

Likely Impacts of Climate Change on Forests & Adaptation Strategies

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Outline...

- Likely impacts of Climate Change on Forests of India
- Evidences of Climate Change
- Why adaptation is important?
- Adaptation strategies for forests sector

Projected Climate Change for India

Current and future climate prediction for India

Current climate (CRU data)

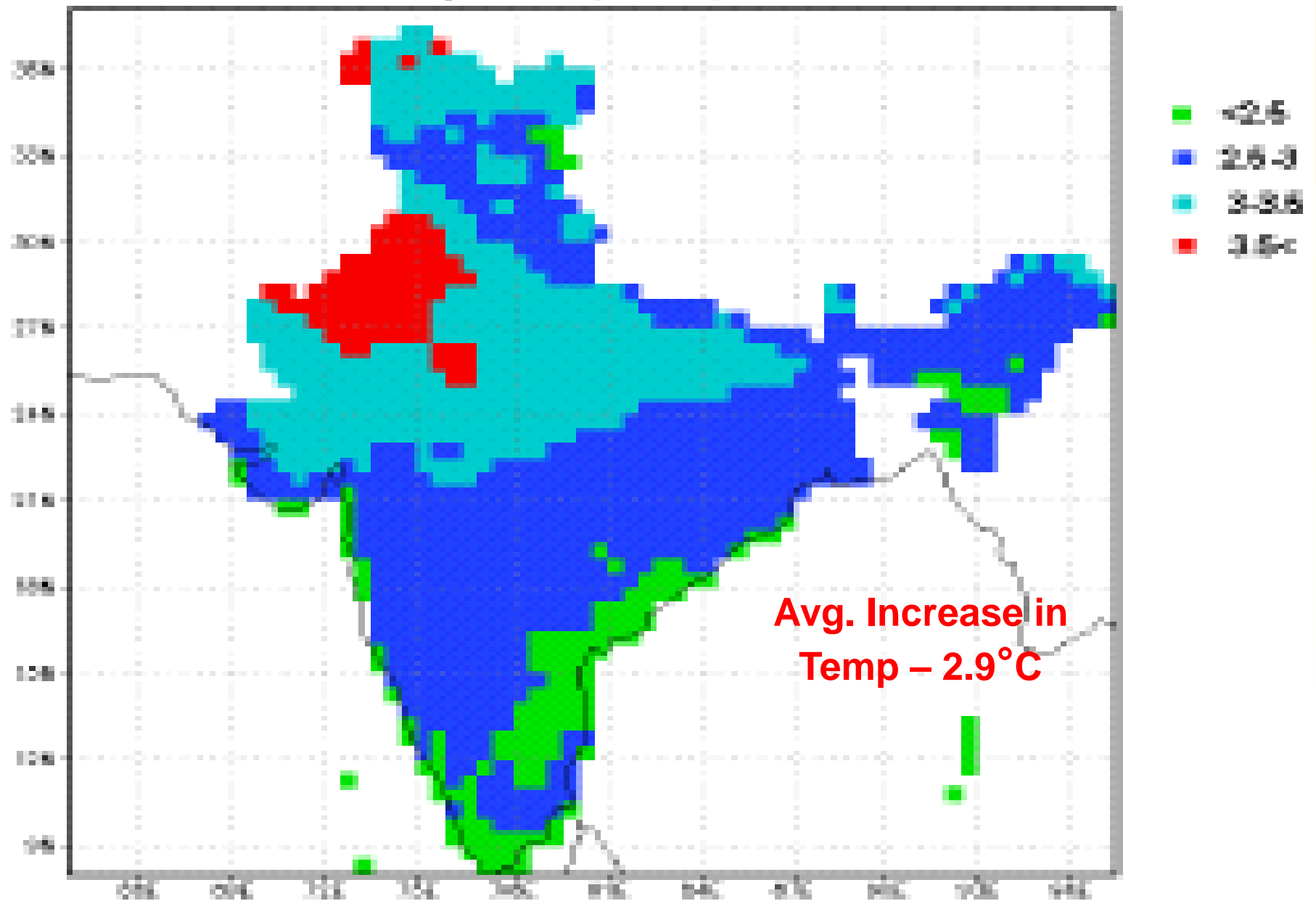
- Mean annual precipitation – 1094 mm
- Mean annual temperature – 22.7°C

Projected climate (average for 2071-2100, i.e., 2085)

