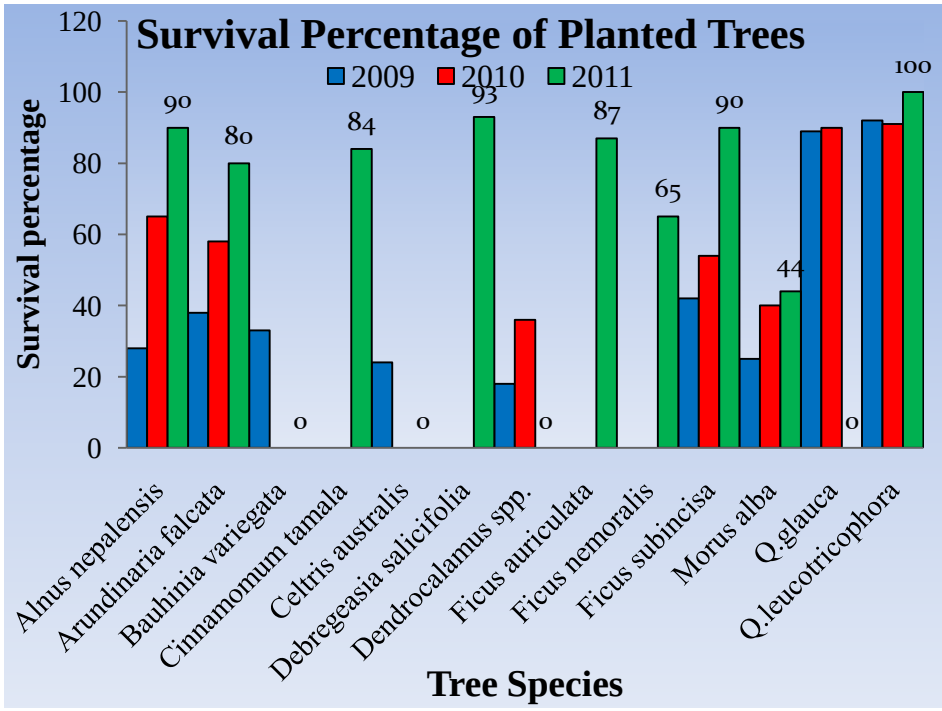
Fodder Bank Nursery at Maikhanda village

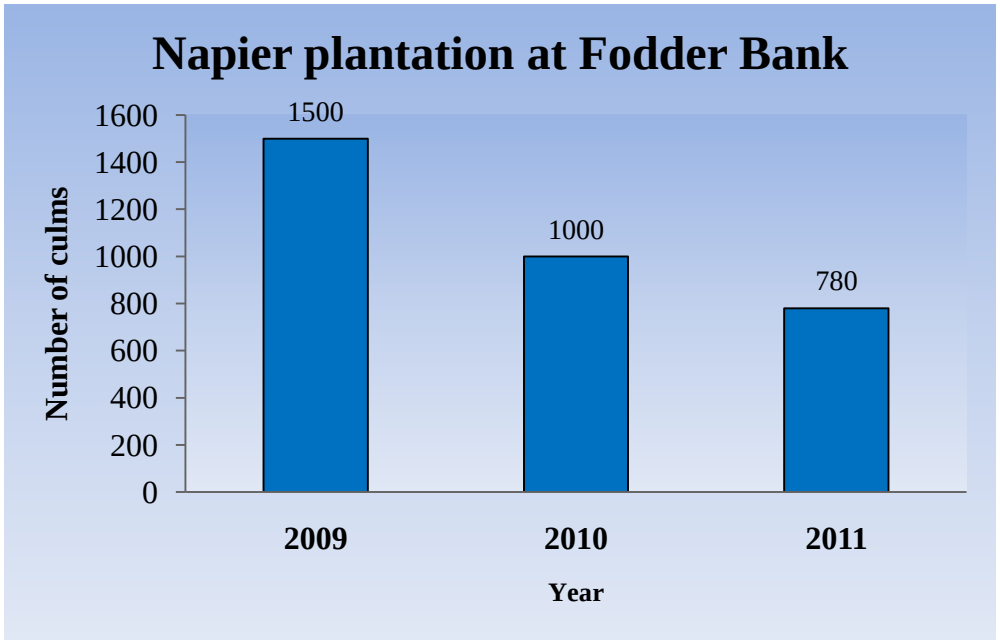
•Area of fodder nursery is 5250 sq.m and land was provided by a local farmer.

• A Poly house (14x10 ft.) and a net-house (14x10 ft) is constructed for seed germination & vegetative propagation in appropriate environment.

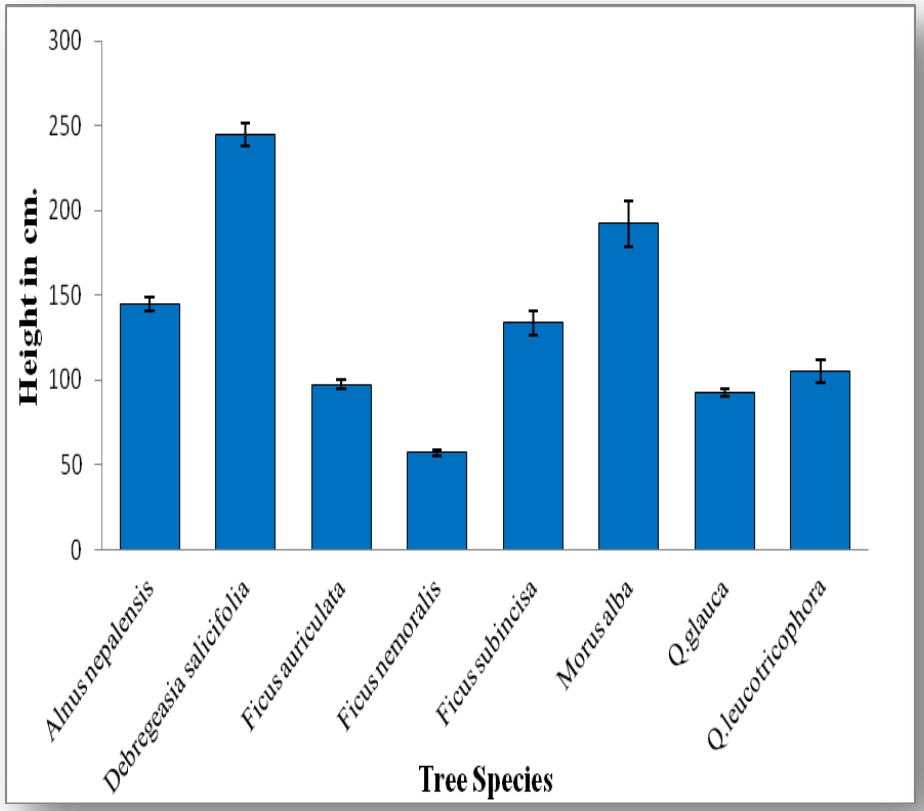
•A 500 litres water storage tank also established to irrigate the seedlings. Area faces water shortage

