

Designing Ecological Restoration Projects

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Restoration: global to national and state missions



GEF Small Grants Programme in India

Community-based Conservation of Threatened Ecosystems and Species

- Strengthening community-led biodiversity conservation and promoting traditional ecological knowledge
- Protecting and restoring threatened, rare, endemic, and endangered species through participatory species monitoring, habitat restoration and addressing threats like poaching, invasive species and habitat degradation



**INTERNATIONAL PRINCIPLES
AND STANDARDS FOR THE
PRACTICE OF ECOLOGICAL
RESTORATION**

SECOND EDITION SUMMARY

Tropical ecosystems: a litany of threats

							
1	2	3	4	5	6	7	8
Logging	Industrial and infrastructure expansion	Agriculture and plantations	Fragmentation	Edge effects and degradation	Invasive alien species	Extreme weather events	Wildfires

THE RESTORATIVE CONTINUUM

Improving biodiversity, ecological integrity,
and ecosystem services



REDUCING SOCIETAL IMPACTS	IMPROVING ECOSYSTEM MANAGEMENT	REPAIRING ECOSYSTEM FUNCTION	INITIATING NATIVE RECOVERY	PARTIALLY RECOVERING NATIVE ECOSYSTEMS	FULLY RECOVERING NATIVE ECOSYSTEMS
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Remediation removes physical or chemical barriers to biological life and mitigate risks to human health and the environment

Rehabilitation aims to revive key ecosystem functions or services but does not target native ecosystem recovery

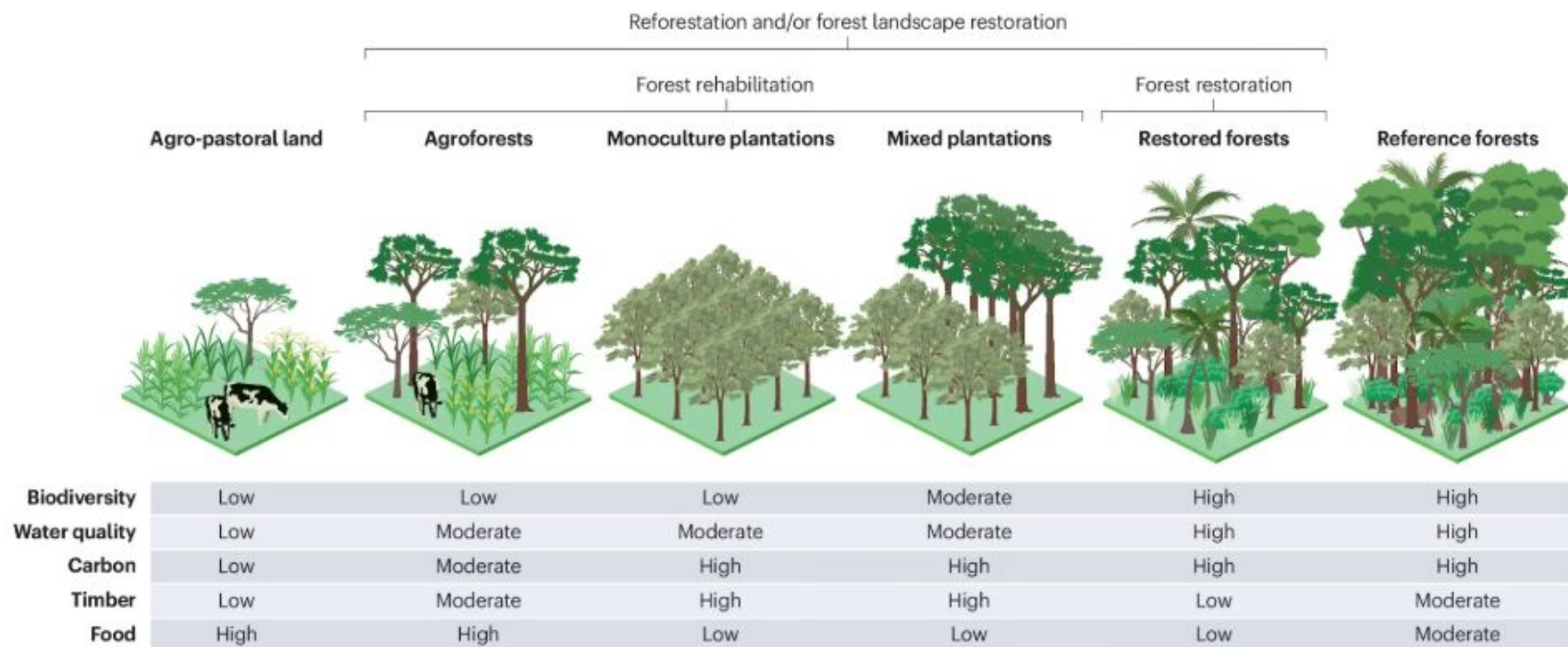
Ecological restoration is the process of assisting the recovery of a native ecosystem that has been degraded, damaged, or destroyed

