

NbS Capacity Building – Session 3

Approaching Regenerative Agriculture, Forests and Ecological Corridors with NbS

Sebastien GOETHALS

Climate Adaptation & NbS Expert

Regenerative Landscape Planning & Design

sgoethals@civilinks-group.com

Technical Assistance Facility to
the Green Team Europe Initiative (TAF-GTEI)

TAF-GTEI is a project funded by the European Union in partnership
with ASEAN



1

Living Rural and Agri-Landscapes :

Regenerative Farming Systems supported by Nature-based Solutions

Case study

Tra Su Melaleuca Forest, Tinh Bien town, An Giang Province, Vietnam

2

Rebuilding Ecological Integrity of Natural Landscapes :

Forests and Natural Habitats

Case study

Restorasi Ekosistem Riau (RER) Peat Swamp Forest Restoration, Indonesia

3

Connecting Landscapes :

Wildlife Corridors for Resilient Ecosystems

Case study

Gunung Leuser National Park, Indonesia

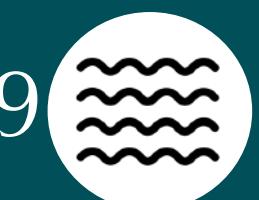
9 Climate-sensitive Landscape Categories ready for NbS Application and Scale-up in Synergy



Climate-smart and Resilient Cities

Green & Blue Eco-Industrial Areas and Ports

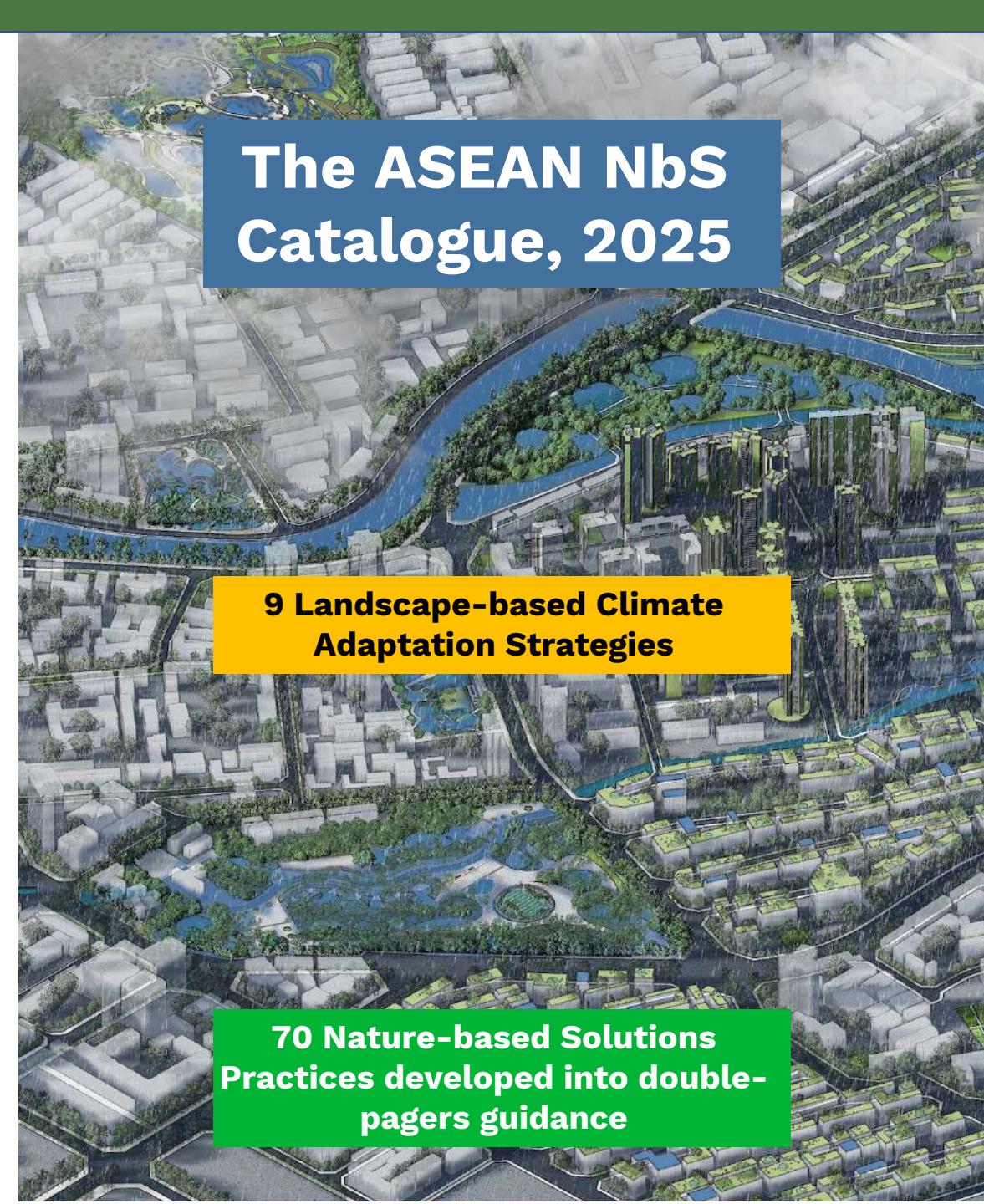
Regenerative Agriculture



Healthy Forests and Natural Habitats

Wildlife Corridors for Ecological Connectivity

Regenerative Seascapes and Marine Habitats



The ASEAN NbS Catalogue, 2025

9 Landscape-based Climate Adaptation Strategies

70 Nature-based Solutions Practices developed into double-pagers guidance

PUBLICATION SET

Nature-based Solution Studies in ASEAN Member States



Access reports here



Soil- and Water-Sensitive Agri-Landscapes:

How Regenerative Agriculture through NbS can Sustain Biodiversity and Rural Landscape Diversity in Southeast Asia



CSL06 **Regenerative Agriculture**

Key Agricultural Practices Driving Risks !

Rural Agri-Landscapes in Southeast Asia

MONOCULTURE CASH CROPS

Soil depletion
Biodiversity Loss
Erosion

UNSTAINABLE PADDY FARMING

Excessive Irrigation
Continuous Rice Cropping
Nutrient Runoff

SLASH & BURN / DEFORESTATION

Landslides
Habitat Fragmentation

SHRIMP / AQUACULTURE EXPANSION

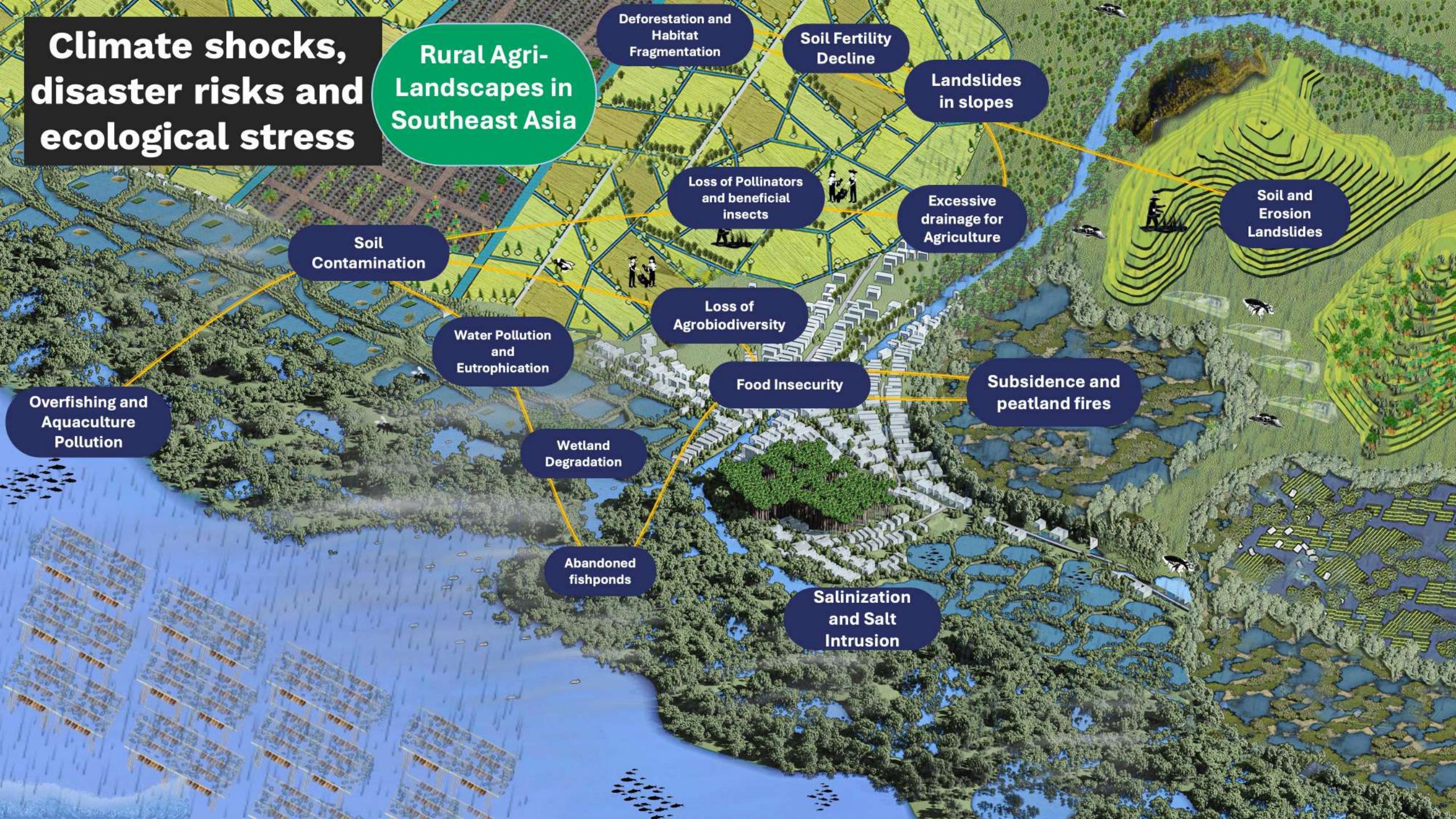
Mangrove Clearance
Coastal Biodiversity Loss