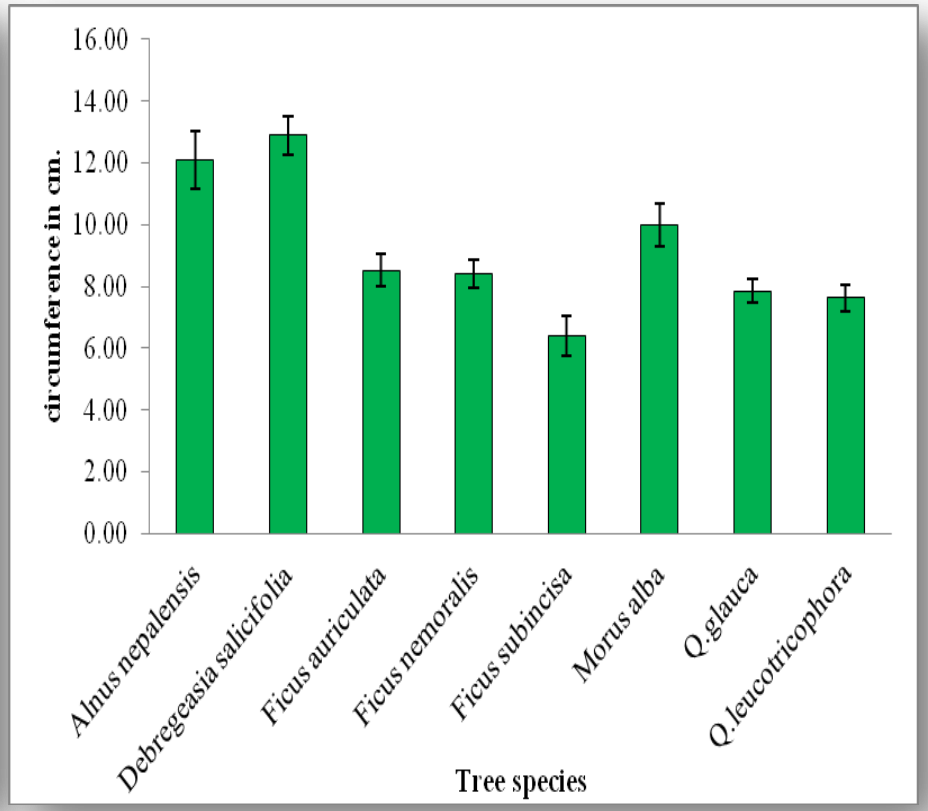

Trees Planted in Fodder bank Site
2009
2010
2011
Number of Trees
1400
1200
1000
800
600
400
200
0
Alnus nepalensis
Arundinaria falcata
Bauhinia variegata
Cinnamomum...
Celtris australis
Debregeasia...
Dendrocalamus spp.
Ficus auriculata
Ficus nemoralis
Ficus subincisa
Morus alba
Q.glauca
Q.leucotricophora
Tree Species

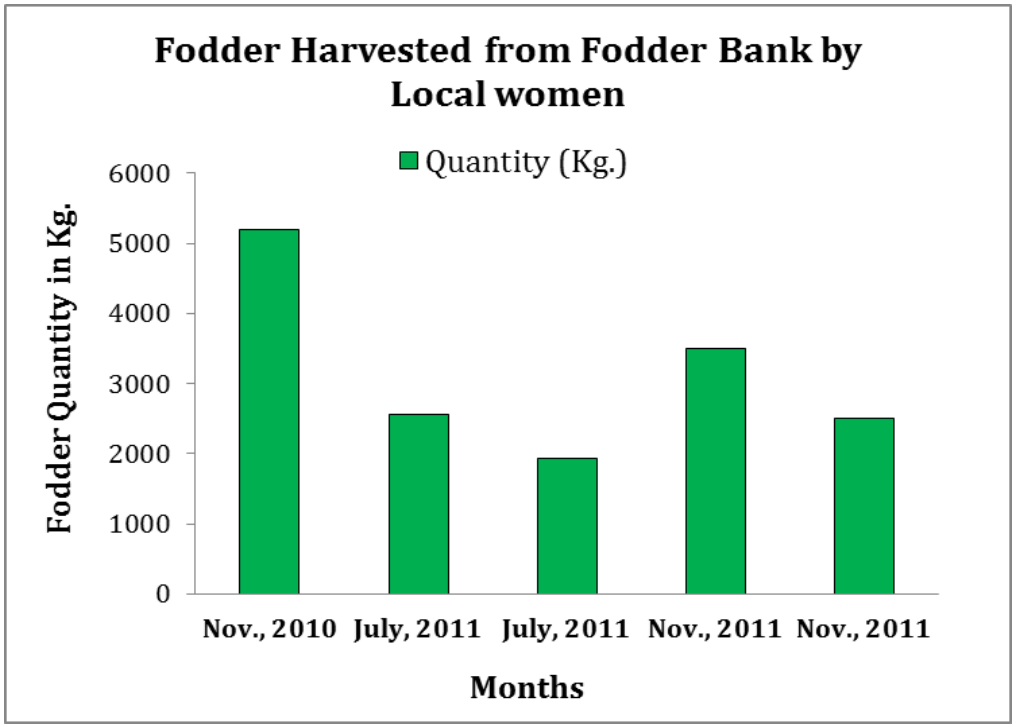

Survival Percentage of Planted Trees
2009
2010
2011
Survival percentage
120
100
80
60
40
20
0
90
80
0
84
0
93
0
87
65
90
44
0
100
Alnus nepalensis
Arundinaria falcata
Bauhinia variegata
Cinnamomum tamala
Celtris australis
Debregeasia salicifolia
Dendrocalamus spp.
Ficus auriculata
Ficus nemoralis
Ficus subincisa
Morus alba
Q.glauca
Q.leucotricophora
Tree Species

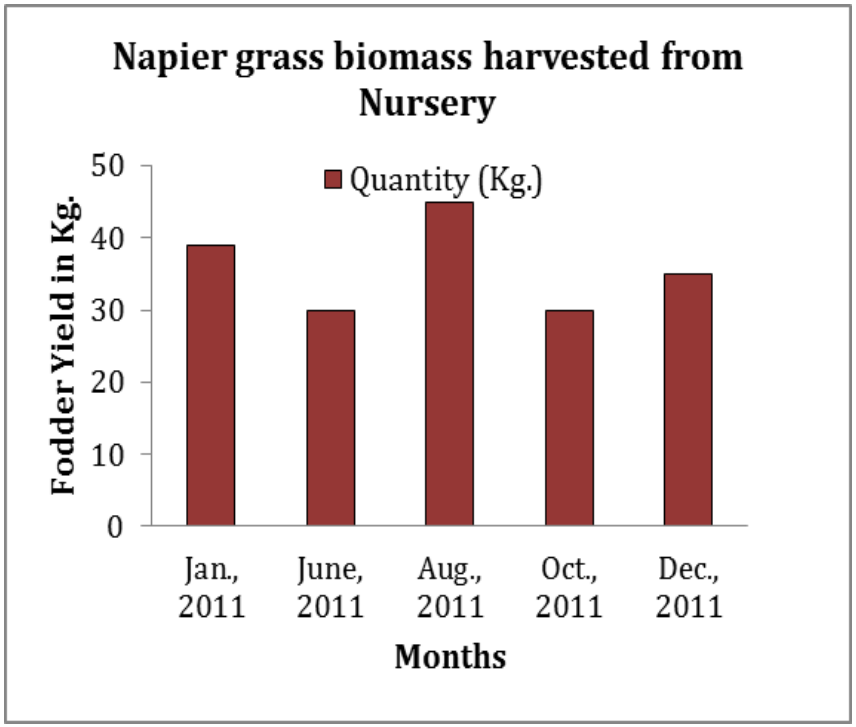

Napier plantation at Fodder Bank
Number of culms
1600
1400
1200
1000
800
600
400
200
0
1500
1000
780
2009
2010
2011
Year

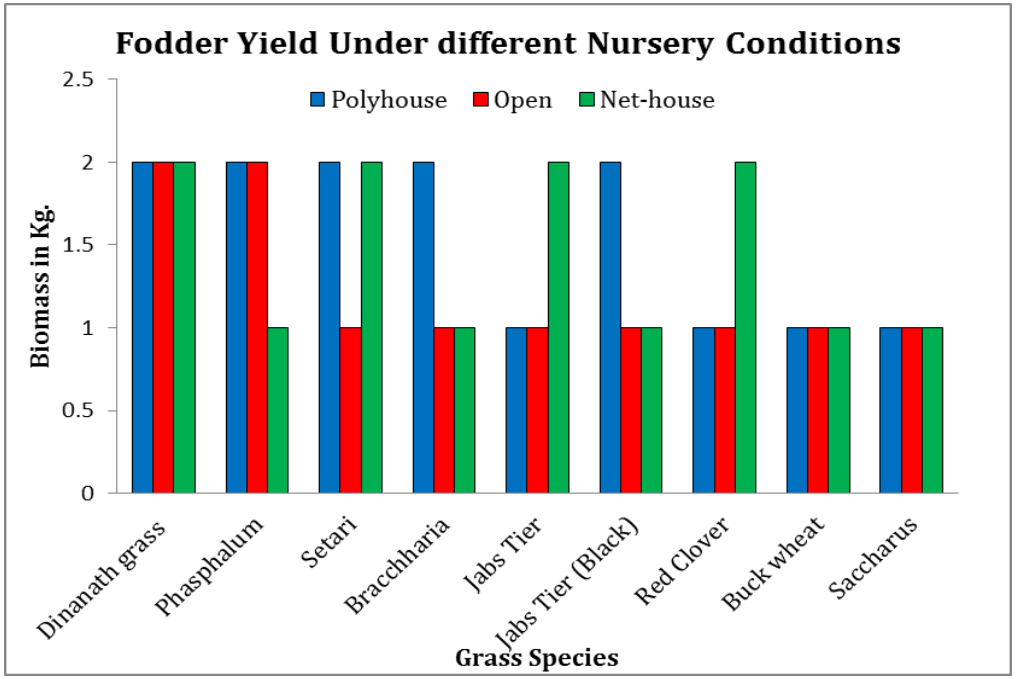
Assessment of Growth Parameter (Height and circumference) of fodder species