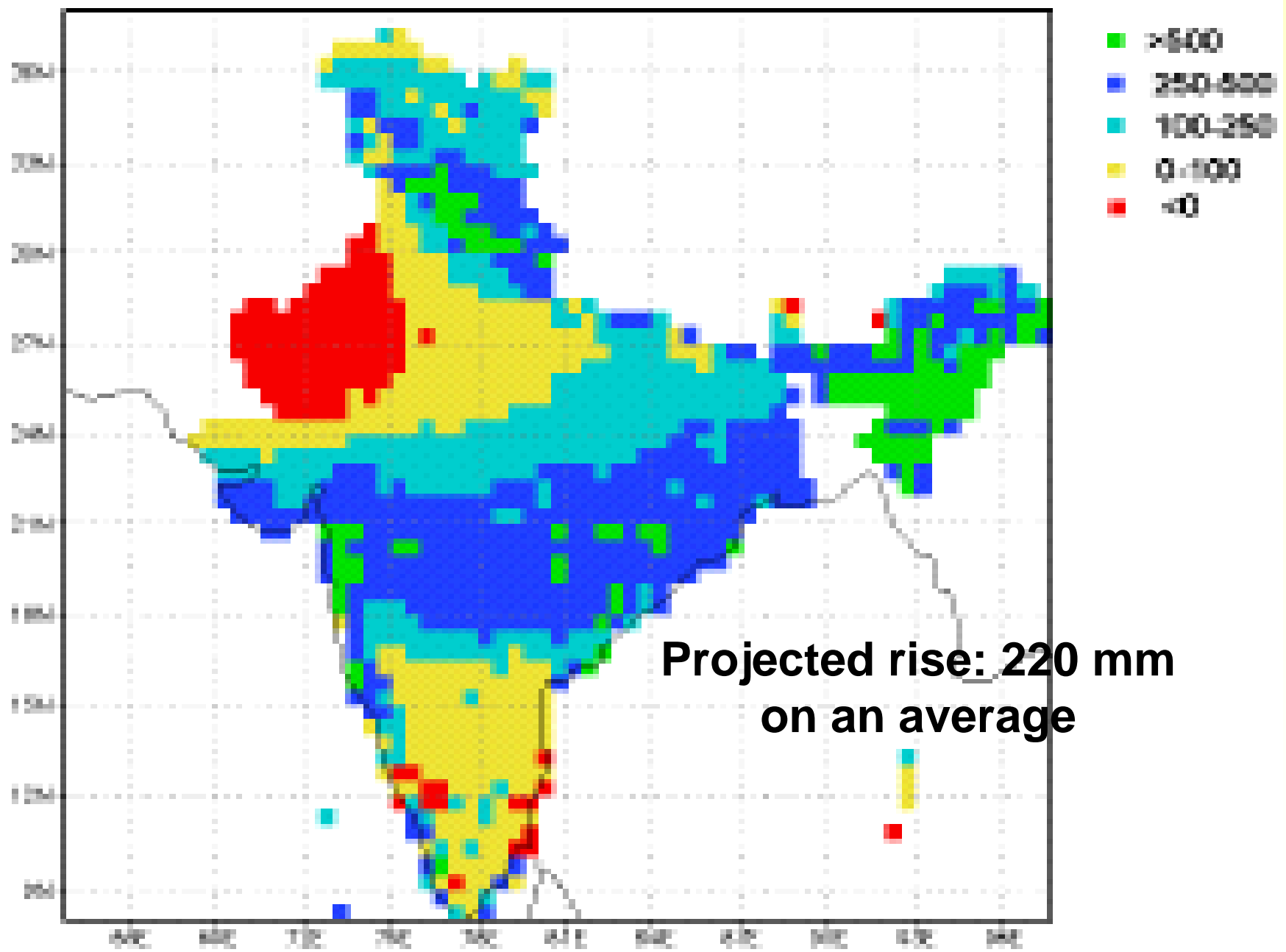
B2 Scenario

- Increase in precipitation – about 220 mm
- Increase in temperature – 2.9°C

Predicted change in temperature in 2085



Predicted change in precipitation



Likely impacts of Climate Change on Forests of India

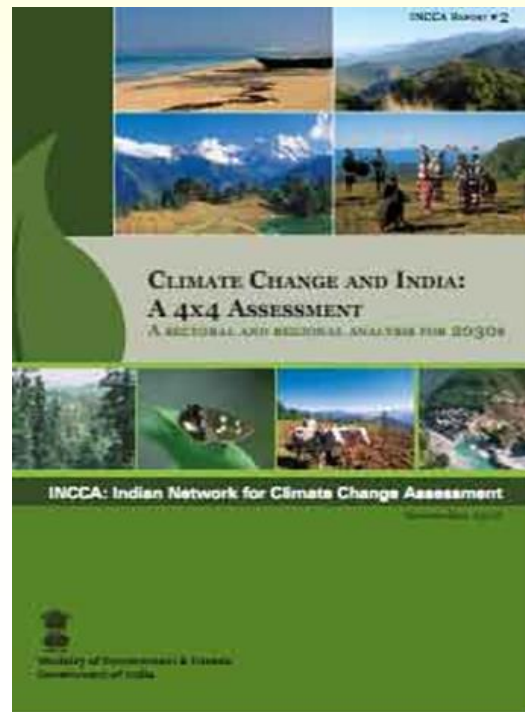
4 Regions

Western *ghats*

Himalayan region

Coastal region

North East region



4 Sectors

Agriculture

Water

Forests

Health

Likely impacts as per INCCA report

Region	No. of grids studied	Grids likely to undergo change in vegetation by 2035	Expected rise in NPP by 2035
Western <i>ghats</i>	54	18%	20%
Himalayan region	98	56%	57%
Coastal region	96	30%	31%
NE region	73	8%	23%