PEATLAND DRAINAGE

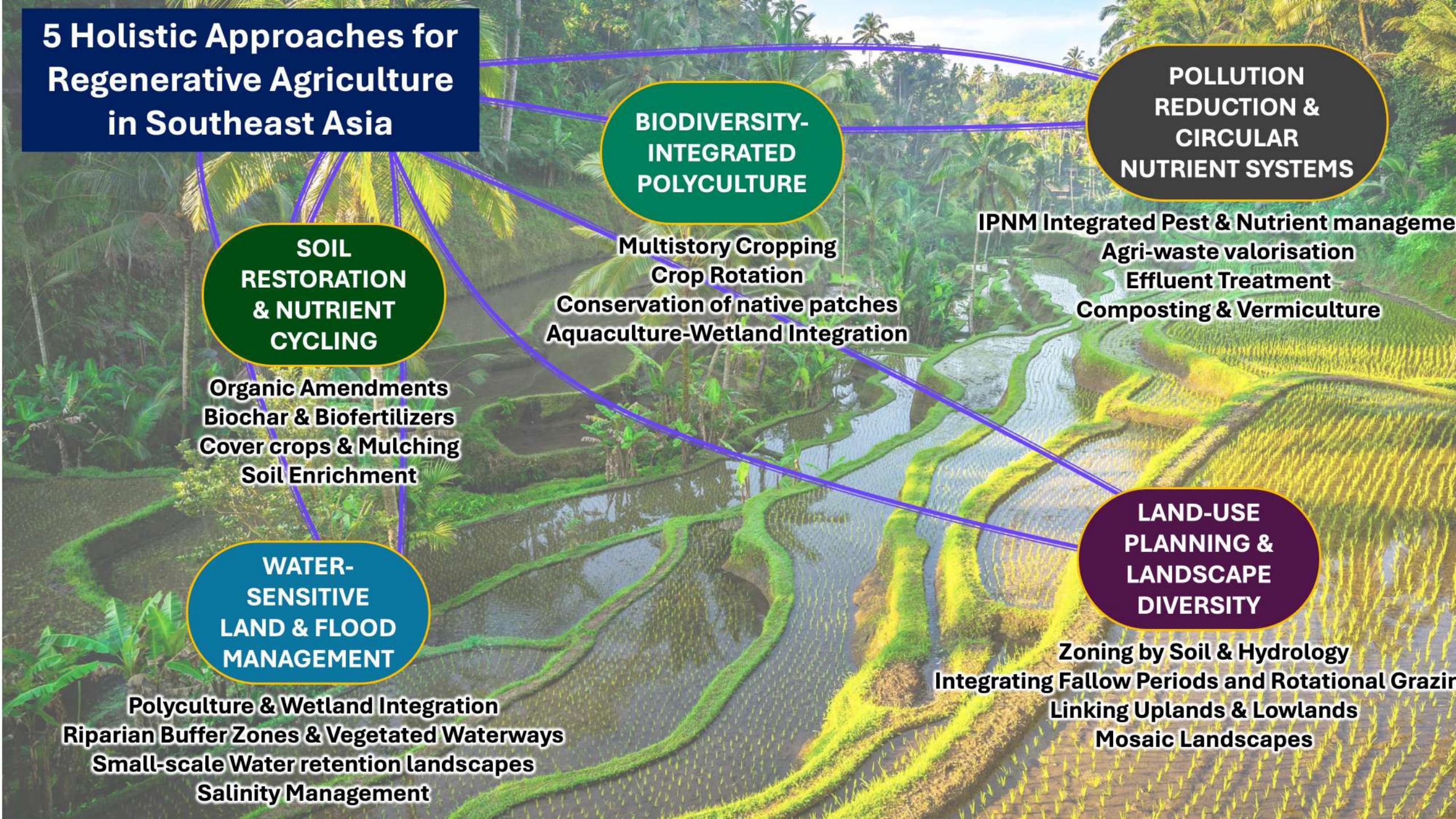
Subsidence
Fire Risk
Carbon Release

Climate shocks, disaster risks and ecological stress

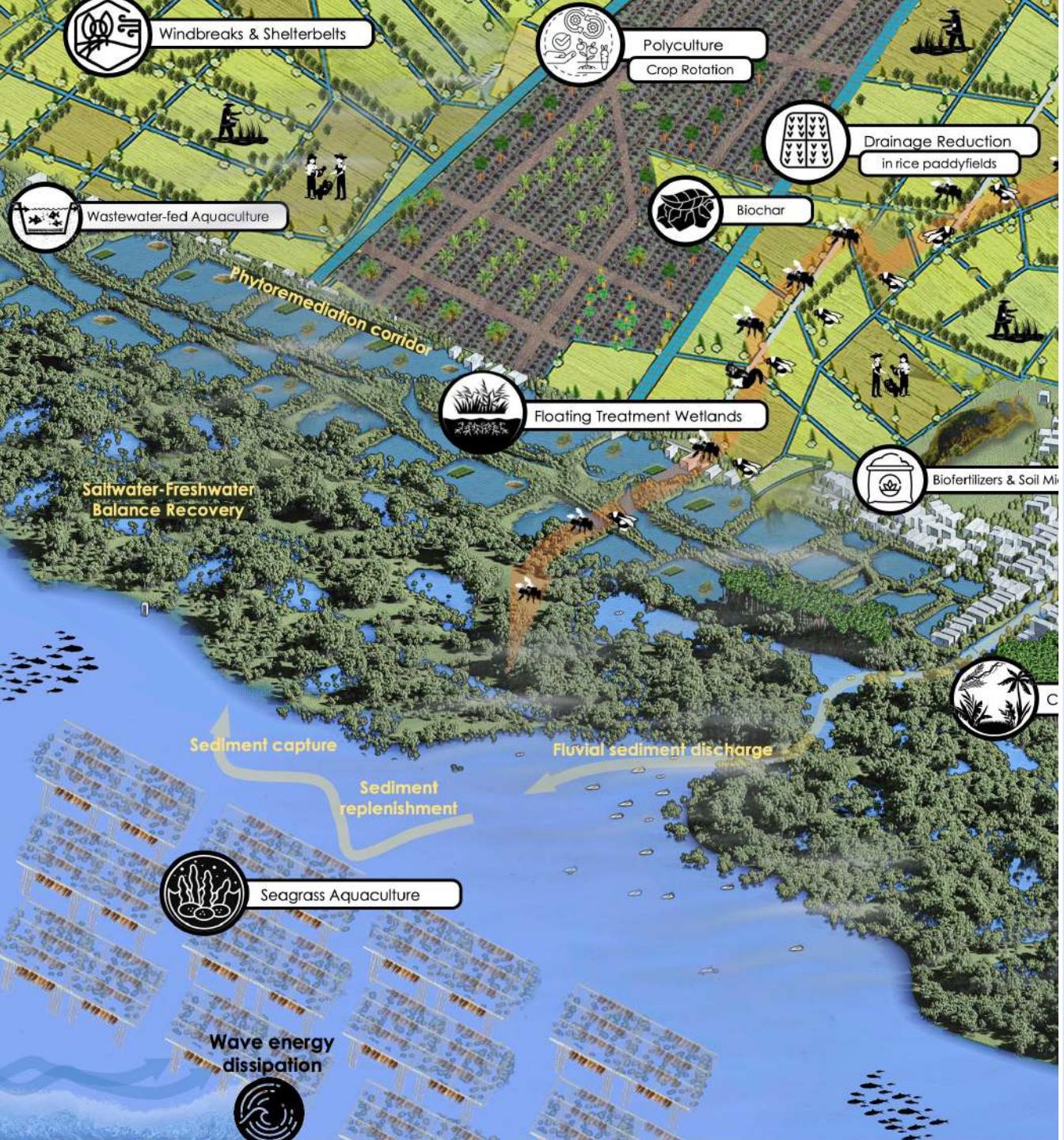
Rural Agri-Landscapes in Southeast Asia



5 Holistic Approaches for Regenerative Agriculture in Southeast Asia







Enablers

Secure and Adaptive Land Tenure and Use Rights

Landscape-Scale Planning & Cross-Sector Governance

Data, Monitoring & Recognition of Ecosystem Services

Farmer-to-farmer Learning

Market Access & Value Chain Support

Finance Incentives & Risk-Sharing Mechanisms

Payments for Ecosystem Services (PES)

Transition Grants or Concessional Loans

Crop Insurance adapted to diversified systems

Carbon, Biodiversity and Water Credits

Tra Su Melaleuca Forest, Tinh Bien town, An Giang Province, Vietnam

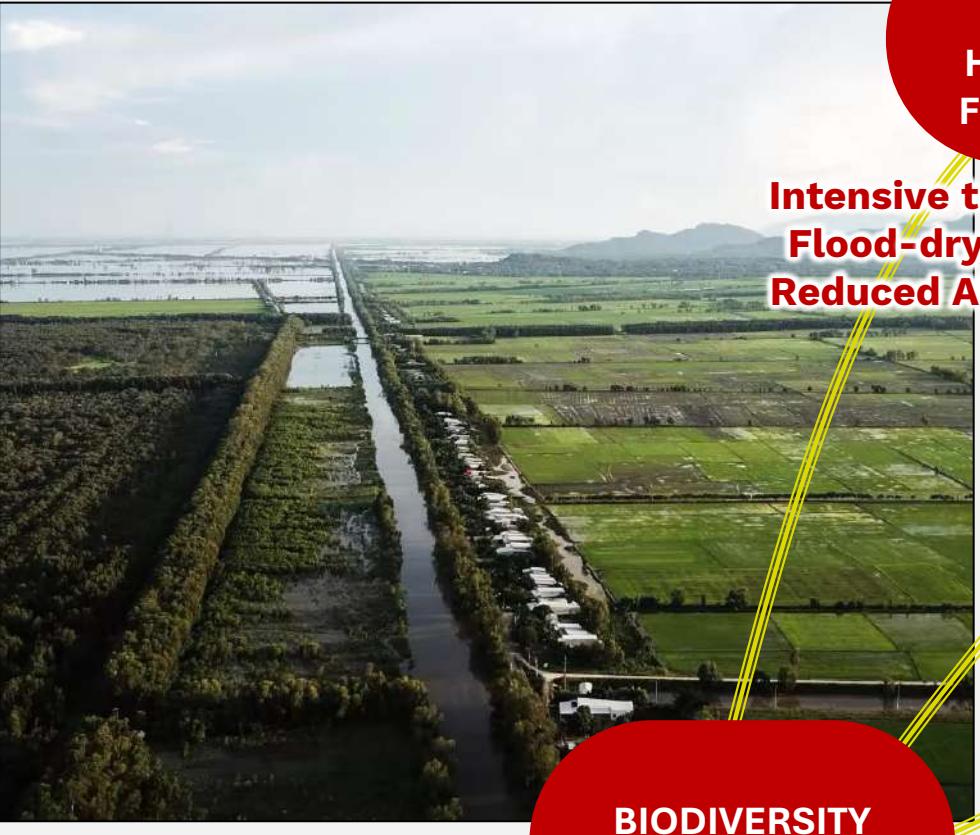
**Cổng vào Khu DLST Rừng Tràm Trà Sư
MEKONG RIVER DELTA**



Tra Su Melaleuca Forest, Tinh Bien town, An Giang Province, Vietnam

Cổng vào Khu DLST Rừng Tràm Trà Sư

UPSTREAM HYDROPOWER DAMS, LARGE-SCALE DYKES, RIVER REGULATION



DISRUPTED
NATURAL
HYDROLOGY &
FLOOD CYCLES

Intensive triple-crop rice farming
Flood-dry Season Cycle altered
Reduced Alluvial deposit delivery

BIODIVERSITY
DECLINE

UNSUSTAINABLE
AGRICULTURAL
PRACTICES

Intensive Monocropping
Overuse of fertilizers

LOSS OF
SEDIMENT &
SOIL FERTILITY

Land subsidence
Weak Soil Structure

DECLINING
WATER QUALITY
&
CONNECTIVITY

Water scarcity in dry seasons
Reduced Floodplain Connectivity

Native and Migratory fish species no longer able to access
floodplain habitats

Tra Su Melaleuca Forest, Tinh Bien town, An Giang Province, Vietnam

Cổng vào Khu DLST Rừng Tràm Trà Sư

Restoration of
floodplain
ecology

Mimicking
natural flood
regimes

MAIN CONCEPTS of the project



Ecotone Area

Automated water
monitoring and
sluice regulation



Integrated
livelihoods and
Regenerative
farming

Tra Su Melaleuca Forest, Tinh Bien town, An Giang Province, Vietnam

Cổng vào Khu DLST Rừng Tràm Trà Sư



Ecotone Area



Tra Su Melaleuca Forest, Tinh Bien town, An Giang Province, Vietnam

Cổng vào Khu DLST Rừng Tràm Trà Sư

BIODIVERSITY REGENERATION

160ha Tra Melaleuca Forest
Regeneration
Re-established water flow
supporting fish species