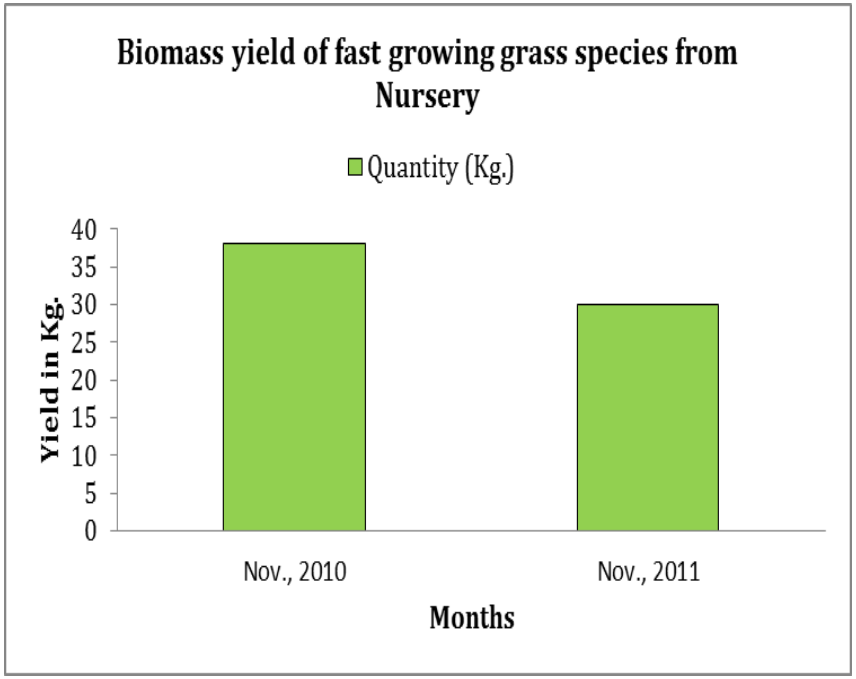





Fodder Harvested from Fodder Bank by Local women
Quantity (Kg.)
Fodder Quantity in Kg.
6000
5000
4000
3000
2000
1000
0
Nov., 2010
July, 2011
July, 2011
Nov., 2011
Nov., 2011
Months


Napier grass biomass harvested from Nursery
Quantity (Kg.)
Fodder Yield in Kg.
50
40
30
20
10
0
Jan., 2011
June, 2011
Aug., 2011
Oct., 2011
Dec., 2011
Months


Fodder Yield Under different Nursery Conditions
Polyhouse
Open
Net-house
Biomass in Kg.
2.5
2
1.5
1
0.5
0
Dinanath grass
Phasphalum
Setari
Bracchharia
Jabs Tier
Jabs Tier (Black)
Red Clover
Buck wheat
Saccharus
Grass Species

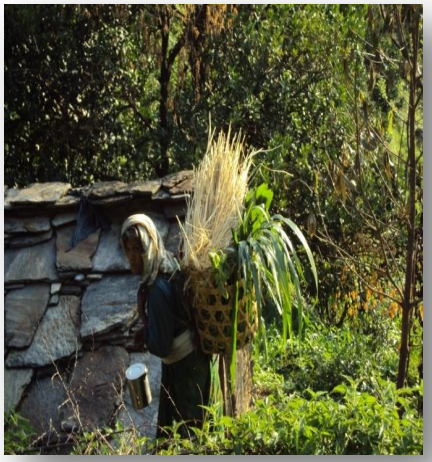
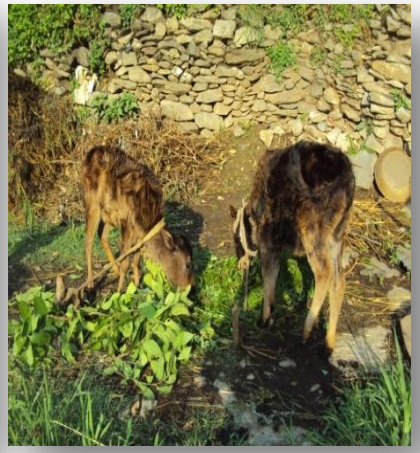

Biomass yield of fast growing grass species from Nursery
Quantity (Kg.)
Yield in Kg.
40
35
30
25
20
15
10
5
0
Nov., 2010
Nov., 2011
Months





The examples above show three distinct strengths of ecosystem-based approaches: they are

(1) environmentally sustainable,
(2) Cost effective, and
(3) socially and economically responsible.


Capacity Building Workshops on strengthening fodder resources

• 11 capacity building and training workshops for women, farmers, school going students and weaker sections (2009-2014).

•More than 378 households were benefited from these one day workshops.

•Seedlings of fodder trees (650), seeds of fast growing grasses and Napier culms (6500 shoots) were also distributed free of cost among interested local women.

	Achievements
To screen and propagate promising fodder species on community lands	Following fodder species were screened and are planted in the fodder bank site and crop land bunds of village **Grasses** Indigenous: Ringal Bamboo (*Arundinaria falcata*) Fast growing: Napier *(Pennisetum typhoides*), Cox-food, Joint Star, Makuni**,** *Brachharia etc* **Trees** Available in the village vicinity: Banj *(Quercus leucotricophora),* Harinj *(Quercus glauca),* Utis *(Alnus nepalensis)* Preferred: Shahtoot *(Morus alba),* Thelka *(Ficus nemoralis),* Timla *(F.auriculata)* Syanru *(Debregeasia salicifolia) etc.*
To rehabilitate village commons with people's participation and develop a fodder based pilot model for replication	Working on rehabilitation of 15 ha. Community wasteland on a small hillock of Maikhanda village by regular plantation (twice in one year) and using *Alnus* & grasses that are effective soil binder.
To build capacity of the women for strengthening fodder resources within village ecosystem	11training programmes were organised and 378 households have been trained by experts. Fast growing, high biomass yielding fodder trees *Morus alba* (450) and *Pennisetum purpureum* Hybrid Napier 2 varieties (>6500 shoots) were also distributed to these women during these capacity buidling workshops.
To suggest a workable strategy for replication of fodder-based approach	Developed strategy to grow fast growing and high biomass yielding fodder is replicated by locals on their cropland and kitchen garden bunds

Sustainability of the Project

Local women are more interested in introducing fast growing, high biomass yielding grasses in their cropland bunds and Kitchen gardens along with *Ringal* bamboo so that time saved from visiting forests can be used in other activities and at the same time some economy can also be earned from *Ringal*.






Shalini Dhyani

Strengthening Community Conservation Initiatives by Establishing Resource Centre for Integrating Livelihood and Conservation in Kedarnath Wildlife Sanctuary

Town/Region	Kedarnath Wildlife Sanctuary
Country	India
Continent	Indian Sub-continent
Categories	Communities, Forests, People
Date	9 Jul 2013

Kedarnath Wildlife Sanctuary (KWLS) in Western Himalaya is a hub of faunal and floral diversity. Forests of KWLS are habitat to many threatened species viz. musk deer, snow leopard, Himalayan Tahr, Monal pheasant and other important ungulates and birds. Upper Kedar Valley and our target project area is a prosperous area in terms of forest biodiversity, indigenous and traditional agro-biodiversity and spiritual as well as cultural diversity. Village on the Sanctuary fringes depend on the forests for their various subsistence demands. Most of these villages are very poor in terms of their socio-economic conditions. It is significant to improve the habitat integrity of these forest adjacent villages while improving the incomes of the people as well as substituting ecosystem services which people derive from the Sanctuary Forests. It is surprising to see that indigenous and traditional values of conservation are been destabilized by the youths, that can be attributed to increasing globalisation, commercial tourism severely affecting survival of the species and their unique habitats. It is highly desirable to enhance community participation in forest management which would improve forest management, enhance local livelihood and potentially reduce the scope of many forest problems. There is a crucial need for managing Sanctuary fringes considering the village economy, social issues and resource requirements. Supporting and providing better livelihood opportunities can be a viable option for minimizing pressure and managing biodiversity of the area through active community participation.