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(Society for Ecological Restoration, 2019)

Recovery is the desired outcome of restoration, measured from change in pre-selected **ecosystem attributes**

Reference model is the target ecosystem aiming to be restored



Forest Landscape Restoration

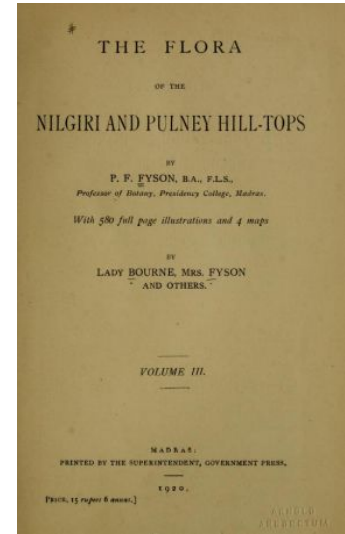
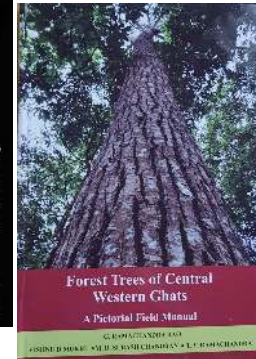
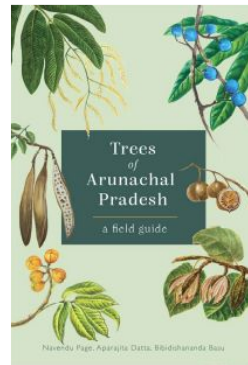
Reference ecosystems | Benchmarks

Sites as they were prior to disturbance

Less disturbed, but otherwise similar, sites

Based on historical evidence and indigenous knowledge

Ecoregion and natural vegetation of the area



Ecoregion

A relatively large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions.

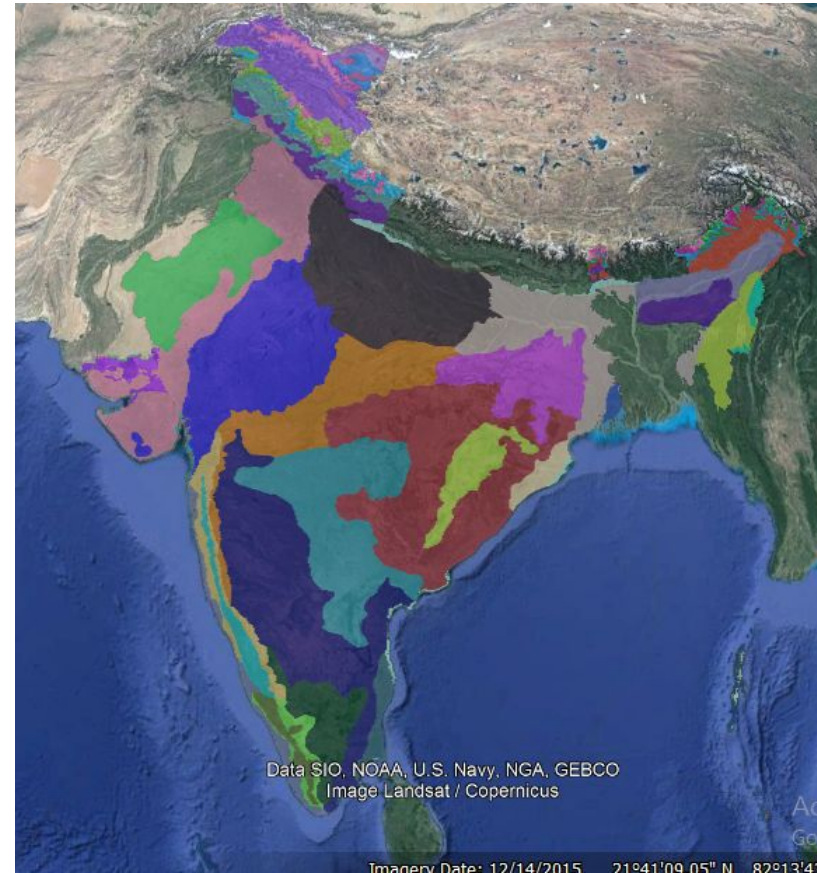
Large area with similar **climate, geology, soils, evolutionary history, and ecological processes** that supports characteristic ecosystems and species assemblages.