The study included the selected region only. At national level, around 30 % forest grids are likely to be impacted by 2035.

Source: INCCA, MoEF, 2010

Likely impacts of Climate Change on Forests

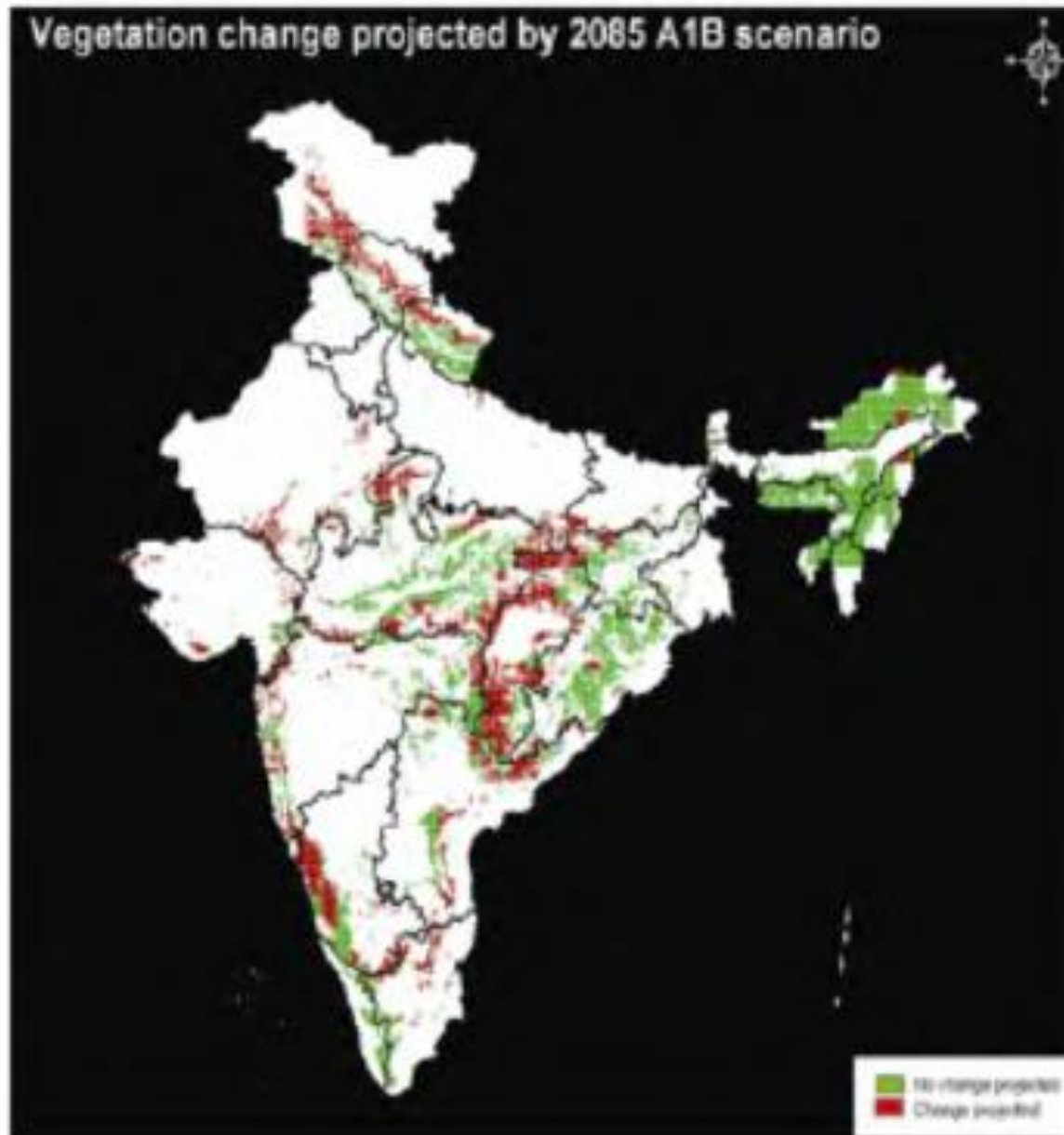
(Vegetation change predicted by 2035)