Local woman with a back load of forest leaf litter

Our project aims for an Integrated Conservation Program to empower the local Garhwali

Key lessons learned

Traditional measures

Effective innovative technological inputs

Community participation

Alternative resources, Build resilience, Reduce Frequency and severity of disasters

"Traditional and indigenous knowledge can guide suitable utilization, management, and conservation of forests to reduce disaster risk in mountains.

Cost effective, nature-based solutions, such as Eco-DRR with active community participation can help to reduce the pressure from forests and at the same time reduce disaster risks."

SOUTH ASIAN ASSOCIATION FOR REGIONAL COOPERATION

Success Stories in Mountain Ecosystem Management

SAARC Forestry Centre
Thimphu, Bhutan

Advances in Natural and Technological Hazards Research

Fabrice G. Renaud
Karen Sudmeier-Rieux
Marisol Estrella
Udo Nehren *Editors*

Ecosystem-Based Disaster Risk Reduction and Adaptation in Practice

Springer

ICIMOD

Strengthening Fodder Resources through Fodder Banks to Reduce Drudgery of Rural Women in Upper Kedarnath Valley, Uttarakhand, India

— Shalini Dhyani

The GB Pant Institute of Himalayan Environment and Development, Garhwal Unit, Srinagar Garhwal has been implementing the project 'Strengthening fodder resources and developing a pilot fodder bank model for reducing drudgery of rural women' at the landscape level in Maikhanda village cluster in Upper Kedarnath Valley, Uttarakhand, India, since March 2009.

Local woman harvesting fodder from fodder bank in Upper Kedarnath valley, Uttarakhand

A meeting with local women's forest conservation group (Mahila Mangal Dal) of Maikhanda village, Uttarakhand, regarding fodder

Problem

Agriculture and animal husbandry are the main sources of livelihood for over 70 per cent of the population in the Indian Himalayan region. Women are the main collectors of forage for livestock feed in the region. Extracting fodder and carrying it long distances on their heads and backs negatively affects women's health and the education and nutrition of their children. It is also a cause of minor and major accidents. Lack of forage for livestock means that women have to go further to extract fodder, adding significantly to their drudgery. It has also led to the illegal harvesting of such resources, putting pressure on forests. The ecological sustainability of biomass extraction is a much-debated issue; many believe that extraction compromises the aims of biodiversity conservation. Information on resource use patterns, particularly fodder extraction, in the Indian Himalayas is insufficient and mainly restricted to inventories.

BIOMASS AND BIOENERGY 35 (2011) 1823–1832

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Energy budget of fodder harvesting pattern along the altitudinal gradient in Garhwal Himalaya, India

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Energy analysis
Women drudgery

ABSTRACT

Fodder plays a major role in crop–livestock–manure–soil nutrient cycle of farms in middle mountains of the Himalaya. In Garhwal part of Indian Himalayan Region fodder is mainly collected by lopping the vegetative biomass of trees, shrubs, herbs and grasses. The present study was carried out to understand the fodder utilization pattern, energy budget and problems related to fodder biomass removal in existing traditional hill agro-ecosystems prevalent at different altitudes of Garhwal Himalaya. The total fodder collection at different altitudes varied for green and dry fodder. The total green fodder collection ranged from 64.4 ± 3.60 to 84.0 ± 6.23 kg household^{-1} day^{-1} whereas, total dry fodder collection ranged from 62.4 ± 1.66 to 80.4 ± 5.11 kg household^{-1} day^{-1}. Fodder collection was varied in summer (March–October) and winter months (November–February) of the year. The labor energy expended for fodder collection varied from 832.78 ± 61.05 to 1192.44 ± 45.66 MJ household^{-1} year^{-1}. In last few years fodder removal has enhanced resource extraction conflicts, malnutrition of women and their off-springs, improper education of females, increased health and life hazards, accidents because of collapse, etc. For better utilization of dry fodder in hilly areas, the farmers and livestock owners should be motivated and educated toward modern feeding options. Novel feeding system of complete feed and silage preparation for lean periods is well suited to hilly states like Uttarakhand that needs to be promoted. The study also aims to help in developing suitable policy to lessen the impact of degradation of forests for fodder by developing fodder bank models in each village cluster of Uttarakhand.

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1. Introduction

Biomass extraction, in the form of fuelwood, fodder collection, grazing and non-timber forest products (NTFPs) extraction, may be the most widespread pressure on forests in countries, where rural populations depend significantly on these activities for household and livelihood needs [1–4]. In India, forests meet nearly 40% of the energy needs of the country of which more than 80% is utilized in the rural areas, and about 30% of fodder needs of the cattle population [5]. Collection of fodder is the first step that turns the wheel of the agricultural economy of the village community [6]. Agriculture along with animal husbandry is the principal occupation and source of livelihood for over 70% of the population of Uttarakhand state, India. Uttarakhand is well endowed with a variety of livestock. Livestock convert fodder shrubs and grasses from forests, crop residues and other fodder into manure through digestion. Large population and low productivity are the hallmark of

Abbreviations: IHR, Indian Himalayan Region; NTFPs, Non-timber forest products; KWLS, Kedarnath Wildlife Sanctuary; IUCN, International Union for Conservation of Nature and Natural Products; FYM, farm yard manure.

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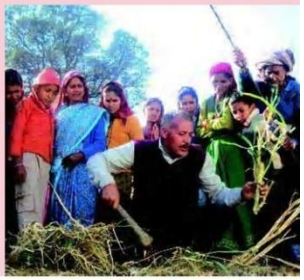
Fodder banks

Relieving women from drudgery

Shalini Misra, R K Maikhuri and Deepak Dhyani

Raising fast growing and high yielding nutritious fodder collecting fodder from distant forests and also protect the degrading forests, G.B.Pant Institute of Himalayan Environment and Development achieved this intent through promotion of Fodder bank model.



Maikhanda village is located in Kedarnath Wildlife Division in Uttarakhand State, situated in Chamoli-Rudraprayag district. The village is inhabited by a large number of local Garhwalese community. Agriculture and animal husbandry along with tourism related jobs are main sources of income in the valley.

Like other high altitude communities, animal husbandry is practiced. Rearing animals is an inevitable part of their social system. Each family maintains 5-8 cattle of indigenous breed i.e. a cow, a pair of bullocks, a buffalo and a horse or mule that are reared on traditional lines. A few families also rear sheep and goats but over the last few decades the number of such families has reduced from 20 to 4-5 because of ban imposed on free grazing in most of the alpine areas and pastures of Garhwal.

Fodder obtained from arable land is not sufficient to maintain the livestock in sound health. Therefore, the inhabitants largely depend upon the forest based fodder resource of the upper Kedar valley.

abandoning traditional crops and cropping practices. This has added more pressure on forests biomass (leaf-litter) for preparing farm yard manure (FYM) and tree branches to support legume crops.

(tree, shrub, leaves and herbaceous ground flora). The remaining fodder (37.8%) is derived from agroforestry systems, low altitude grasslands, degraded lands, high altitude grasslands and crop residues. A large variety of tree species, forest floor phyto-mass and agricultural by-products are used as animal fodder.

In earlier times, livestock was left to graze in the forests of community lands. The animals sought out their own food and were assembled only for milking and to protect them from wild animals.

sheep and goats are left for grazing in nearby forests, alpines and *kharaks* or pastures. With the introduction of stall feeding, the demand for fodder has increased greatly with subsequently increased workload on women.

Unavailability of green forage during winters in higher Himalayan

drudgery of women. Women in hills are mostly involved with t collection of fodder so, they spend more of manual energy for

collection is quite a frequent household activity. Almost one women from each household visits the forests twice a day to collect fodder and other forest produce. Women walk atleast 1-2.5 km for harvesting fodder and during winters walk more than 3-4 km. During winters, local women leave their houses before sunrise and climb the rocks and mountains to collect dry grass and come back to their dwellings by afternoon. They carry a backload of more than 50-65 kgs.

The model

Developing fodder bank models among a few village clusters was tried by G.B.Pant Institute of Himalayan Environment and

pressure on women by reducing their fodder collection time as well as the distance they travel. It was also meant to create awareness among them on better methods of livestock feeding,

of fodder. Fodder bank initiative was taken up in March 2009 b the financial support from Department of Science and Technology, Government of India under it's Science and Society Scheme.