ERA-India Ecoregions explorer:

<https://era-india.org/map/>

Open Natural Ecosystems (ONEs):

<https://mdm.users.earthengine.app/view/open-natural-ecosystems>



What are these ecosystems?

India has high diversity of natural ecosystems

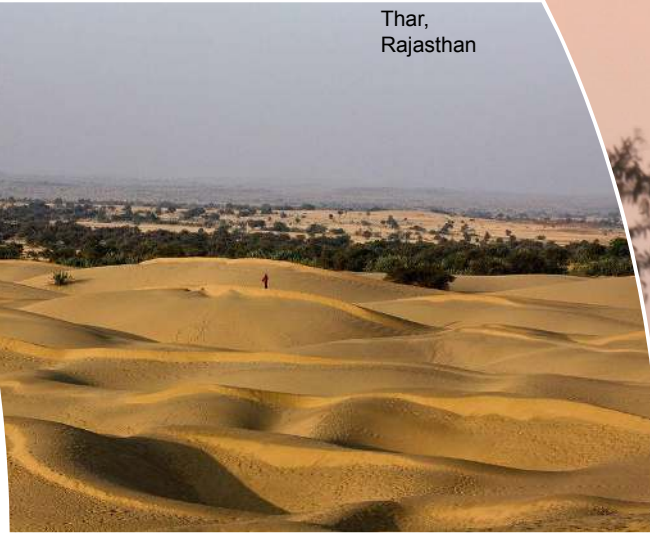


Which of these
ecosystems would you
restore by planting trees?

Restoration is not about
planting trees. It is about
recovering ecosystems

Recovery from a degraded
state

Thar,
Rajasthan



Western Ghats,
Maharashtra



Wetland, Kutch,
Gujarat



What is degradation?

Loss of structure

Loss of biodiversity

Loss of function

Arrested recovery

Further reading: Ghazoul et al. (2015).
Conceptualizing forest degradation. *TREE*, 30 (10),
622-632.



Causes of degradation

FORESTS

Overexploitation
Overgrazing
Fire
Fragmentation
Defaunation/hunting
Invasive species



GRASSLANDS and SAVANNAS

Overgrazing
Fertilisation
Tree planting
Invasive species
Woody encroachment



WETLANDS

Infrastructure
Conversion
Water withdrawal
Eutrophication and pollution
Overharvesting
Invasive species