RESTORED NATURAL WATER CYCLES & FLOOD DYNAMICS

Soil replenished with fertile
alluvium
Aquatic Habitats restored

WATER- SENSITIVE AGRICULTURAL PRACTICES

Deep-water rice & fish
stocking
Natural buffers against
saline intrusion

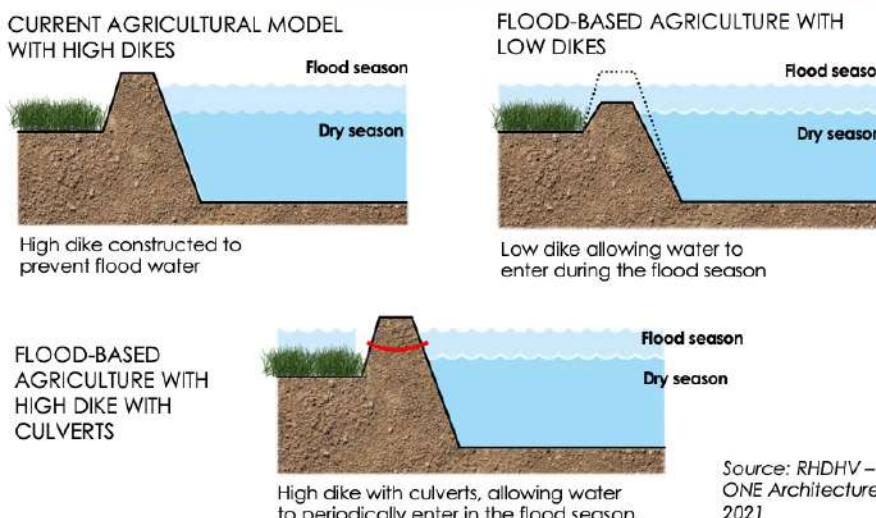
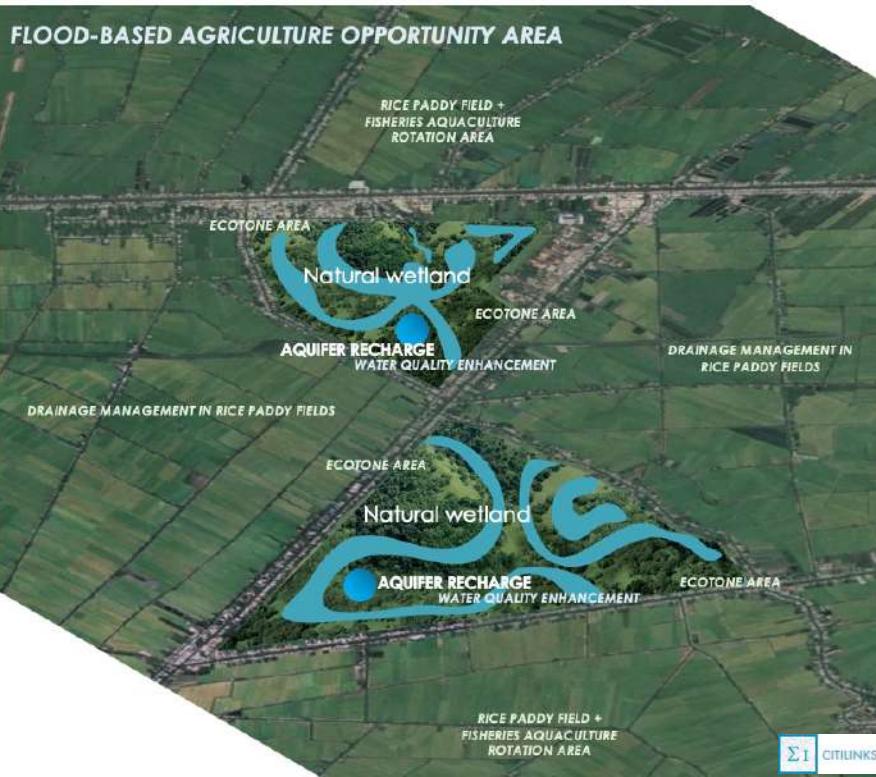
SOIL ENRICHMENT THROUGH FLOOD-BASED FARMING

Rice-fish-lotus integrated
systems
Sediment accumulation

**A Restorative NbS
Approach with 4
outputs**



NbS-44: FLOOD-BASED AGRICULTURE



PROJECT'S CHALLENGES & RISKS

- ❖ **Unpredictable Flood Patterns:** Climate change-induced variability in flood timing and intensity can disrupt agricultural cycles and reduce yields.
- ❖ **Land Use Conflicts:** Competing demands for floodplains, such as urban expansion or infrastructure development, can limit the availability of land for flood-based agriculture.
- ❖ **Community Adaptation:** Traditional knowledge of flood-based farming may be lost or insufficient, requiring significant training and capacity-building efforts.
- ❖ **Water Quality Issues:** Floodwaters may carry pollutants, such as agricultural runoff or industrial waste, posing risks to soil health and crop safety.

NbS co-BENEFITS AND THEIR INDICATORS

- **Increased Soil Fertility**
Improvement in soil organic matter content and nutrient levels (e.g., nitrogen, phosphorus) after flood events.
- **Enhanced Water Retention**
Higher groundwater recharge and sustained soil moisture during dry periods compared to non-flooded areas.
- **Improved Crop Resilience**
Higher crop survival rates during droughts or extreme weather events due to better soil moisture and nutrient availability.

- **Biodiversity Conservation**
Increased diversity of aquatic and terrestrial species in floodplain ecosystems, monitored through biodiversity indices.

- **Carbon Sequestration**
Measurable increase in soil carbon stocks, tracked by soil carbon content assessments post-flooding.
- **Strengthened Local Livelihoods**
Increased income from diversified agricultural activities and improved food security for local communities.

COST ANALYSIS

- **Direct Costs**
The costs of land preparation, flood management, and crop inputs range from \$300 to \$500 per ha annually.
- **Indirect Costs**
Between \$50 to \$150 per ha per year for training, extension services, and monitoring programs.
- **Time Horizon**
10 to 20 years, with a discount rate of 5-7% to reflect long-term benefits like soil fertility and water management.
- **Direct Benefits**
Increased crop yields provide direct economic benefits of \$100 to \$400 per ha annually.
- **Indirect Benefits**
Flood regulation and improved biodiversity can save \$50 to \$150 per ha annually in disaster risk reduction and ecosystem health.
- **Risk Assessment**
Unpredictable flood patterns may generate costs of \$50 to \$200 per ha annually for risk management or adaptive strategies.

REFERENCES:

Vietnam and Cambodia, Integrated Rice-Fish Farming Systems in the Mekong River Delta.
Cambodia, Floating Agriculture in Tonle Sap.

IMPLEMENTATION OPPORTUNITIES:

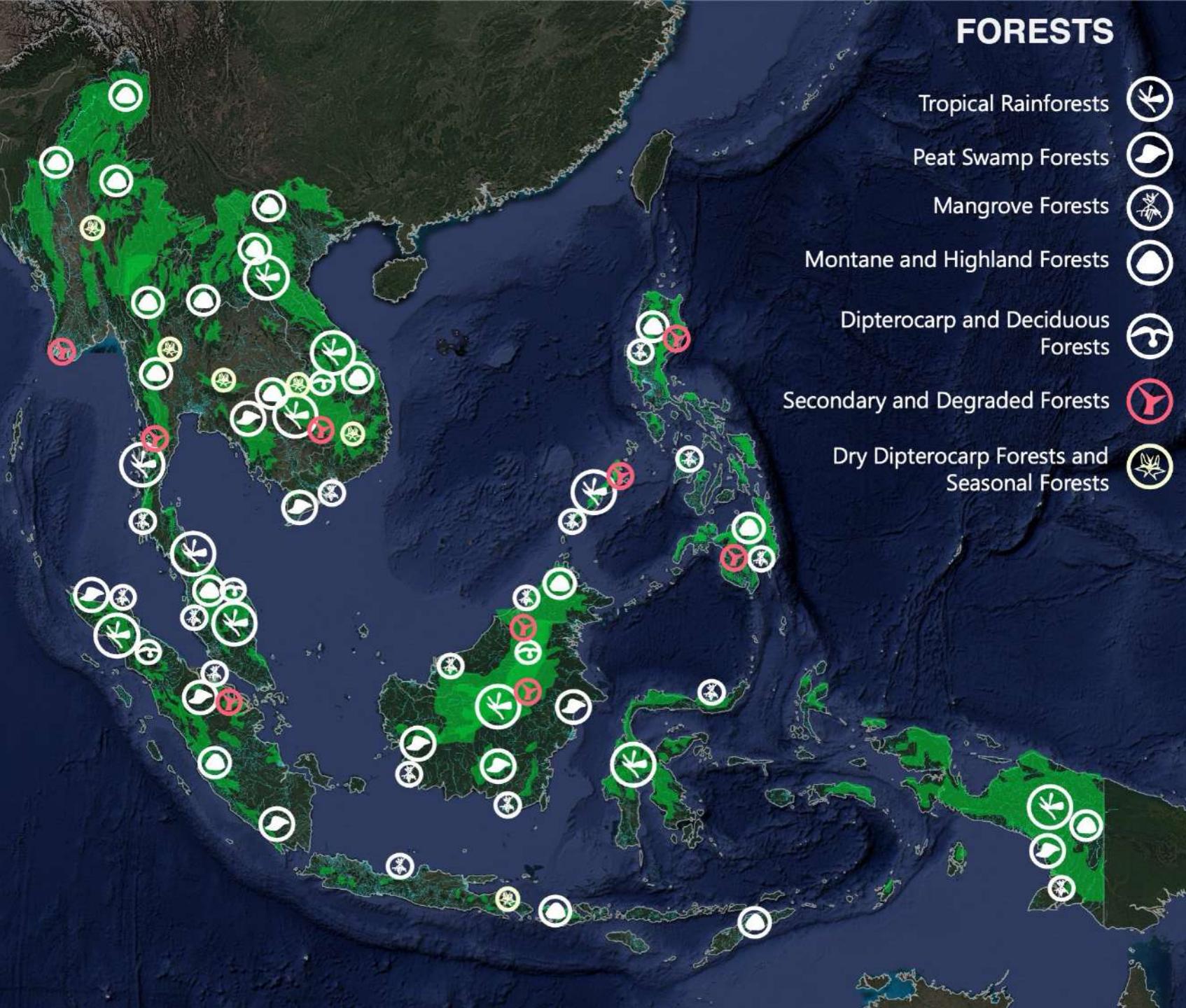
Thailand, Chao Phraya Basin.
Myanmar, Irrawaddy Delta.
Indonesia, South Kalimantan.
Vietnam, Mekong River Delta.

Rebuilding Ecological Integrity of Natural Landscapes:

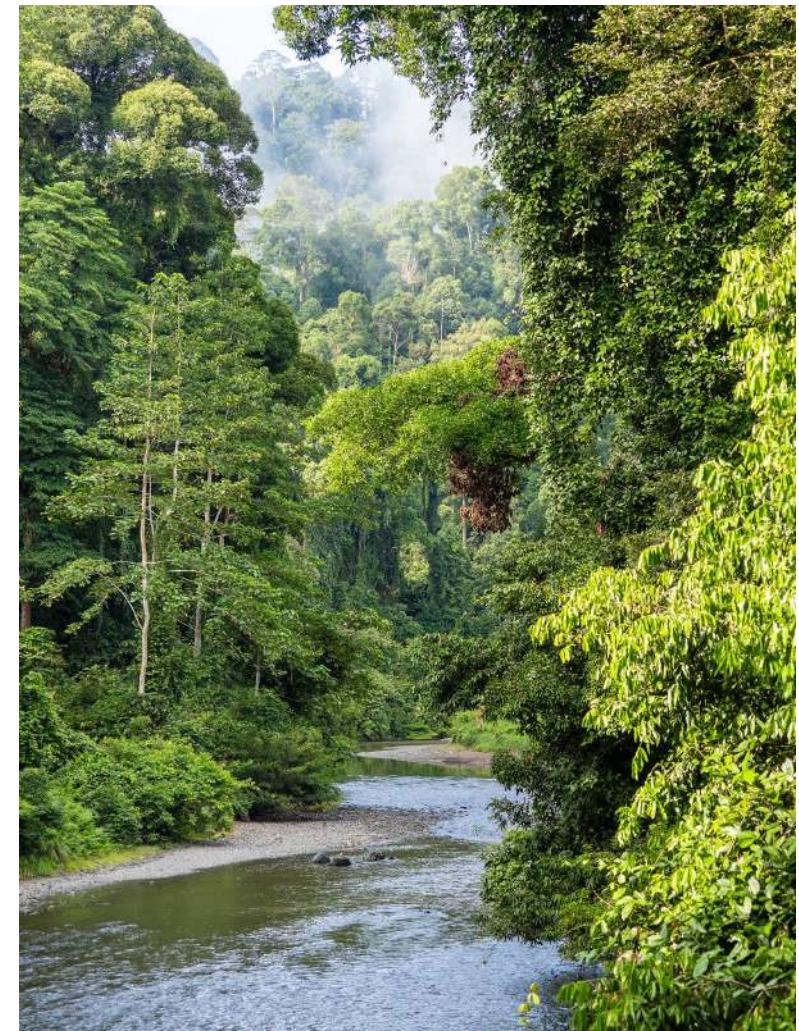
Nature-based Solutions as a pathway to recover biodiversity, stabilize soils and water regimes, and reconnect fragmented ecosystems