Maikhanda village cluster with a majority of poor people and with

willingn ss of local communities to provide huge villag

ROLE OF FODDER BANKS TO CHECK RAPID DEGRADATION OF FORESTS IN HIMALAYAS

Shalini Dhyani

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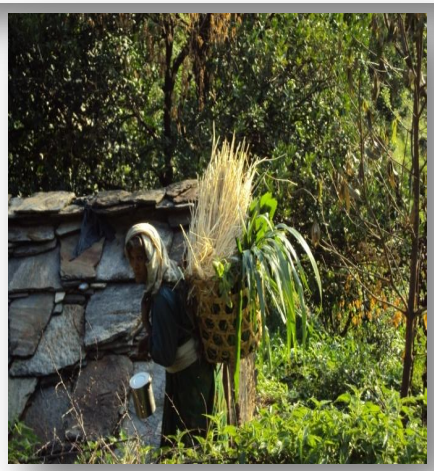
Summary
Forests of Western Himalaya are considered among one of the most diverse patches of moist and dry temperate forests of India. Due to rich floral and faunal diversity of these forests. Western Himalayas are considered biodiversity hotspots of India. The vegetation cover of these forests has been depleting at a very fast rate and a significant portion of such areas is used to meet the growing need of the ever increasing human population. At present, forest management in mountains is facing more challenges than ever due to anthropogenic pressure. Removal of fodder is one practice that is not only reducing regeneration of many important forest tree species but is also leading towards enhanced invasion of exotic species. Based on my in-depth research on impact of natural and man-made pressure on forests of Upper Kedar valley we have worked for developing fodder bank model. More than 6 hectare of fodder Bank model is in Maikhanda village cluster of district Rudraprayag in Upper Kedar Valley. Model lies in the same Kedarnath valley where on June 16th 2013 continuous cloud burst and flood events have caused huge damage. The model was developed during a five year period from the year 2008-2013. This model is developed by using fast growing high biomass yielding and nutritious fodder species both indigenous lesser known based of local people's knowledge and some species were introduced based on expert suggestion of grassland institutes of India. This model was later taken at a better level when we decided to introduce these fodder species on crop land bunds and kitchen garden bunds of the village to enhance fodder availability during lean periods. Model was considered innovative by national and international agencies and is being considered for replication by other villages of the valley where flood has caused major damage. Model has reduced winter fodder shortage for the locals and has helped them to enhance milk yields of their animals. There are also plans to introduce concept of market to earn some alternative livelihood for local women as valley offers huge fodder market every year during Kedarnath Shrine *yatra* period when valley is flooded with more than 10,000 pack animals for tourism purpose.

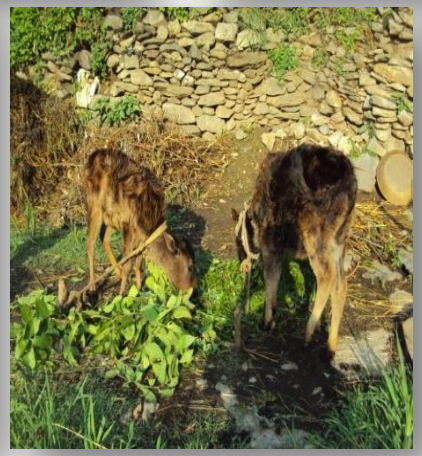
Key words:Temperate Forests, Kedarnath Valley, Livestock, Fodder, Drudgery,

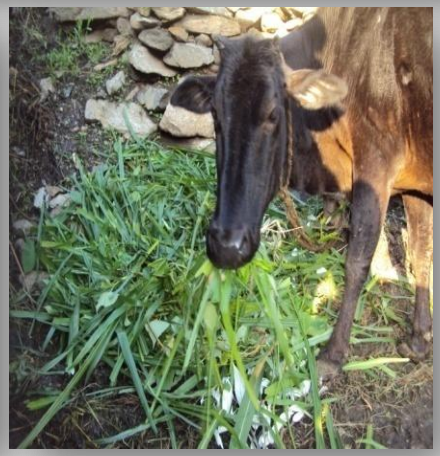
Chapter 22
Strategies for Reducing Deforestation and Disaster Risk: Lessons from Garhwal Himalaya, India

Shalini Dhyani and Deepak Dhyani

Abstract Forest ecosystem services are significant for local communities, especially for mountain communities dependent on natural resources. This chapter examines the contribution of forests to local communities dwelling at various elevations (from 1400 to 2800 m.a.s.l.) in Upper Kedarnath Valley of Garhwal, India. It is based on a study which provides an overview of common fodder extraction practices in the region and their impact on disaster risk. The research







Biodiversity & Ecology Restoration Plan for Rat Hole Coal Mine Sites in Meghalaya (on directions of Honorable NGT, India)

Natural Vegetation in the State of Meghalaya

- The forests of Meghalaya can be broadly grouped into tropical, subtropical, and temperate types. **The district of Jaintia Hills has the biggest forest reserve in the State of Meghalaya.**

- Unlike the rest of the country where forests are mostly owned by the state and managed by the state forest department, in **Meghalaya substantial forest areas are under the un-classed category, and are owned by private individuals, clans, village councils, district councils and other traditional community institutions**.

- *Castanopsis purpurella* (Chestnut) and *Quercus griffithii* (Paisang and also a **Keystone Tree Species**) are among the most dominant tree species in un-mined areas of the study area.

- **Subtropical Pine forests have developed as a stable secondary community on the disturbed evergreen and semi-evergreen subtropical broad-leaved forest sites**, which are seasonally dry and nutrient-poor.




Impact of rat hole mining on Vegetation and Landscape

•The **presence of isolated patches of degraded forests amidst the grassland imparts a savanna like appearance** to the landscape of the region. Though, **typical grasslands are not found in the state**. The rolling grasslands covering large areas in Jaintia Hills are found on degraded land developed either due to biotic pressure or due to interactive influence of topography, climate, fire, and grazing.

•**Ecosystem is degraded and have resulted in unfavorable habitat conditions for plants growth**. The prevailing habitat conditions in these areas seem to have reduced the chances of regeneration of many native species, thereby reducing the number of species in the mined areas

•The highly **impoverished shallow soil layer doesn't seem to be conductive** for either regeneration through seeds or for healthy plant growth.

Patch under rat hole mining
At Khliehriat (extensively mined area)

Patch of forest under Jhum (slash and burn)
cultivation practice

Impact of rat hole mining on Vegetation and Landscape

- The large-scale unscientific land use practices have resulted in the depletion of primary forest and **colonization of the degraded sites by *Pinus kesiya***, which grows well to develop into secondary forests.

- Besides, the **forest floor is covered with the invasive and thorny species** like *Eupatorium adenophorum, Lantana camara, Rubus sp. Paspalum orbiculare, Isachne himalaica, Globba clarkii* and others. **This indicates disturbance and anthropogenic interferences.**

- Mostly lower groups of plants ferns (Pteridophytes); bryopytes (thallus); along with *Melastoma nepalensis, Selaginella semicordata, Plectranthus striatus* and grass species *Paspalum orbiculare* were observed dominantly around the abandoned rat hole mine area.

- **No faunal component observed in the village except a few butterflies, No avifauna no mammals.**




Bio-restoration plan to facilitate re-vegetation on road heads and upstream areas near rat hole mined and/or coal storage

Initiating re-vegetation in rat hole mined areas

Selection of plant species → Indigenous species natural succession

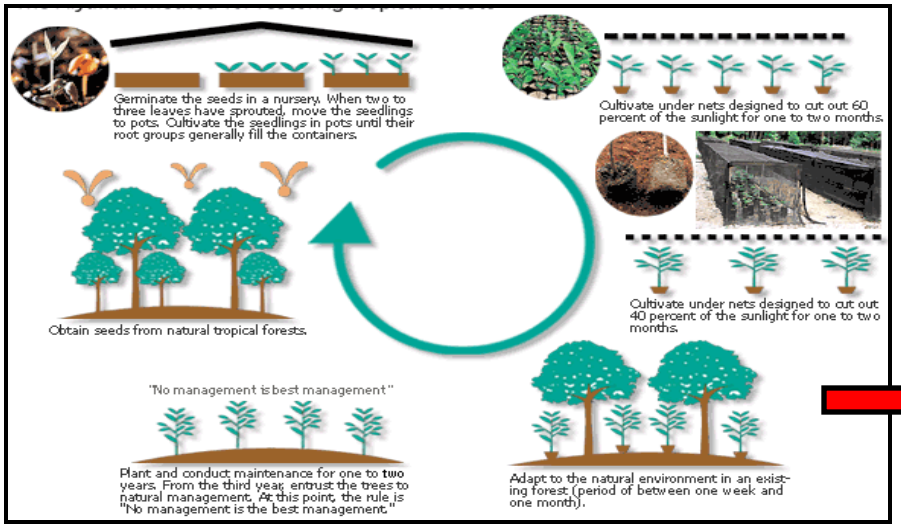
Soil Amendments
(Assisted Natural Remediation and/or Restoration)