Forest grids likely to be impacted - **30.6 %** by 2035

(Source:
Gopalakrishnan, 2011)

Vegetation change predicted by 2085



Forest grids likely to be impacted - **45.9%**

(Source:
Gopalakrishnan,
2011)

Percentage of forested grids projected to undergo change

State	Number of FSI grids	Projected to change by 2035 (%)	Projected to change by 2085 (%)
Rajasthan	802	61.22	78.18
Jammu and Kashmir	910	57.03	88.35
Chhattisgarh	3292	48.00	75.85
Himachal Pradesh	838	47.49	65.39
Andhra Pradesh	2288	39.20	51.57
Karnataka	1947	38.37	62.20
Tamil Nadu	776	27.45	47.04
Madhya Pradesh	4432	22.59	48.17
Maharashtra	2197	21.21	45.33
Uttaranchal	1203	19.04	31.92
Arunachal Pradesh	2666	12.27	6.90
Orissa	2564	9.71	13.53
Meghalaya	829	7.96	0.00
Assam	1261	5.23	1.11
Jharkhand	1148	0.00	24.30

(Source: Gopalakrishnan, 2011)

Likely impacts of Climate Change on Forests & Biodiversity

- Around **45%** of forests are likely to be impacted
- Some regions are more vulnerable (**NW Himalaya**)
- Vulnerability linked to **low tree density, higher levels of fragmentation, low biodiversity & higher elevations**
- Likely impacts:
 - **Increased incidence of drought & fire**
 - **Migration of species towards higher latitudes & elevations**
 - **Decrease in area under socio-economic important species like Deodar, Oak, Sal etc.**
 - **Increasing spread of invasive species**
 - **Flora & fauna falling out of synchrony**
 - **Adverse impact on biodiversity**
 - **Adverse impact on forest ecosystem services**



Multiplier affect of climate change

Already heavy biotic pressures on Forests

- Encroachment on Forest lands
- Diversion of forest land for non-forest purposes
- Unregulated grazing
- Damage due to forest fires
- Incidences of insect/pest attack
- Increasing area under forest invasive species
- Man-animal conflict (***Shrinkage of habitat***)
- Impacts of Climate change (***Multiplier affect***)



Evidences of climate change impacts on forests ...

- Devastation caused by **Mountain Pine beetle** in forests of Rocky mountains/ British Columbia/Alaska. (*Lodgepole pine & Ponderosa pine*)
- Population increase due to insufficient low winter temperature (**winter warming**).
- Due to longer, warmer and dryer seasons, the life cycle is reduced to **one year** from two.



Evidences of climate change impacts ...

- Species are expected to migrate **pole ward in latitude** or **upward in elevations** and eventually run out of habitat.

- Ex. Pika in N America
(also called 'rock rabbit')
- Polar bear in Arctic region
(loss of habitat - **sea ice**)



Pika, rock rabbit



Polar bear

Observed ecological changes (winter warming)

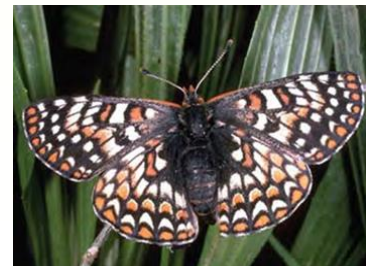
– Advance of spring events

- Earlier end of hibernation (**Marmot**)
- Earlier emergence of leaves
- Earlier migration
- Earlier breeding