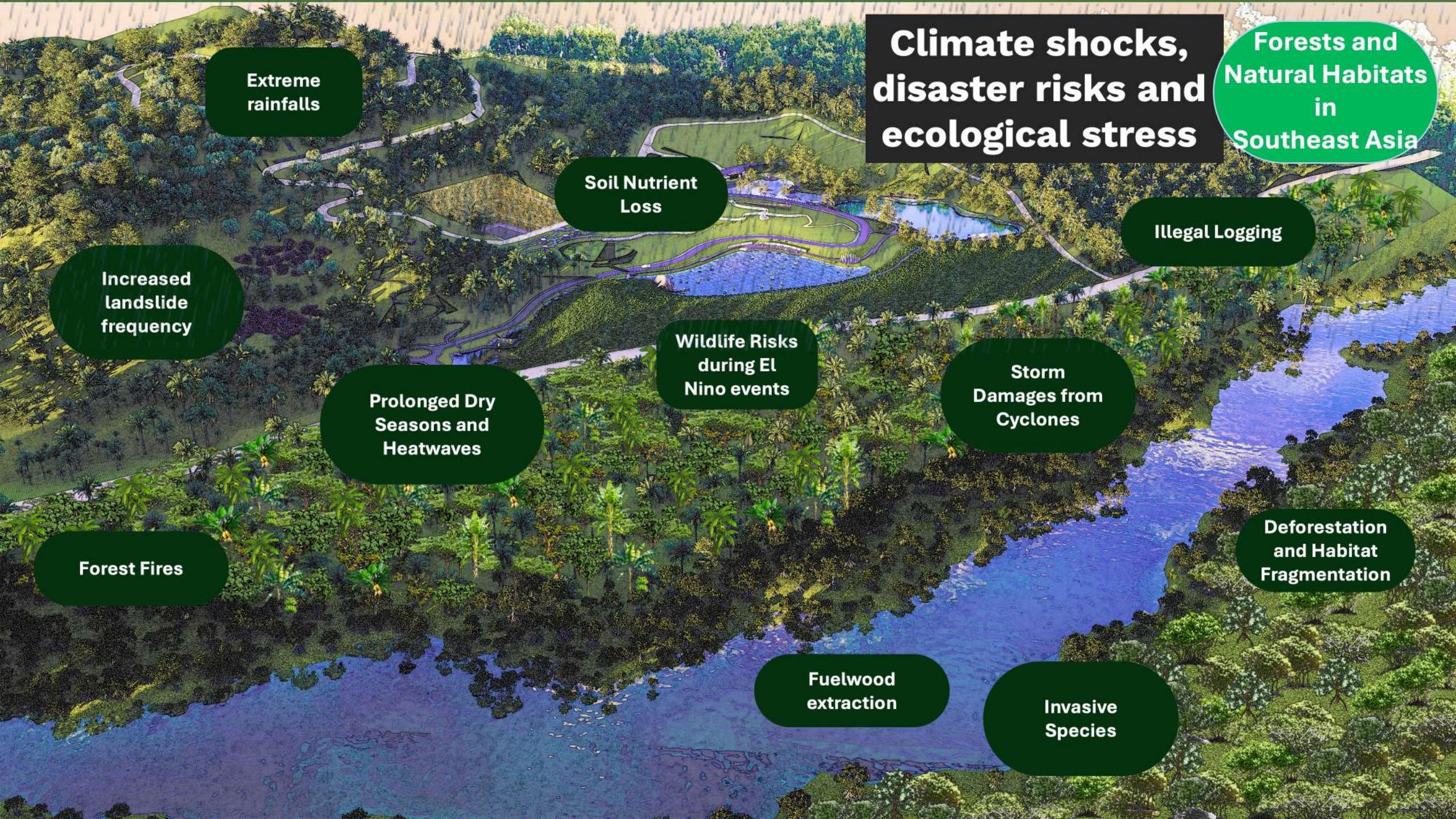


CSL07 Forests and Natural Habitats



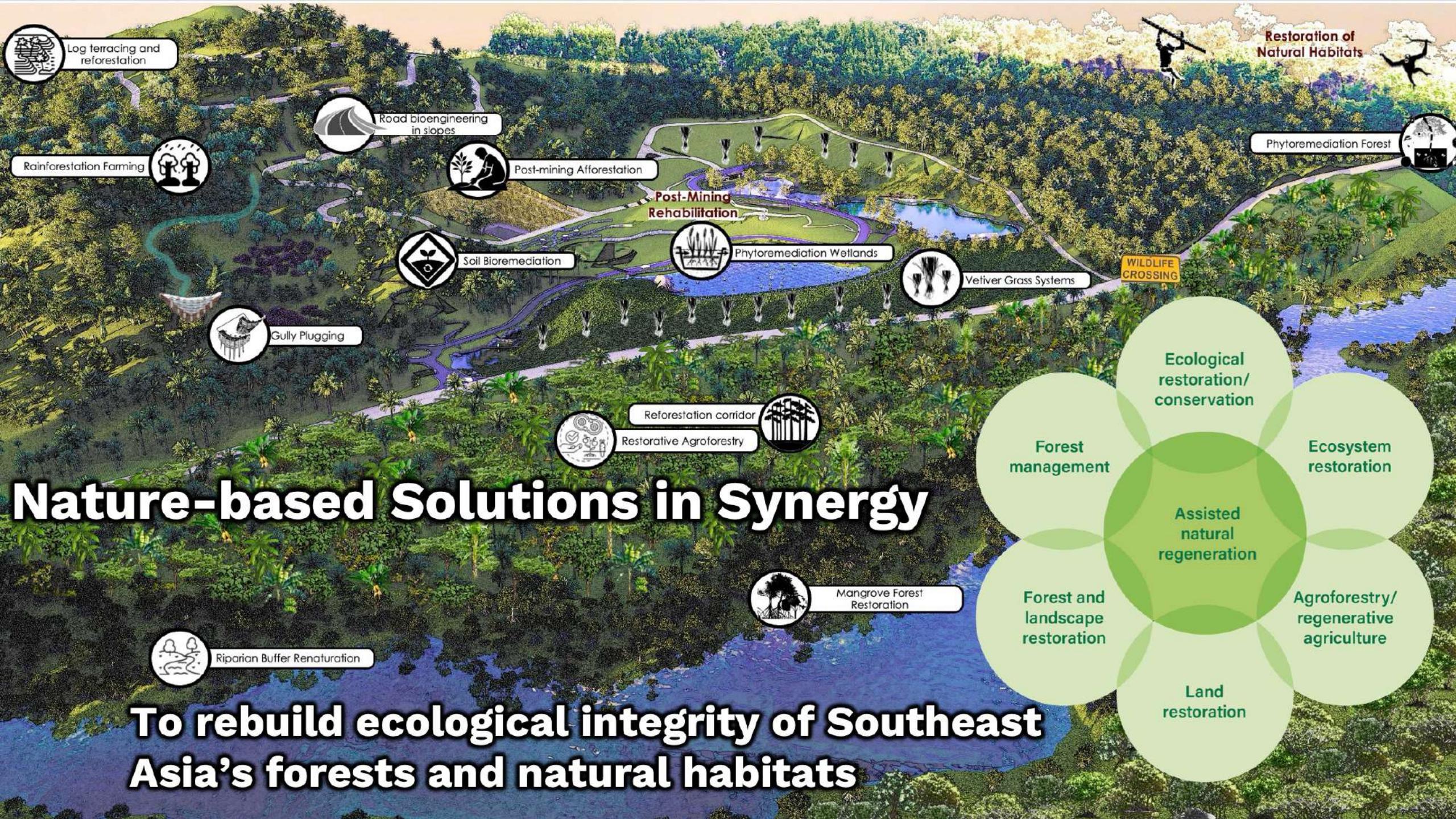
Forest Protection and Regeneration Through Nature-based Solutions





Climate shocks, disaster risks and ecological stress

Forests and
Natural Habitats
in
Southeast Asia





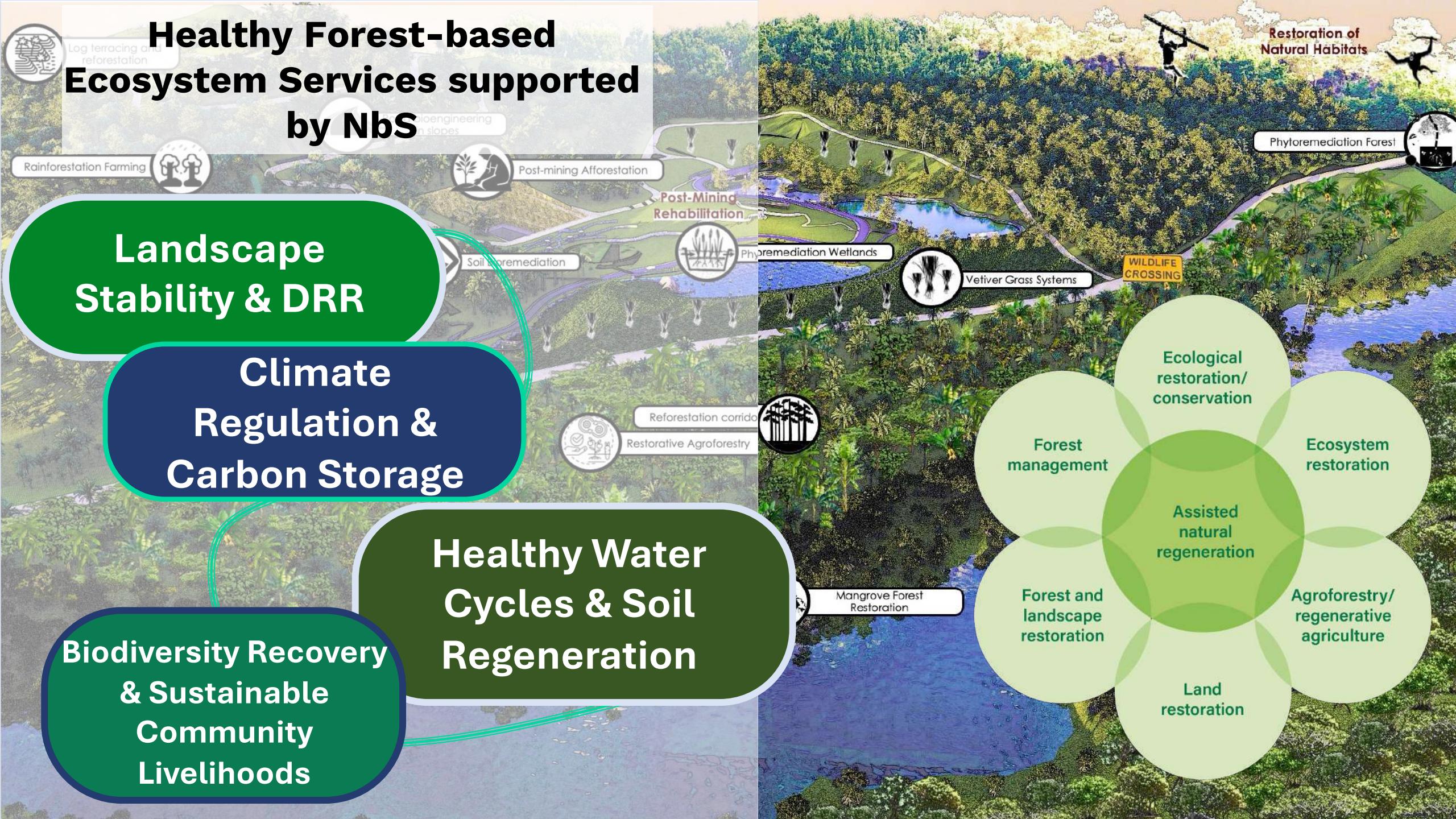
Healthy Forest-based Ecosystem Services supported by NbS