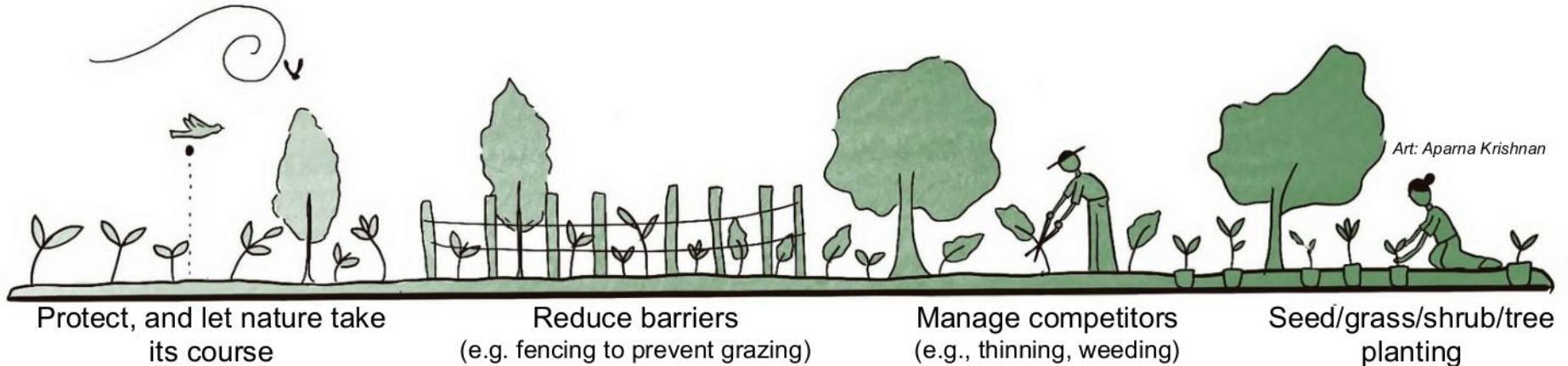


Restoration – a continuum of interventions

Intervention continuum – different methods, varying intensities

Choose methods based on barriers identified

Reintroductions (e.g., planting flora) is just one of many options, not always needed



Protect and let nature do the rest
Control sources of degradation
Assist natural recovery processes
Introduce missing plant species

Four **key aspects** of ecological restoration

Pinpoint
causes of degradation
and sites
needing
restoration



Select the right
benchmark or
reference ecosystem



Identify and
implement the
right
restoration intervention



Monitor and
assess recovery
and restoration
success, revise if
needed



Questions to guide a restoration project proposal

- What is the restoration goal?
- What are we restoring?
- Why is it degraded?
- What prevents recovery?
- What intervention is required?
- How do we know if restoration is succeeding?

What is the restoration goal?

- Reviving the natural forest that was once there
- Conservation of endemic and rare plant or animal species
- Corridors for movement of animals
- Creating habitat islands
- Soil and water conservation
- Facilitating livelihoods and human well-being

Stakeholder mapping and partnerships

Local communities

Indigenous peoples

Forest Department and state authorities

Private landowners

Gram sabhas

Ecological and social researchers and organisations



Photo courtesy: ATREE

Restoration as a sequence

Reference
ecosystem

Assess
degradation

Identify barriers

Select
interventions

Implementation

Monitoring

Adaptive
management

Where would you begin?



Reference ecosystem

- What existed before degradation?
- What would exist without disturbance?

Sources:

- Nearby intact sites
- Historical records
- Local knowledge
- Old maps
- Understanding historical disturbances
- Collecting primary data



Assess degradation

- What is degraded?
- How degraded?

Dimensions of degradation

- Species composition
- Structure
- Ecological processes
- Soils
- Landscape connectivity



Barriers to recovery

Why is the ecosystem not recovering on its own?

- Fire
- Grazing
- Invasive species
- Alien species
- Soil degradation
- Lack of seed dispersal
- Hydrological alteration

Doctors treat causes, not symptoms.

Do not plant before understanding barriers.



Different methods of restoration

Community interventions and
behavioural change



Assisted Natural Regeneration (ANR)

Direct seeding

Nurse species planting

Framework species method

Maximum diversity method

Applied nucleation ('tree islands')