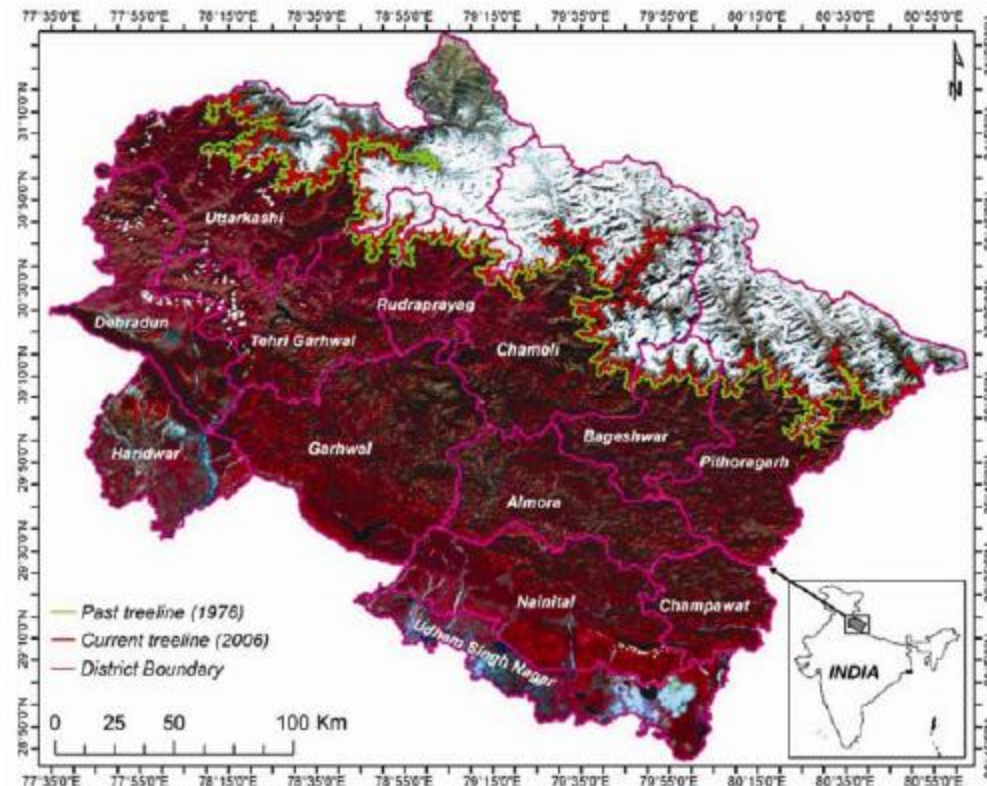


– Changes in species distribution

– Expansion of range of some butterfly species



Evidence of impacts of CC on forests...



Map showing the status of alpine tree line in 1972 and 2006 in the state of Uttarakhand (overlaid on false colour composite of IRS-P6, LISS-III, year 2006)

Mean upward shift of tree line as observed from 1970 to 2006

District	Mean shift (m)
Uttarkashi	360
Tehri Garhwal	400
Rudraprayag	390
Chamoli	430
Bageshwar	360
Pithoragarh	390

Species studied – *Betula utilis*

(Source: Singh et al, 2012)

The Sundarbans Mangrove Forest



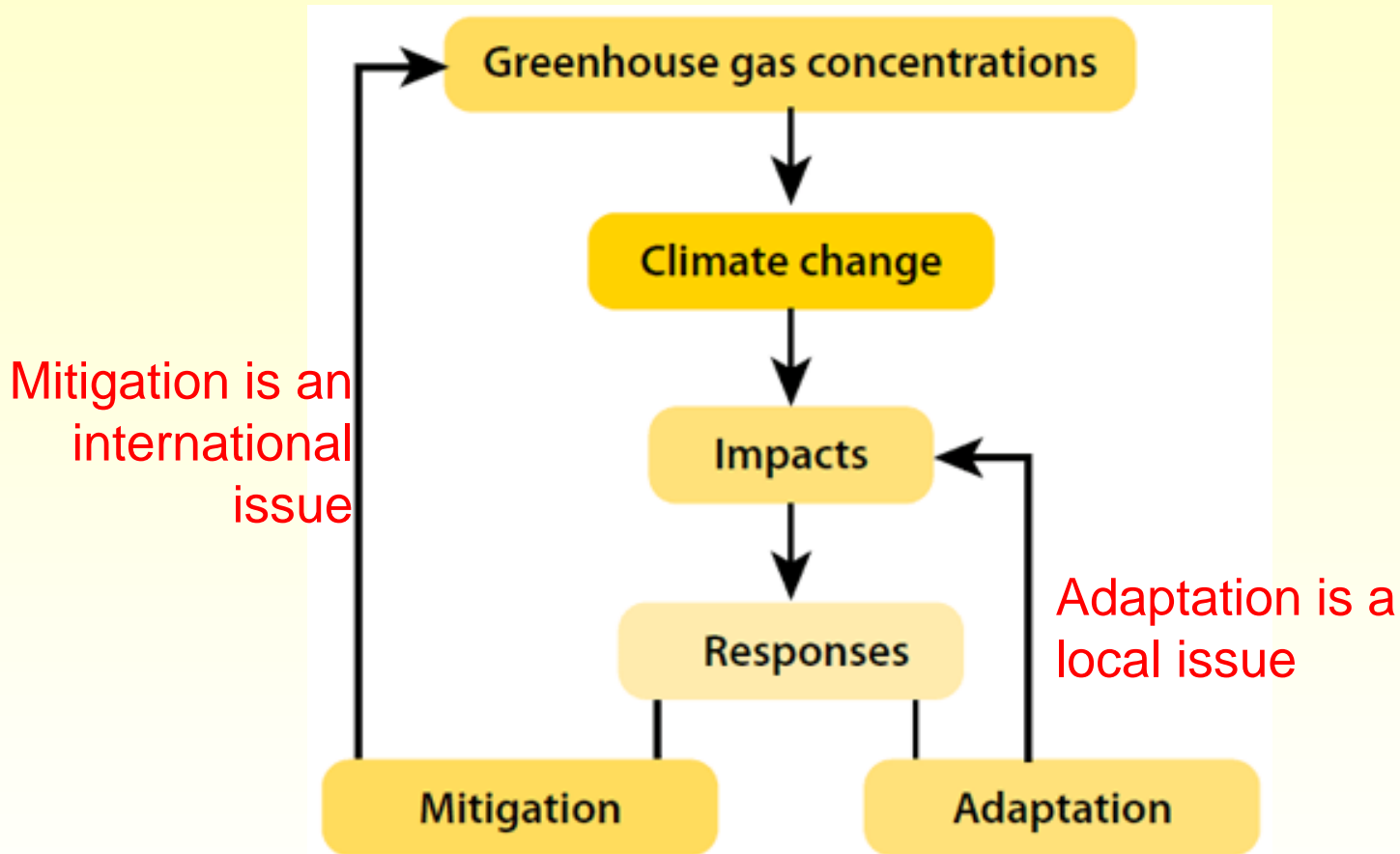
A 45 cm sea level rise would inundate 75% of the Sundarbans, and 67 cm sea level rise could inundate all of the Sundarbans. Even a 25 cm sea level rise would result in a 40% mangrove loss