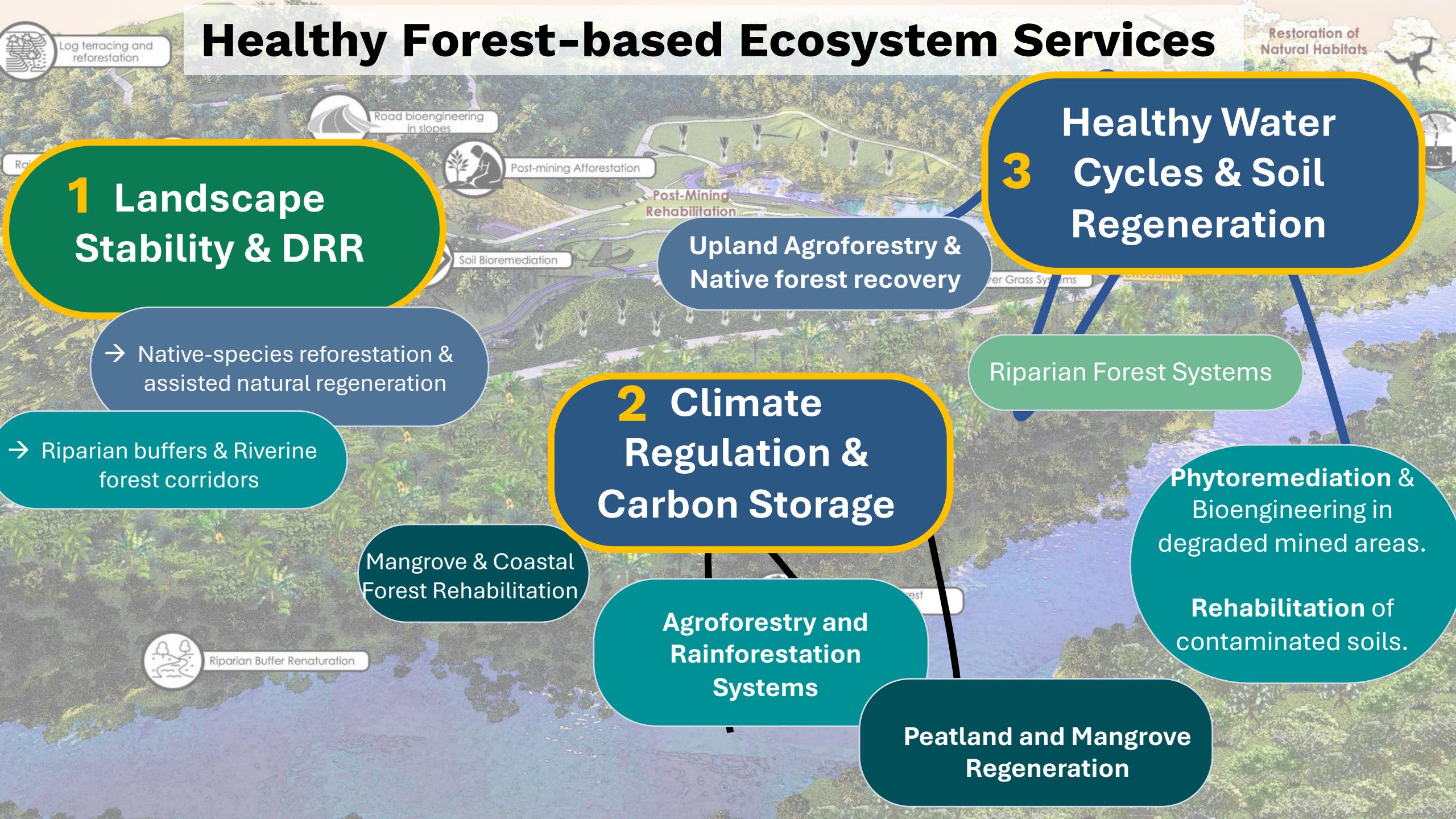
Landscape Stability & DRR

Climate Regulation & Carbon Storage

Biodiversity Recovery & Sustainable Community Livelihoods

Healthy Water Cycles & Soil Regeneration





Healthy Forest-based Ecosystem Services

1 Landscape Stability & DRR

→ Native-species reforestation & assisted natural regeneration

→ Riparian buffers & Riverine forest corridors

2 Climate Regulation & Carbon Storage

Mangrove & Coastal Forest Rehabilitation

Agroforestry and Rainforestation Systems

Peatland and Mangrove Regeneration

3 Healthy Water Cycles & Soil Regeneration

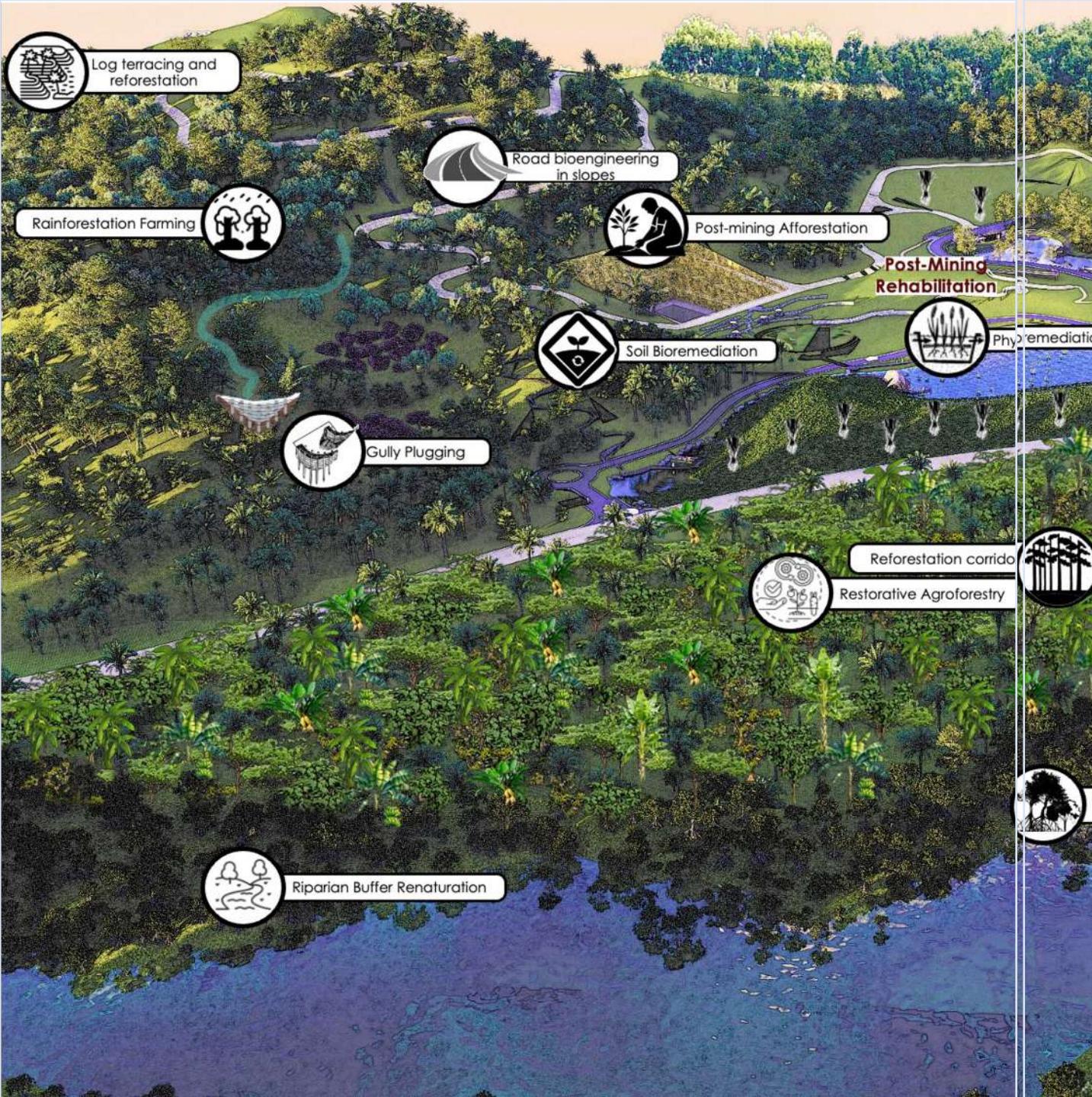
Riparian Forest Systems

Phytoremediation & Bioengineering in degraded mined areas.

Rehabilitation of contaminated soils.

Log terracing and reforestation

Restoration of Natural Habitats



Enablers

Integrated Forest-Land-Water Planning

Establish Ecosystem Restoration Concessions (ERC) with Production-Protection Models

*Cross-border Conservation Mechanisms
In mountains and watersheds*

Policy Incentives for Sustainable Agroforestry

Blended climate finance, Payment for Ecosystem Services (PES), Biodiversity credits

Technical Capacity, Digital & Community-based Monitoring Tools

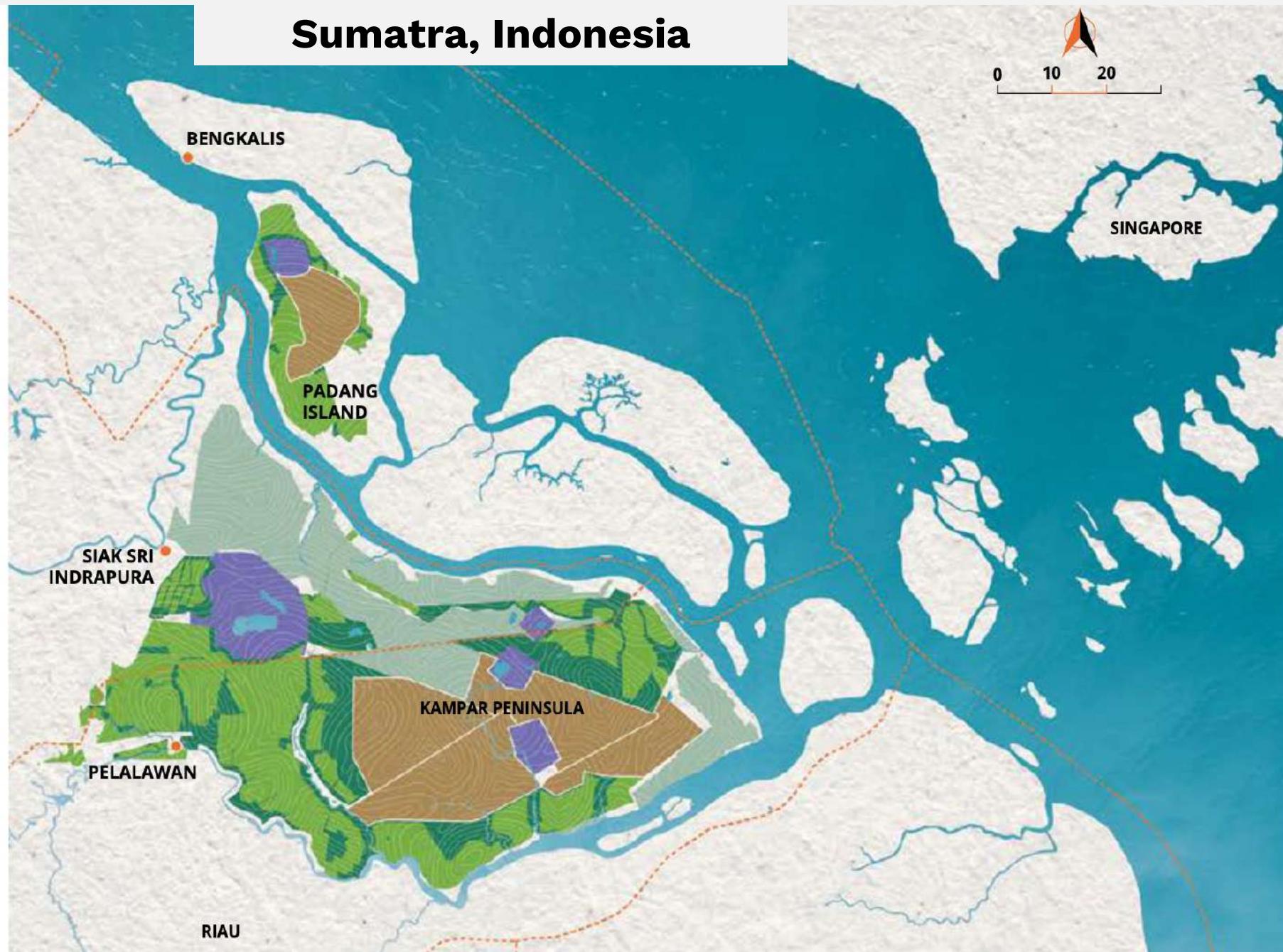
Restorasi Ekosistem Riau (RER) : Peat Swamp Forest Restoration