Plantation Following MIYAWAKI Plantation Technique

Irrigation

Monitoring success of re-vegetation/restoration

Community Participation



The species raised should be preferably fast growing species, local species though, some exotic species could be selected. A few of them are *Alnus nepalensis (Dienglieng iong); Ligustrum robustum (Lapoiat); Myrica esculenta (Sohphie); Pinus kesiya (Kseh Khasi); Pinus patula (Kseh patula); Psidium guajava (Soh priam); Podocarpus species (Kseh um); Euginea praecox (Soh um);Cinnamomum tamala (Latyrpad); Randia tetrosperma (Soh mon); Glycosmis pentaphylla (Jyllop);Cedrella toona (Bti saw); Michelia champaca (Diengrai); Exbucklandia populnea (Dieng Doh); Cryptomeria japonica (Kseh bilat); Prunus nepalensis (Sohiong); Prunus cerasoides (Dieng cherry) etc.*

Global Uptake of EcoDRR and EbA/NbS

United Nations Decade on Biodiversity

IUCN

Helping nature help us

Transforming disaster risk reduction through ecosystem management

Fabiola Monty, Radhika Murti and Naoya Furuta

World Wetlands Day

2 February 2017

Wetlands for Disaster Risk Reduction

COP21 · CMP11

PARIS 2015

UN CLIMATE CHANGE CONFERENCE

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

#urbanSDG

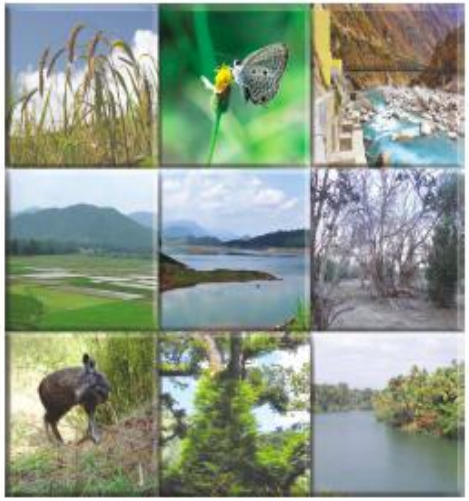
Sendai Framework for Disaster Risk Reduction

2015 - 2030

IUCN CEM Leaders for Nature

MASTERCLASS WORKSHOP PROCEEDINGS

Ecosystem Management, Nature Based Solutions and SDGs



December, 4th 2017

Venue

Magnolia Hall, Habitat World Center, New Delhi, India

LfN India Member Companies

WIPRO | ACC | TATA POWER | VEOLIA | TATA STEEL | RioTinto | Hindustan Unilever Limited | apollo | Ambuja Cement

IUCN CEM Leaders for Nature

Workshop on Ecosystem Management, Nature Based Solutions and SDGs

Date : Monday, December 4, 2017 **Time:** 9 am onwards
Venue : India Habitat Centre, Lodhi Road, New Delhi, Delhi 110003

IUCN Leaders for Nature India and CEM, invite you to the Master Class on "Ecosystem Management, Nature Based Solutions and SDGs – Perspectives from South Asia" . This would involve a multi-stakeholder dialogue to bring together South Asia's leading researchers, scientists, professionals, practitioners, educators, and managers to exchange and share their ideas and experiences about different aspects of Ecosystem Management, Nature Based Solutions, SDGs and related issues to discuss the practical challenges on field.

Look forward to:
- Participate and contribute to shape up motions from India for the next World Conservation Congress
- Learn about IUCN tools and approaches to assess and mitigate biodiversity and natural capital conservation.
- Participate and network with different subject matter experts.

LfN India Member Companies

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For queries and more details, Email us at : aditya.petwal@iucn.org, shalini3006@gmail.com

IUCN CEM teri school of advanced studies NEERI Leaders for Nature

Webinar on Intergenerational Partnerships for Conservation: Identifying Regional Issues and Youth Leaders

Date: 26th March 2018 **Time: 8:30AM-10:30 AM**

The webinar will cover:

- The scope of Intergenerational Partnership for Conservation and need for its facilitated implementation.
- Regional Issues and Challenges for Intergenerational Partnership for conservation and the role of youth women taskforce and local communities; further widening the scope of IPS in context of South Asia.
- Perspectives of corporates highlighting Youth Leadership for ecosystem and biodiversity conservation under CSR initiatives.

Speakers:

Dr. Leena Srivastava, VC, TERI SAS
Dr. Sudipto Chatterjee, HOD, Natural Resources Dept. TERI SAS
Dr. Shalini Dhyani, Chair South Asia IUCN CEM & NEERI
Mr. Aditya Petwal, Coordinator, LfN India
Ms. Alice C Hughes, ATBC Asia Pacific & IUCN CEM YPN
Corporate sustainability Representatives (LfN member companies)

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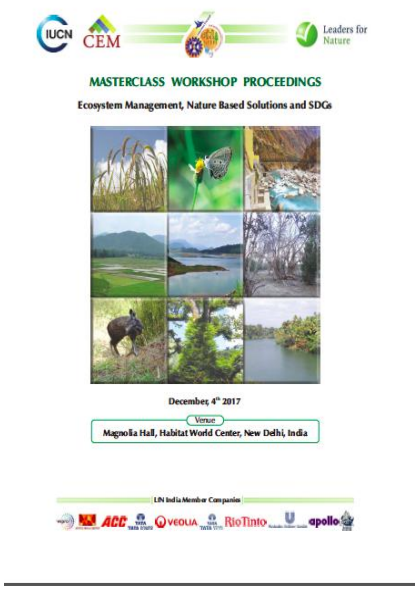
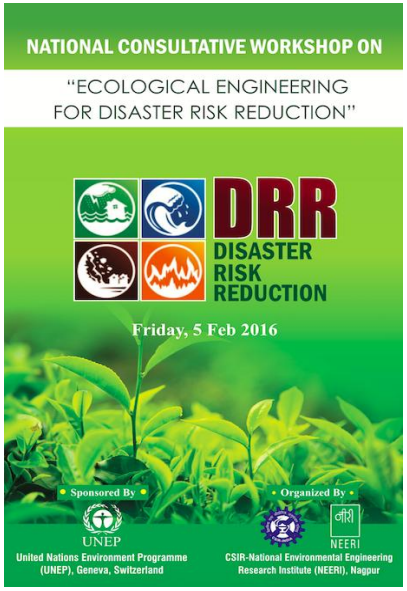
For queries and more details , Email us at: aditya.petwal@iucn.org, s.chatterjee@terisas.ac.in, shalini3006@gmail.com

Addressing Uncertainties…





Environmental Science and Pollution Research

October 2016, Volume 23, Issue 19, pp 20049–20052 | Cite as

Ecological engineering for disaster risk reduction and climate change adaptation

Authors | Authors and affiliations

Shalini Dhyani ✉, Muralee Thummarukuddy

Urbanization is both a challenge and an opportunity to manage ecosystem services globally

Rich biodiversity can exist in cities

Biodiversity and ecosystem services are critical natural capital

Why Indian urban agglomerates are increasingly vulnerable to disaster risks-1

- **Rapid urbanization: Rural - urban migration-growing urban agglomerates**
- **Growing population - already stretched resources**
- **Poor living standards - build without consideration of safety**
- **Lack of public awareness to hazards/risks**
- **Building codes are poorly enforced or non-existent**
- **Environmental degradation - resource depletion - lowers resilience**