Some more evidences...

- **Sikkim** (*Ref. Sikkimforest.gov.in*)
 - Range extension/shift in some bird species
 - Change in breeding seasonality (Reasons - Dry spells, altered plant phenology & insect emergence).
 - Skewed sex-ratio towards females snakes
 - Near disappearance of turtles
- **Arunachal Pradesh** (*Ref. Current Science, 2011*)
 - Phenological changes in floral spp. (Ex. Orchids, Ginseng & Rhododendron spp.,)
- **Himachal Pradesh** (*Ref. IISc, Bgl*)
 - Vulnerability assessment of forests indicate that districts of Chamba, Kullu, Shimla, Mandi & Kangra are most vulnerable (Him moist temperate, Sub-tropical pine, Tropical moist deciduous forests are most vulnerable).

Suggested Forest Management Strategies for Adaptation to Climate Change

Forests & Climate Change Interface



Why is adaptation important?

- Adaptation is a local or national issue & will have direct impact on us, whereas mitigation is a global issue
- Climate change is a reality and is happening.
(UNFCCC-Tragedy of commons in making!)
- **Adaptation is complex** - it is difficult to estimate vulnerability and to quantify the impact of adaptation, unlike mitigation
- **There are no markets** or international funds for adaptation except with in UNFCCC

Need for more action to understand the Vulnerability of Forest Sector

- Impact studies with fine resolution data, & vulnerability assessment of our forests
- Use of India specific multi-dimensional CC impact assessment models
- Setting up new & revival of old preservation plots for long term observations
- Long term scientific studies
 - *Natural regeneration;*
 - *Species migration, habitat; range*
 - *Incidences of fire; droughts; trends*
 - *Species phenology, growth & establishment.*

Rehabilitation of degraded forests & gap plantations

- Improvement of stocking levels by **ANR** and gap plantations
- Strengthening of **fire prevention & control**, and other forest protection & management practices
- **Sustainable harvest** of timber and non-timber products (ban on green felling?)
- **No grazing** in regeneration areas

New plantations

- Are species adapted to the future climate?
- Provenance testing – very important
- Developing pest resistance varieties
- Identifying drought tolerant genotypes



Promoting agroforestry / farm forestry

- Reduce pressure on natural forests
- **High potential** and 10-20% sown area can be brought under agro/farm forestry in plains
- Suggested improvements
 - Quality control & certification
 - Rationalization of felling/transit restrictions
 - Effective marketing and extension strategies
 - Promoting farmer-industry tie-up



Enhancing & strengthening PA network

- Currently around 5% of the geographical area of India is under PAs
- Degradation of wildlife habitat and fragmentation is a serious issue
- Improving WL corridors is important
- Studies required on the impacts of climate change on fauna

Demand side management

(Addressing drivers of degradation)

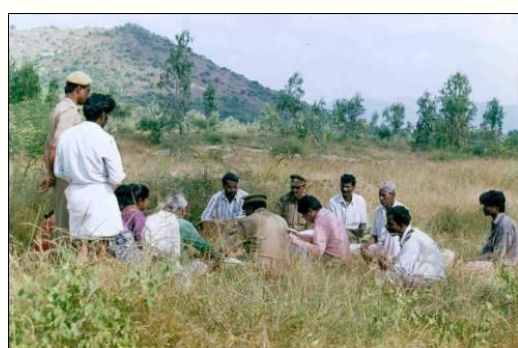
- Increasing fuelwood use efficiency
 - Improved *chullahs*
 - Fuelwood substitution
(Pine briquettes, biogas)
 - LPG
- Alternate energy sources
 - Solar, Wind power
- Enhancing life of wood products
- New wood use technologies – Bamboo, Poplar