MAP OF RESTORASI EKOSISTEM RIAU (RER)

Kampar Peninsula +
Padang Island



- RESTORASI EKOSISTEM RIAU (RER)
- APRIL CONSERVATION
- APRIL PLANTATION
- CONSERVATION AREA
- OTHER COMPANIES



Restorasi Ekosistem Riau (RER) : Peat Swamp Forest Restoration

Sumatra, Indonesia



Restorasi Ekosistem Riau (RER) : Peat Swamp Forest Restoration

Sumatra, Indonesia

CASCADING PROBLEMS
ACCUMULATING IN SOIL AND
HYDROLOGY, FIRE RISKS,
BIODIVERSITY LOSS, WATER
DYNAMICS

SELECTIVE
LOGGING,
ENCROACHMENT

Timber, pulpwood, oil palm plantations
Land Use Conversion Pressures

CANAL
EXCAVATION,
SLASH & BURN
CLEARING

Canal Networks have
lowered water tables
Hydrological functions down

DEGRADATION
OF PEATLAND
and SOIL
STRUCTURE

Fire Risks, Carbon
Emissions rising
Loss of intact forest
habitat

DOWNTSTREAM
& REGIONAL
RISKS

LOSS OF NATIVE
VEGETATION and
BIODIVERSITY

Reduced population
of moisture-
dependent species

Peat Subsidence (soil compaction after
drainage) increases flood risks

Restorasi Ekosistem Riau (RER) : Peat Swamp Forest Restoration

Sumatra, Indonesia

**SHIFT from
Forest
Restoration to
Ecosystem
Function
Restoration**

**The Approach:
Reframe the
problem from
“tree loss” to
“ecosystem
malfunction”**

**Diagnose the
landscape at
the peat dome
scale, not plot
scale**

**Identify the Root
Driver, not the
visible symptom**

**Integrate People
as co-Managers
of Risk, not
beneficiaries**

**Accept Natural
regeneration as
the default**

**Prioritize
Prevention over
Repair**

Restorasi Ekosistem Riau (RER) : Peat Swamp Forest Restoration

Sumatra, Indonesia

RESTORATION
OF 150,000 HA
OF PEAT SWAMP
FOREST

BIODIVERSITY
RESILIENCE
THROUGH
MONITORING

ZERO REPORTED
FIRE INCIDENTS
REPORTED
RECENTLY

A Restorative NbS
Approach with 4
outputs

INCREASED
LOCAL
EMPLOYMENT

Plantation as
Buffer Zone

Conservation

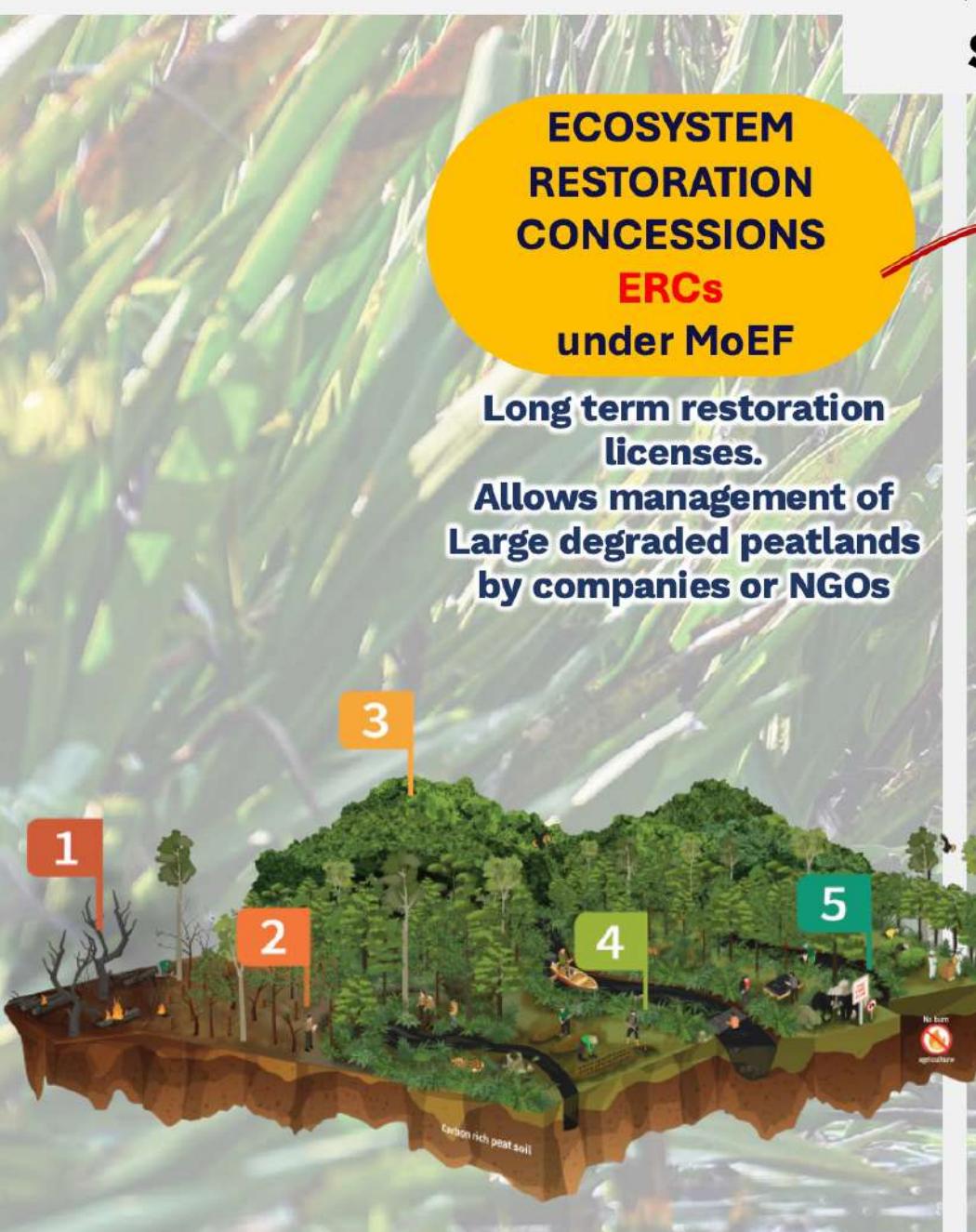
Community
Settlements
& Agriculture



→ Production-protection integrated landscape model

Restorasi Ekosistem Riau (RER) : Peat Swamp Forest Restoration

Sumatra, Indonesia



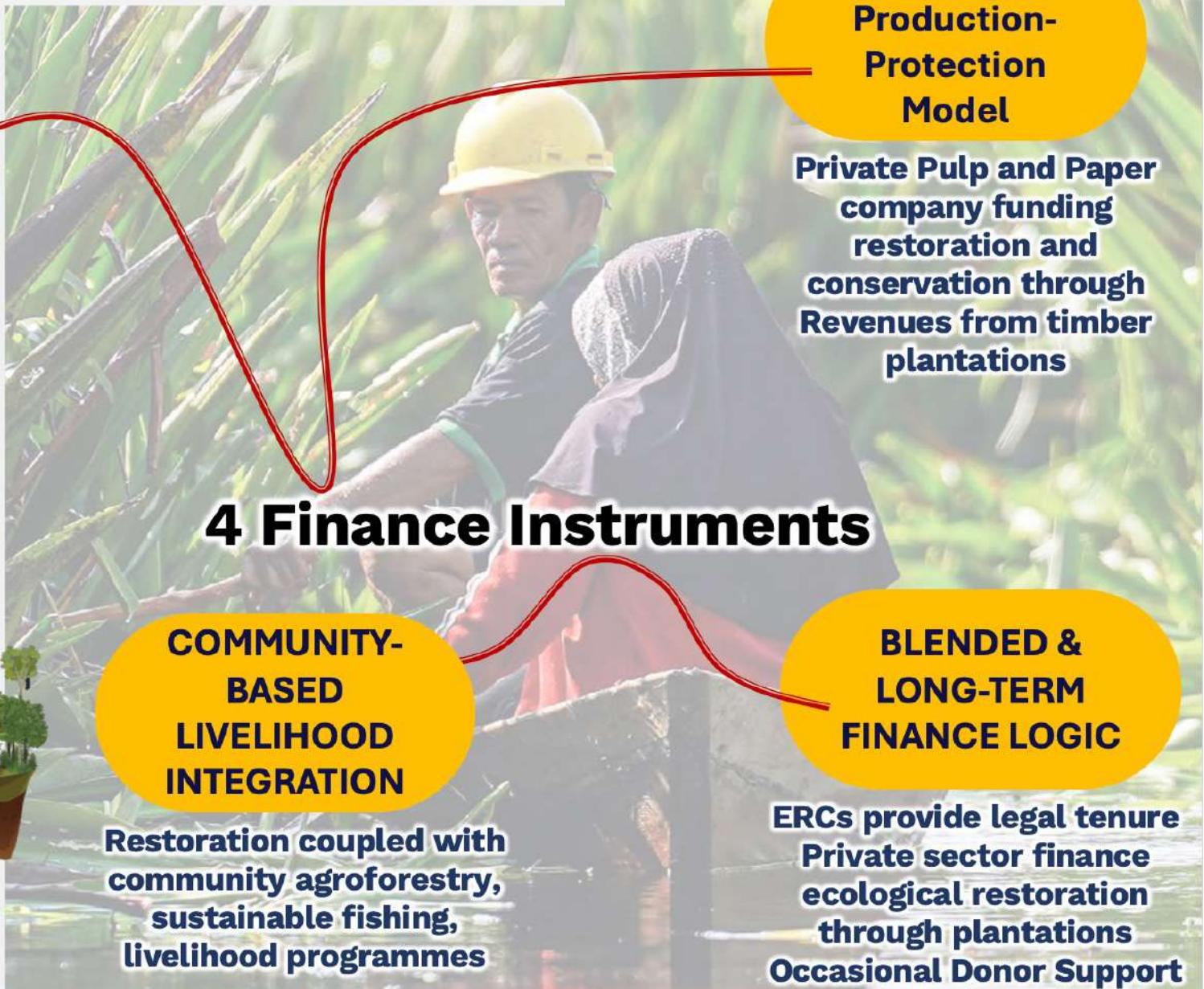
ECOSYSTEM RESTORATION CONCESSIONS

ERCs

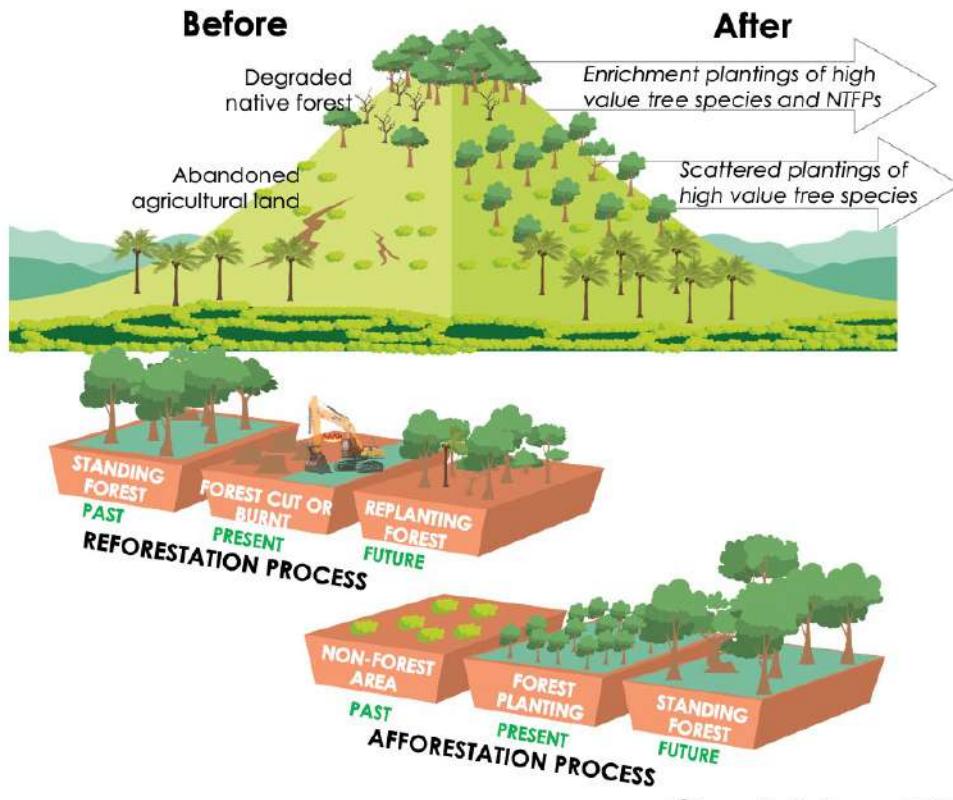
under MoEF

Long term restoration licenses.