Lack of Early Warning Systems and Identification of Threats

Contents lists available at ScienceDirect

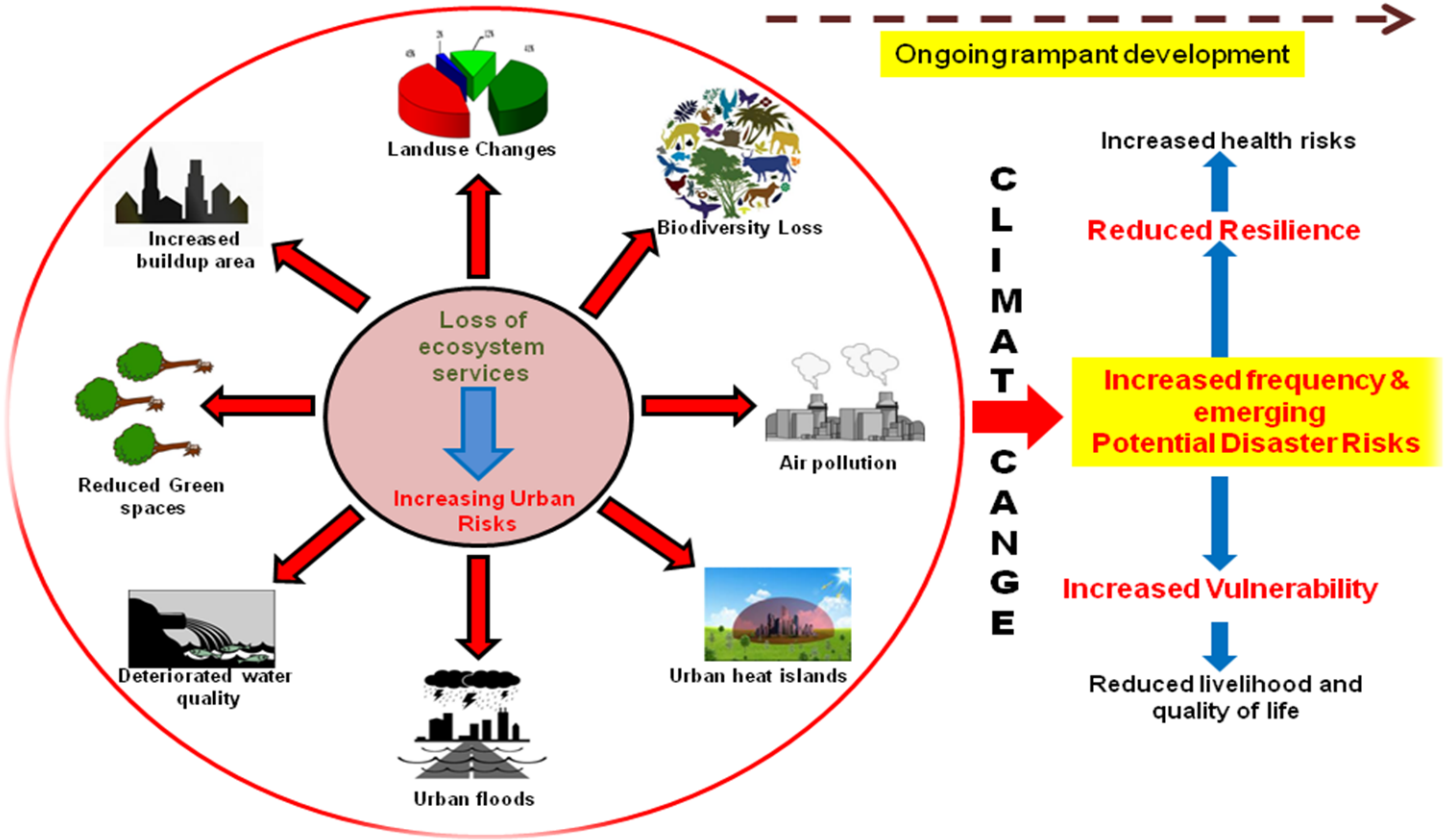
International Journal of Disaster Risk Reduction

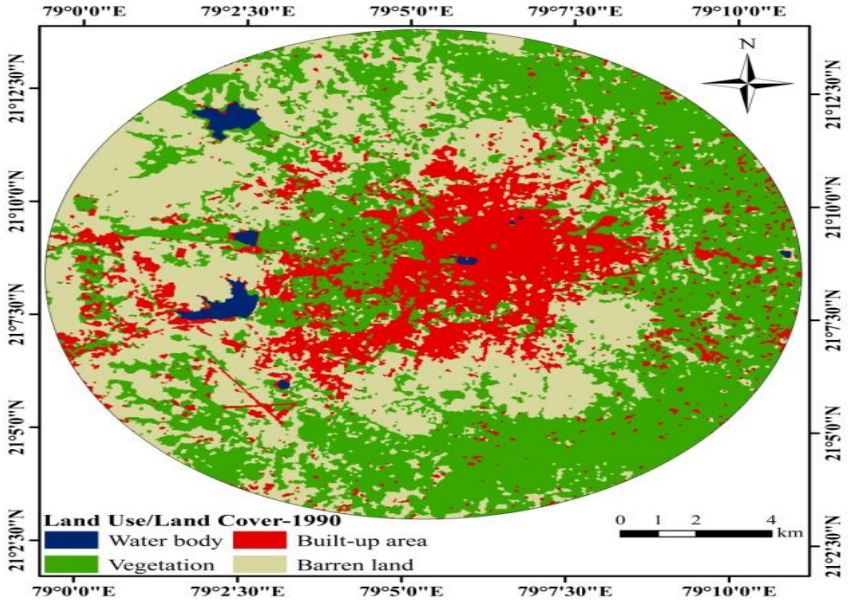
journal homepage: www.elsevier.com/locate/ijdrr

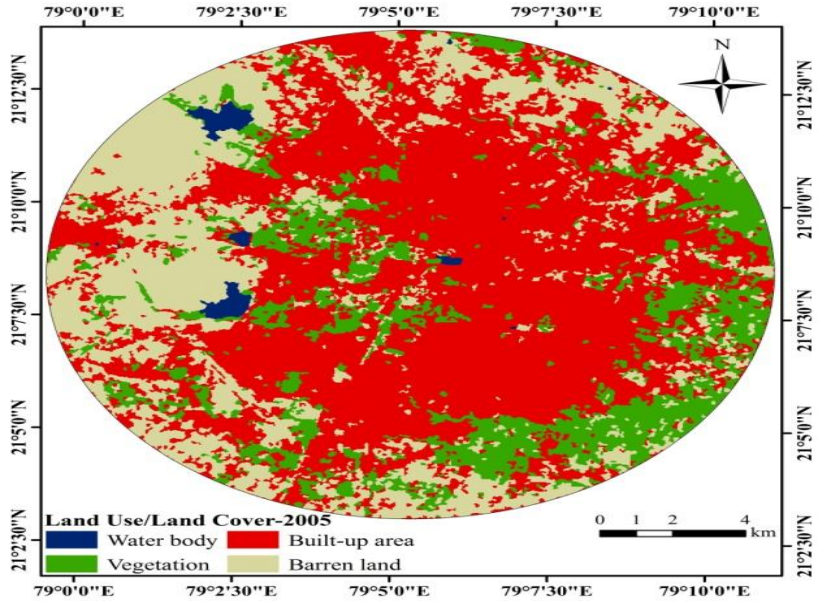
Ecosystem based Disaster Risk Reduction approaches (EbDRR) as a prerequisite for inclusive urban transformation of Nagpur City, India

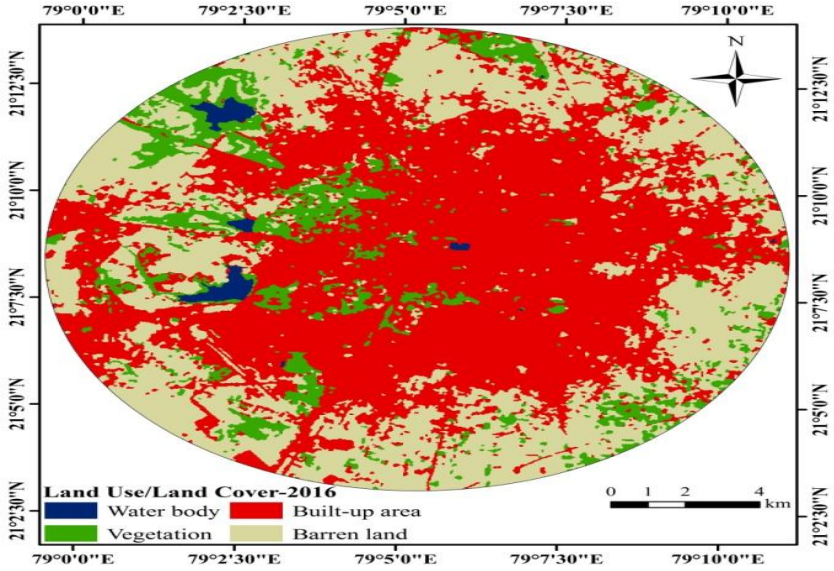
Shalini Dhyani[a,*], Shruti Lahoti[b], Shubhankar Khare[a], Paras Pujari[a], Parikshit Verma[a]