Green India Mission

“Green India Mission” - Crafted as forest restoration & enhancement strategy for mitigation & adaptation to climate change

- Aims is to cover 10 m ha in ten years (*In addition to BAU*)
 - Moderately dense / degraded & open forests
 - Scrubs & grasslands
 - Mangroves / wetlands & urban forests
 - Degraded & fallow agriculture lands
 - Wildlife corridors outside PAs
- Empowerment of forest communities

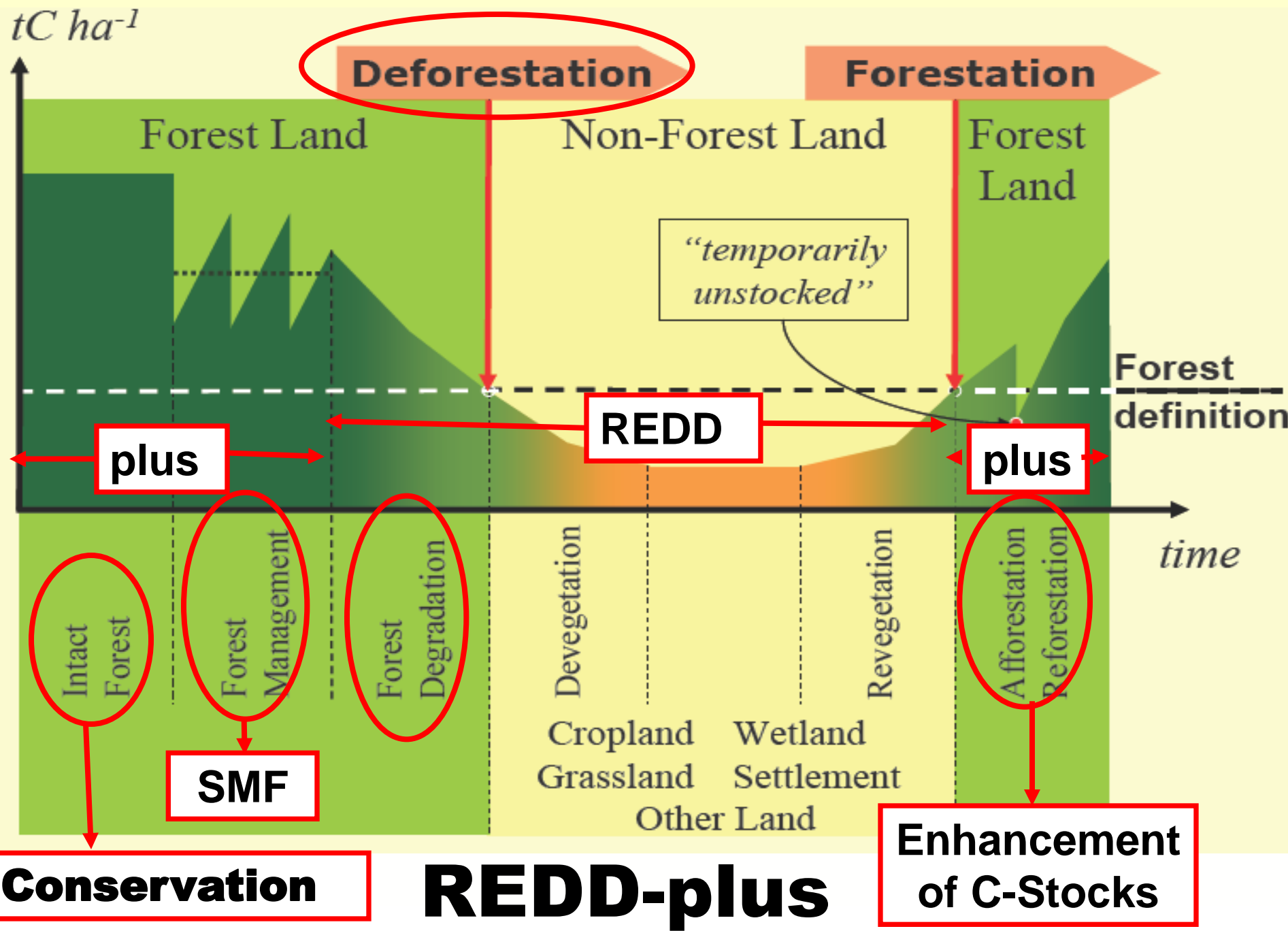


Payment for ecosystem services

(Financing conservation)