Allows management of Large degraded peatlands by companies or NGOs



NbS-57: UPLAND REFORESTATION, AFFORESTATION AND AGROFORESTRY



LANDSCAPES SUPPORTED



EbA (ECOSYSTEM-BASED APPROACHES)

- FOREST LANDSCAPE RESTORATION
- AGROECOLOGICAL PRACTICES
- WATERSHED MANAGEMENT
- SUSTAINABLE RESOURCE MANAGEMENT
- WILDLIFE HABITAT CREATION
- CLIMATE CHANGE MITIGATION

MAIN PROBLEMS ADDRESSED



Upland reforestation, afforestation, and agroforestry are vital nature-based solutions (NbS) for addressing reforestation needs in the slopes, valleys, and upland areas of Southeast Asia, where rapid deforestation, land degradation, and extreme weather events threaten ecosystems and local livelihoods. These approaches focus on restoring degraded forests, establishing new forested areas (afforestation), and integrating trees with agricultural practices (agroforestry) to stabilize slopes, reduce soil erosion, mitigate landslides, and enhance water retention.

By blending native species with fruit or timber-yielding trees, agroforestry systems balance biodiversity conservation with sustainable resource use, benefiting local communities economically and ecologically. Reforestation efforts in montane tropical rainforests, dry deciduous forests, and mangroves also enhance carbon sequestration, provide critical wildlife habitats, and regulate hydrological cycles, reducing the risks of floods and sedimentation in valleys.

These NbS approaches foster community engagement, create livelihood opportunities, and restore ecological integrity, making them indispensable for building resilient landscapes and promoting sustainable development in Southeast Asia.

ECOSYSTEM SERVICES AND ACTIONS

SUPPORTING

- Soil Formation and Fertility:** Trees improve soil structure, prevent erosion, and enhance nutrient cycling for long-term agricultural productivity.

REGULATING

- Water Regulation:** Forests stabilize water cycles by reducing runoff, improving infiltration, and maintaining groundwater recharge.
- Climate Regulation:** Tree cover sequesters carbon, reduces heat islands, and mitigates local and global climate impacts.

PROVISIONING

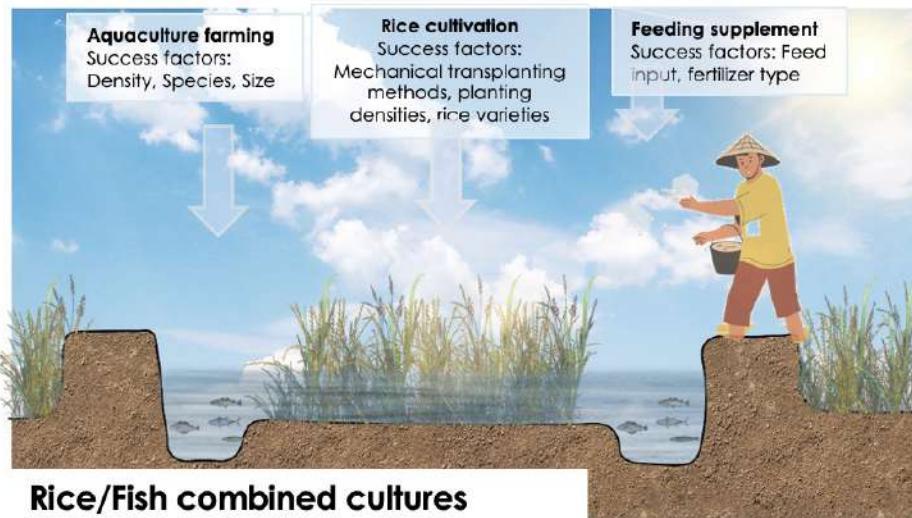
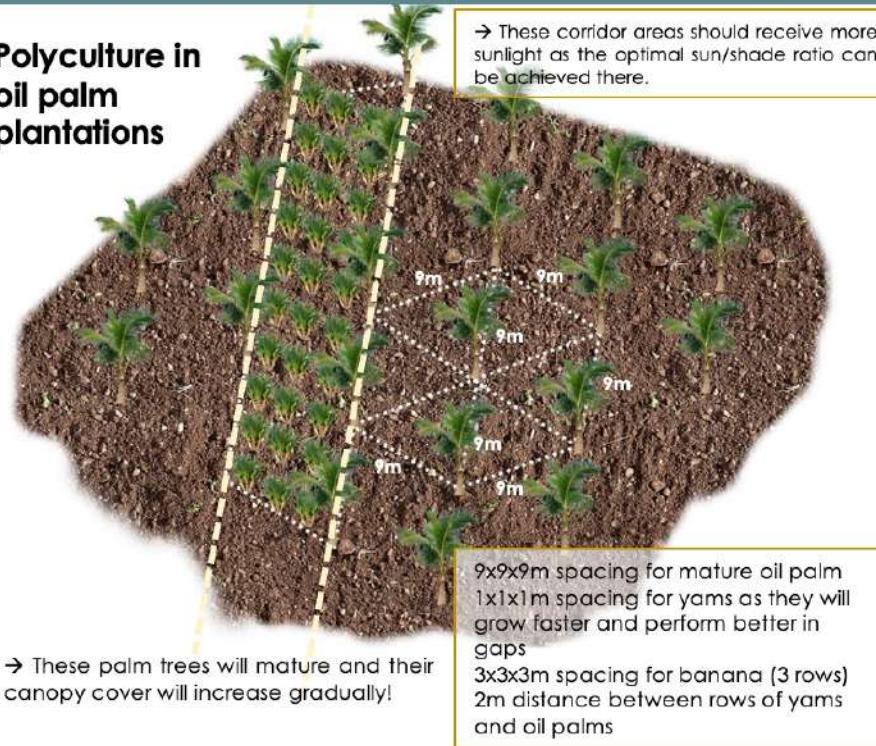
- Timber and Non-Timber Products:** Sustainable harvesting of wood, fruits, and medicinal plants for economic and subsistence use.

SOCIAL BENEFITS

- Livelihood Enhancement:** Agroforestry systems create diverse income sources for rural communities.
- Disaster Resilience:** Trees reduce landslide risks and buffer communities from floods, protecting lives and assets.

NbS-45: POLYCULTURE & CROP ROTATION

Polyculture in oil palm plantations



PROJECT'S CHALLENGES & RISKS

- ❖ **Knowledge and Training Gaps:** Lack of access to knowledge and training on effective polyculture and crop rotation techniques.
- ❖ **Market Accessibility and Demand:** Diverse crop production may face challenges in reaching markets that favour monoculture crops with established supply chains.
- ❖ **Initial Labor and Management Intensity:** Polyculture and crop rotation require more planning, labor and monitoring compared to conventional monoculture practices.
- ❖ **Climatic Variability and Pests:** Unpredictable weather patterns and emerging pests can disrupt crop cycles and affect the success of rotational or mixed farming systems.

NbS co-BENEFITS AND THEIR INDICATORS

- **Enhanced Soil Fertility**
Increased organic matter and nutrient cycling, measured by higher soil organic carbon levels.
- **Improved Biodiversity**
Greater species richness on farms, tracked through the number of plant, insect, and bird species observed.
- **Reduced Dependency on Chemical Inputs**
Decreased use of synthetic fertilizers and pesticides, measured by lower annual expenditure on agrochemicals per hectare.
- **Climate Resilience**
Increased yield stability during extreme weather events, measured by year-on-year production variability.
- **Livelihood Diversification**
More income sources for farmers, tracked through the percentage of households with multiple crop-based revenue streams.
- **Water Efficiency**
Improved water retention and reduced irrigation needs, measured by decreased water use per ton of crop yield.

COST ANALYSIS

- **Direct Costs**
Seeds, tools, and training range around \$1000/ha, depending on crop types and land preparation requirements.
- **Indirect Costs**
Knowledge transfer and community engagement costs around \$200/farmer/year.
- **Time Horizon**
Implementation spans 2–5 years for significant results.
- **Direct Benefits**
Increased crop yields and reduced input costs lead to net revenue gains of \$300 to \$700/ha/year.
- **Indirect Benefits**
Ecosystem services like improved pollination and reduced soil erosion.
- **Risk Assessment**
Risks from market volatility and pest outbreaks could cause losses of projected revenues.

REFERENCES:

Integrated Farming Systems Project, Mindanao region, **Philippines**.
Agroecology Learning Alliance in Southeast Asia (ALSEA), **Cambodia, Laos, Myanmar**
Zero Budget Natural Farming (ZBNF), **India**

IMPLEMENTATION OPPORTUNITIES:

Mekong Delta, Vietnam: Polyculture of salt-tolerant crops, rice and aquaculture integrated into rotation systems.
Northern Uplands, Laos: Shifting cultivation and deforestation contexts.
Central Dry Zone, Myanmar: Polyculture with drought-resistant crops to address low rainfall and soil erosion.