Open Natural Ecosystems

Thinning trees to promote non-tree native vegetation

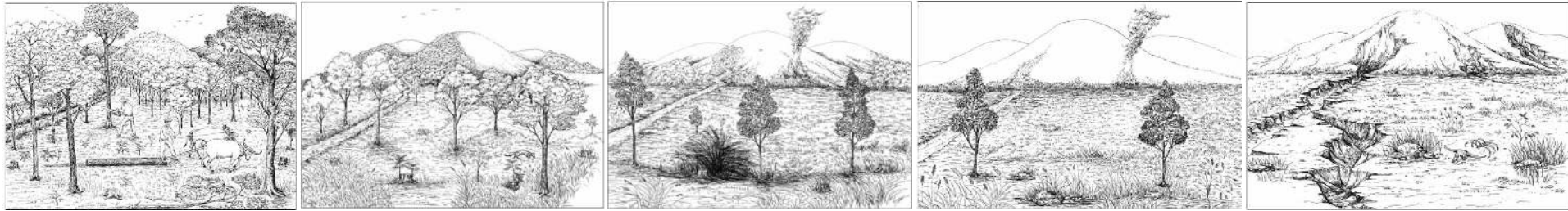
Traditional fire regimes

Natural flood as in the Terai grasslands

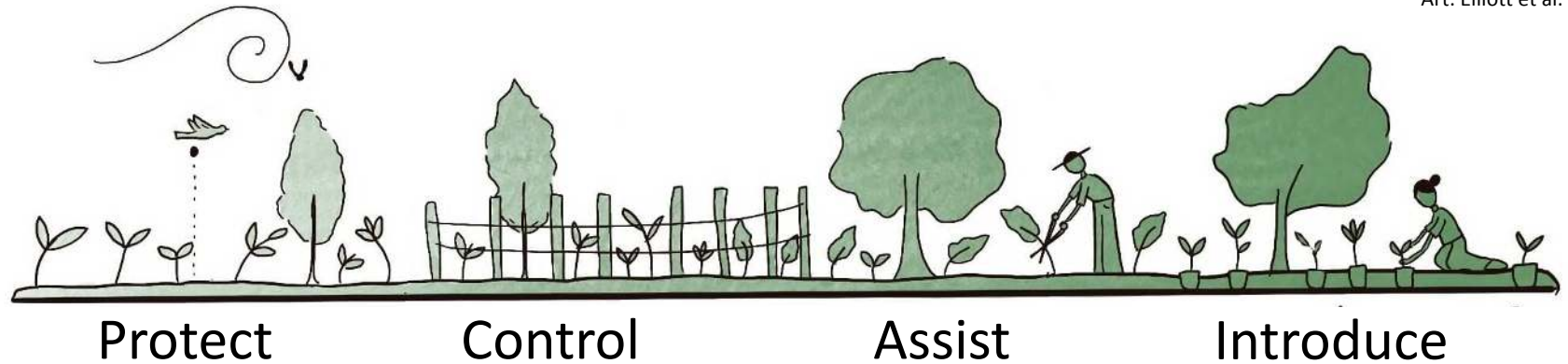


Removing invasive Black Wattle from Western Ghats grasslands

Decide intervention intensity



Art: Elliott et al. (2013)





Collecting data from benchmark sites

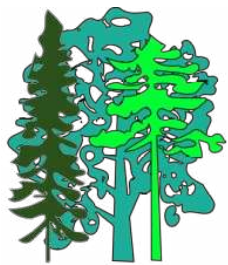


Why restoration projects fail?

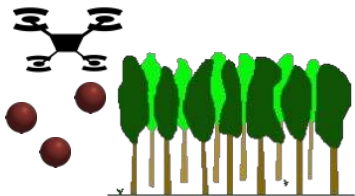
- No reference ecosystem
- Wrong species
- Ignoring causes of degradation
- No monitoring
- Unrealistic goals

What is **not** restoration?

Ecosystem restoration $\neq$ tree planting



Setting
wrong targets



Quick-fix
solutions

Ecosystem destruction
Hydrology losses



Other degraded states
Restoration failure

Biodiversity loss
Poorer carbon storage



Planting
monocultures

Biodiversity loss
Alien species invasion

Planting wrong
species



What all should we monitor?

- Structure
- Richness
- Regeneration
- Soil condition
- Faunal return



Assessing recovery

Of **form** (e.g., trees / grasses)

Of **diversity** (e.g., multispecies communities)

Of **function** (e.g., seed dispersal / carbon)

Of **relationships** (e.g., stewardship / interactions)



Collecting data

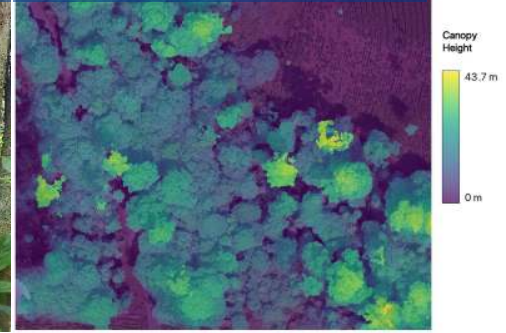
Photo point monitoring



Field measurements



Remote sensing



Wildlife monitoring



Acoustics



Planning for restoration (4-year window)

- Make a plan (- 2 years)
- Seed collection
- Sapling production
- Hardening saplings
- Site preparation
- Transportation
- Planting (0 year)
- Tagging
- Monitoring survival & growth
- Firebreaks
- Weeding
- Water
- Maintenance (+ 2 years)

Take home message

- Restoration begins with diagnosis
- Not every site needs planting
- Remove barriers before adding plants
- Identify the source of plants or develop a nursery
- Match intervention intensity to levels of degradation
- Monitoring is critical part of restoration, not an afterthought
- Think long-term

Thank you!