[a] CSIR-National Environmental Engineering Research Institute, Nagpur 440020, Maharashtra, India
[b] United Nations University, Institute for the Advanced Study of Sustainability (UNU-IAS), 5-53-70 Jingumae, Shibuya, Tokyo 150-8925, Japan



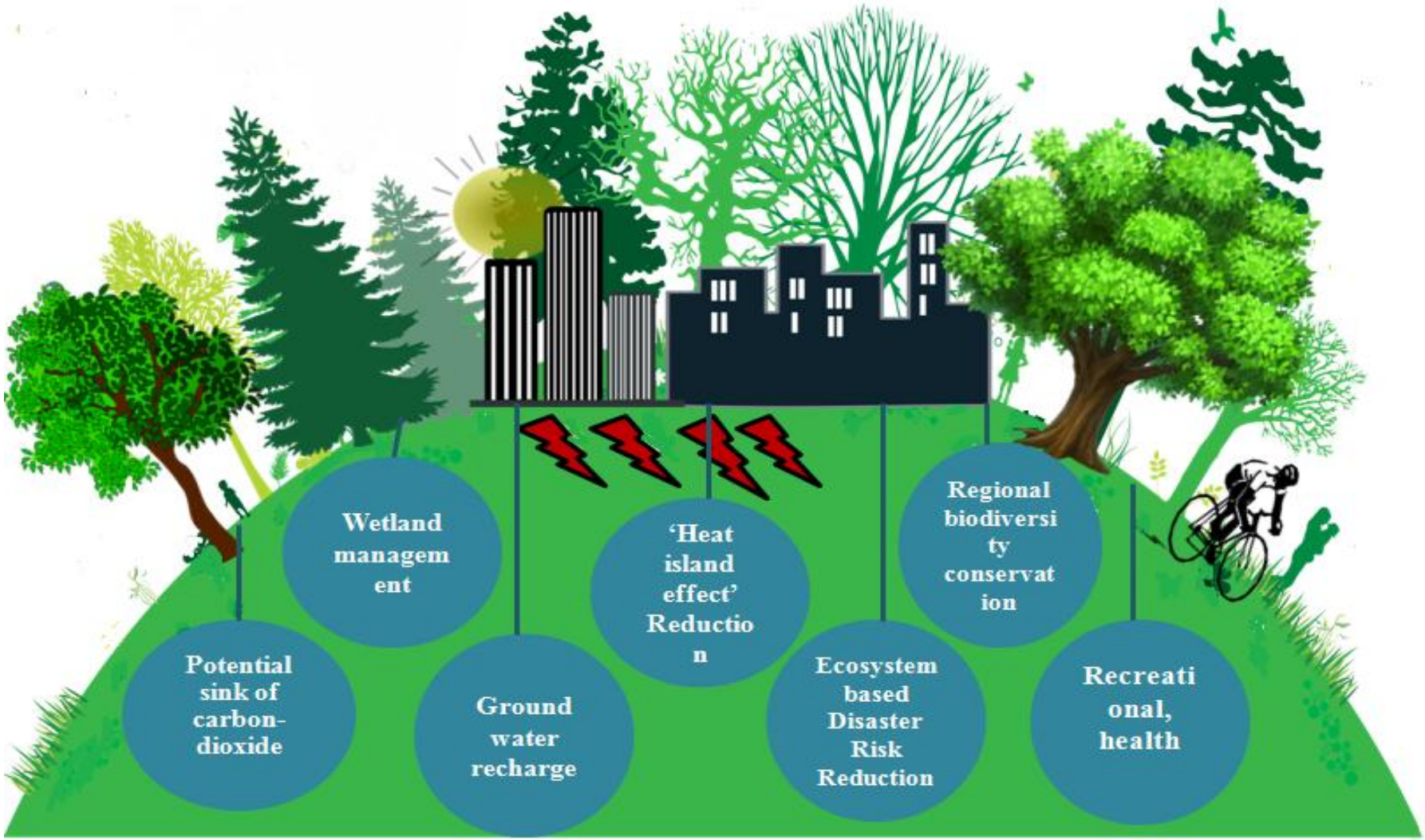






Spatio-Temporal land use changes in Nagpur city (1990-2016)

Dhyani et al., 2018 IJDR



It was fascinating to find >250 plants, >75 birds, >50 butterfly, many moths, mammals, reptiles, in 41 ha. Of our NEERI urban forests…many macro faunal components still to be studied

Source: Singh and Dhyani, 2016; Gujre et al., 2016

NEERI Biodiversity Portal

Easy access to campus Biodiversity...

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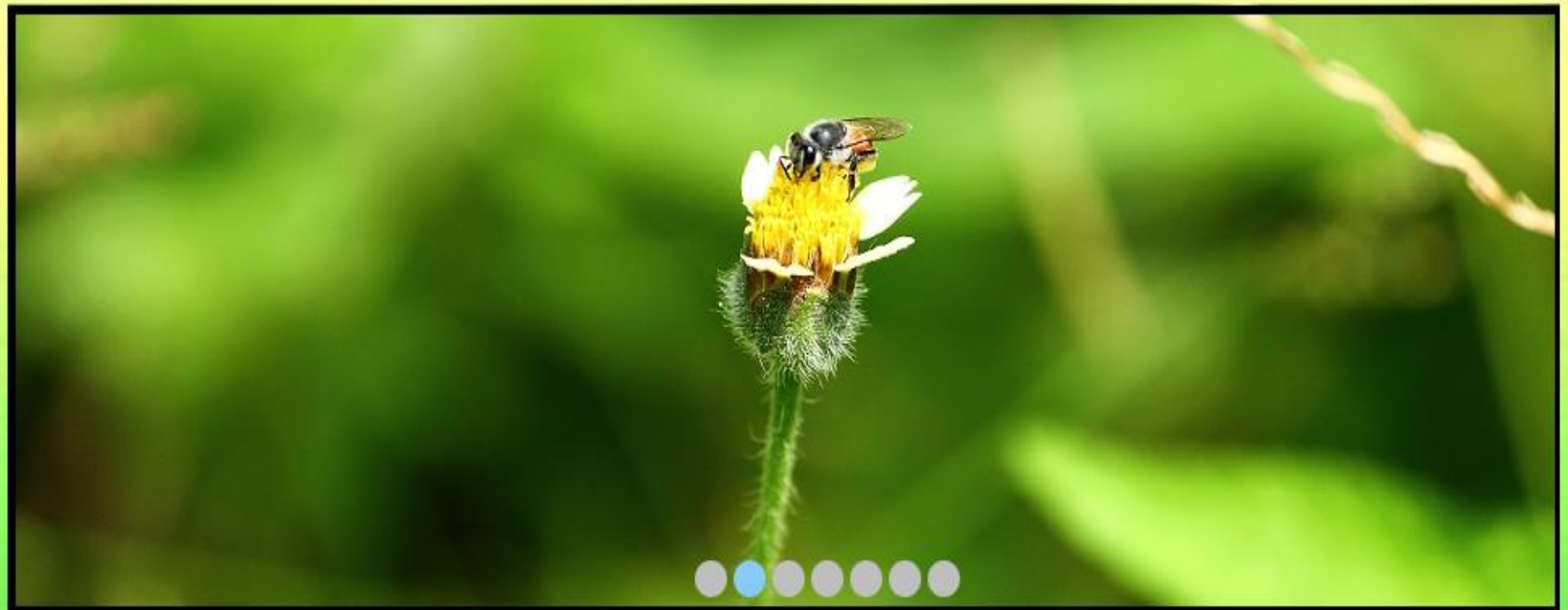
Facilitates Learning & Sharing Knowledge of Biodiversity on a Click

NBP was inaugurated by Dr. M.S. Ladania, Director, NRCC Nagpur on 8 April 2015



NBP was inaugurated by Dr. M.S. Ladania, Director, NRCC Nagpur on 8 April 2015

TREES

1. KACHNAR

(Bauhinia variegata)

2. NEEM

(Azadirachata indica)

3. GULMOHAR

(Delonix regia)

4. AMALTAS

(Cassia Fistula)

5. DESI BADAM

(Terminalia cattapa L.)

6. JACKFRUIT

(Altrocarpus heterophyllus)

7. AMROOD

(Psidium guajava)

8. IMLI

(Tamarindus indica L.)

9. WEEPING BOTTEL BRUSH

(Callistemon viminalis)

10. BER

(Ziziphus maurtiana L.)

सत्यमेव जयते

Department of Science & Technology
Govt. of India

COPAL, India NGO, Uttarakhand

Thank you for your patience!!

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