- Markets are **slowly evolving** for goods & services from forest ecosystems
- Few examples
 - Ecotourism – mainly domestic market
 - Carbon benefits – international markets
 - Water – local markets
- Demand exist for
 - Watershed benefits
 - Biodiversity conservation
 - Carbon sequestration & storage (**REDD-plus**)
- Challenges
 - Quantification of services
 - Monetary valuation of goods & services





$tC\ ha^{-1}$

Deforestation

Forestation

Forest Land

Non-Forest Land

Forest Land

temporarily unstocked

Forest definition

plus

REDD

plus

time

Intact Forest

Forest Management

Forest Degradation

Devegetation

Revegetation

Afforestation Reforestation

SMF

Cropland

Wetland

Grassland

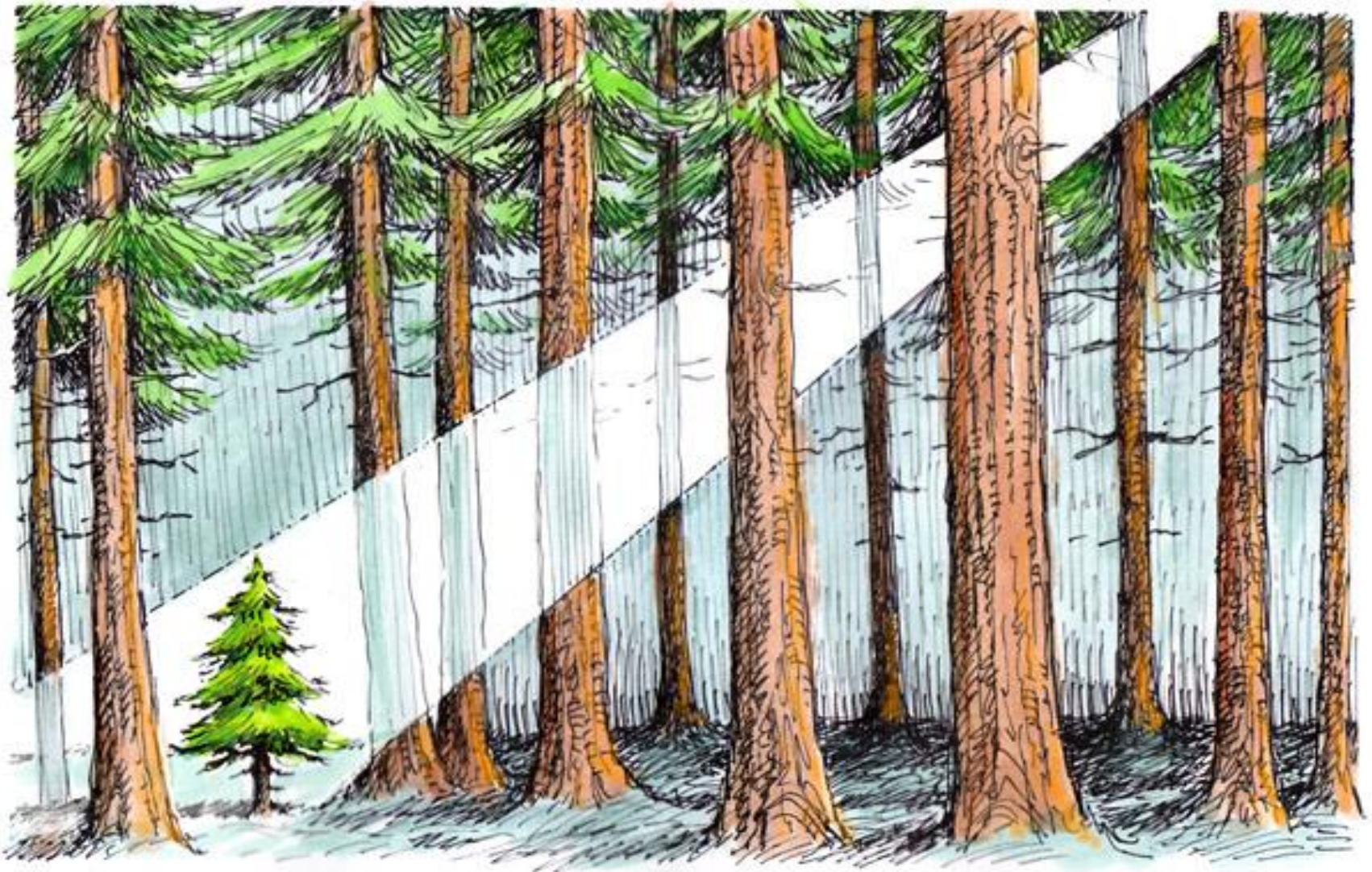
Settlement

Other Land

Enhancement of C-Stocks

Conservation

REDD-plus



Thanks for your Attention...