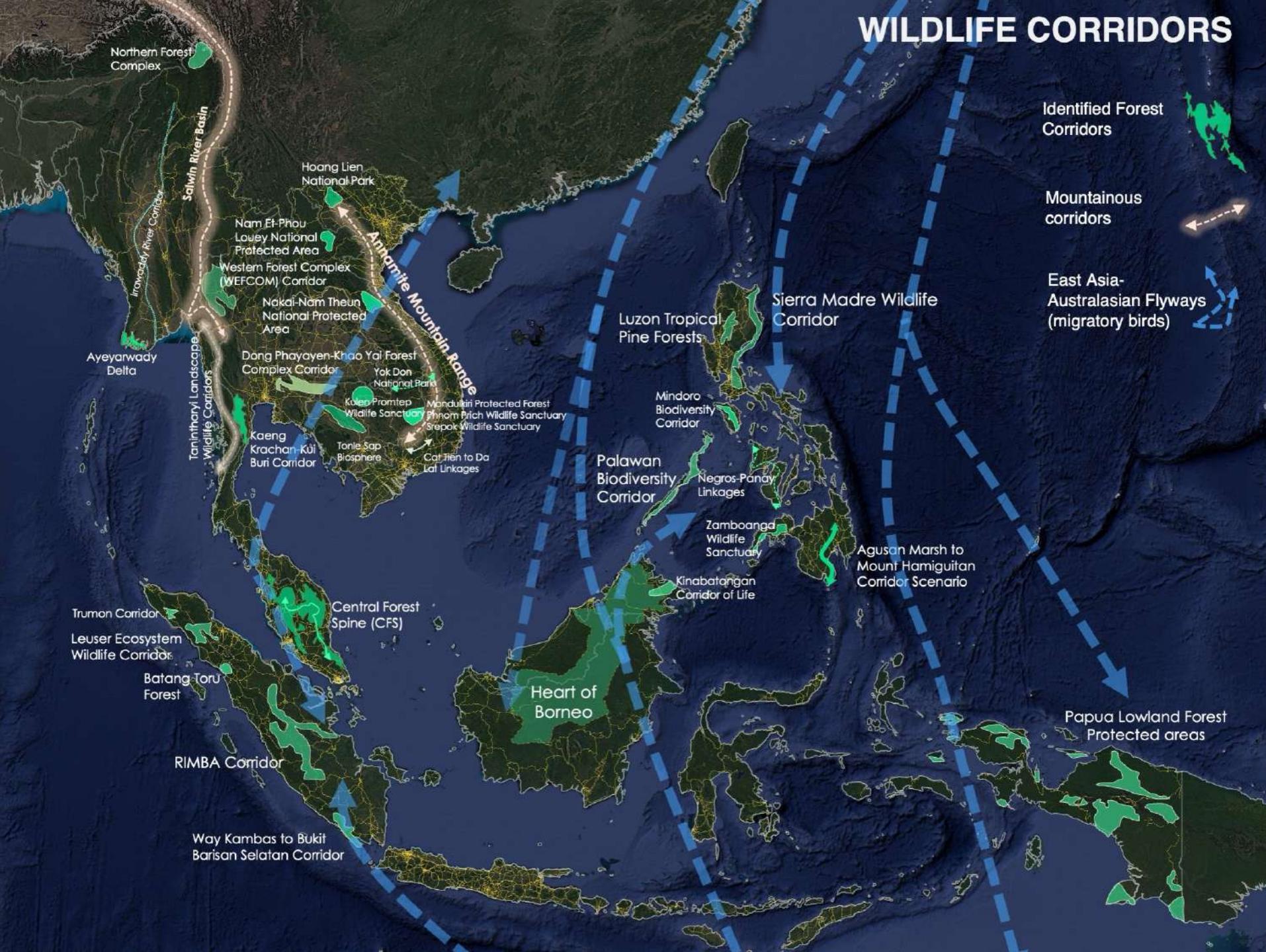
Connecting Landscapes through Wildlife Corridors for Resilient Ecosystems:

Restore and link habitats, enabling species movement, genetic exchange, and ecosystem resilience across fragmented rural and natural landscapes.



CSL08 Wildlife Corridors & Ecological Connectivity

WILDLIFE CORRIDORS



Enhancing and
Expanding Wildlife
Corridors Through
Nature-based Solutions



Climate shocks, disaster risks and ecological stress

Wildlife Corridors in Southeast Asia



Can Spatial Planning become a Safeguard of Ecological Integrity ?



How can spatial planning leverage Nature-based Solutions to maintain peatland hydrology, protect biodiversity, and ensure ecological connectivity amid rapid land conversion?

Can Spatial Planning become a Safeguard of Ecological Integrity ?

How can spatial planning around the Selangor River leverage Nature-based Solutions to maintain peatland hydrology, protect biodiversity, and ensure ecological connectivity amid rapid land conversion?

Selangor River



Nature-based Solutions in Synergy

To relink habitats and enable movements of species for a better ecosystem resilience

Enhancing and Expanding Wildlife Corridors Through Nature-based Solutions

Habitat Continuity & Landscape Connectivity

Buffering & Human-Wildlife Coexistence Services

Riverine, Wetland restoration for Flyway & Amphibian routes



Enhancing and Expanding Wildlife Corridors Through Nature-based Solutions

1

Habitat Continuity & Landscape Connectivity

2

Buffering & Human-Wildlife Coexistence Services

3

Riverine, Wetland restoration for Flyway & Amphibian routes

→ Corridor reforestation between AHP protected areas

→ Native forest restoration and assisted regeneration

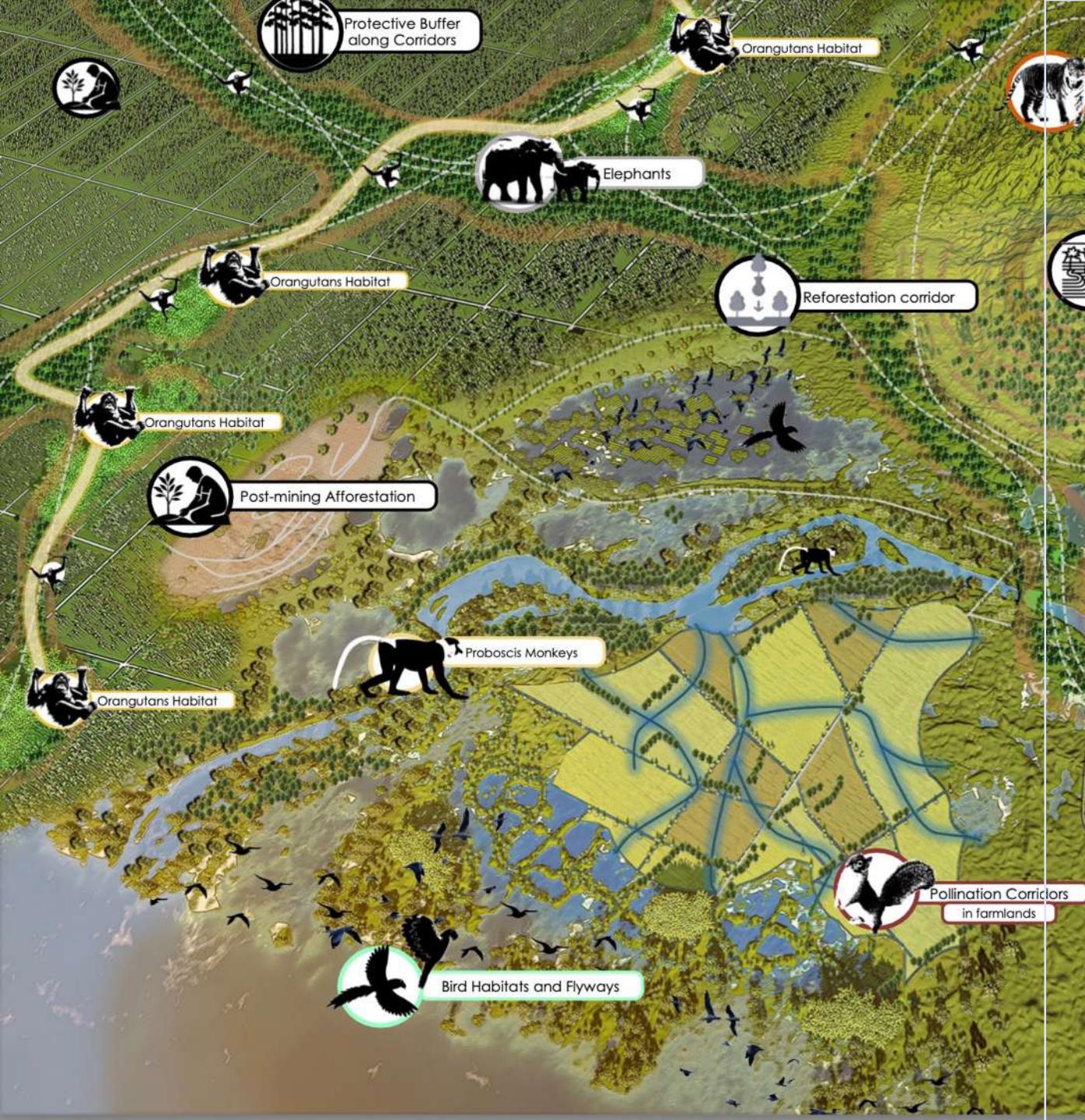
→ Ecological bridges, canopy linkages, wildlife underpasses

Climate-buffer Landscapes: low conflict / semi-natural matrix

Community-managed buffer zones, eco-tourism

→ Riparian and wetland restoration for flyways and amphibian routes

→ Wetland – forest – coastal NbS linkages, Upland-Coastal Ecological Planning



Enablers

Cross-border coordination frameworks

Integrated Landscape Management / Spatial Planning

Flyway Conservation Partnerships
Joint patrols/anti-poaching networks

Livelihood diversification

Conflict mitigation strategies

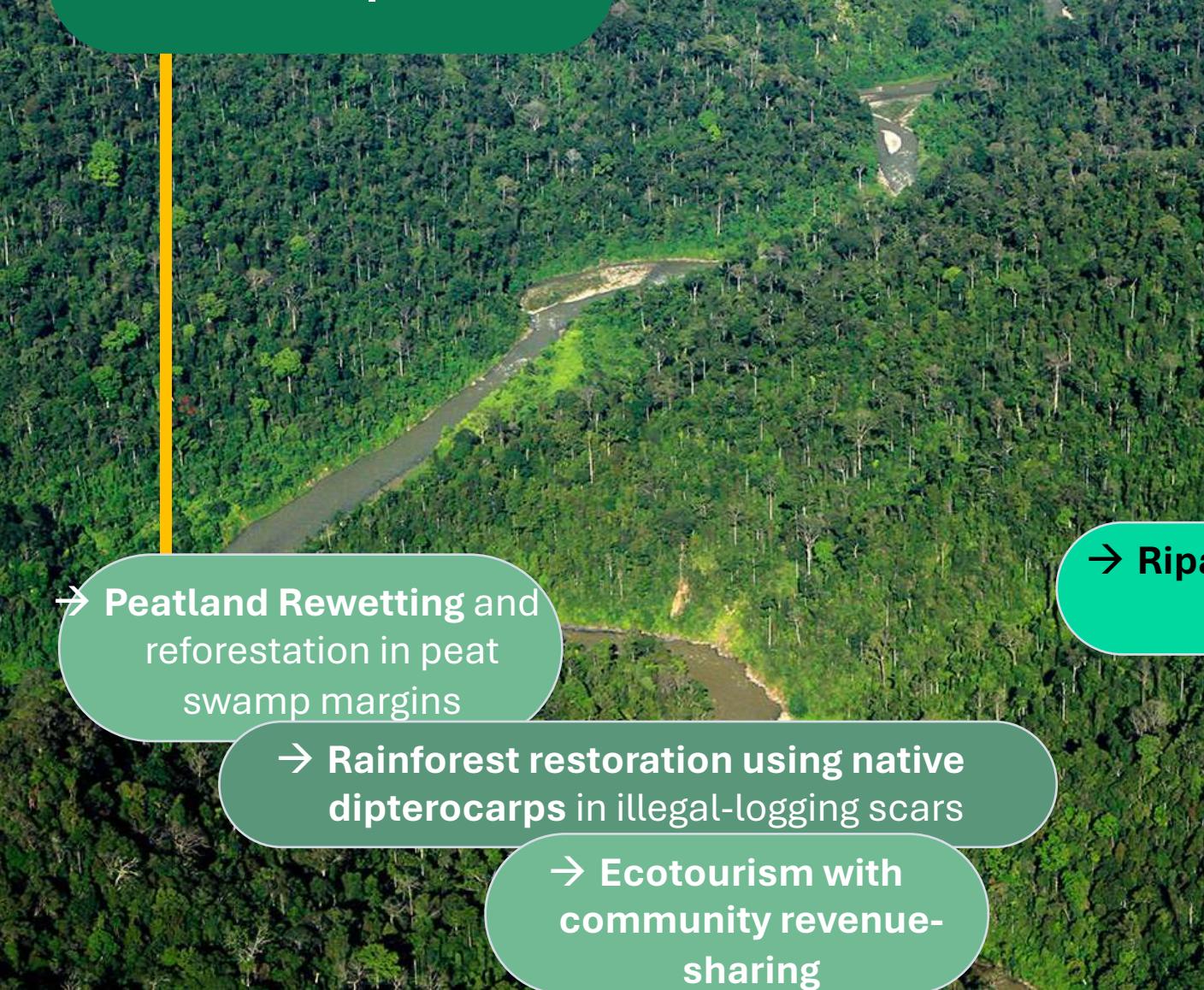
Finance & Incentive Instruments:
GCF for Corridor Restoration
Forest Carbon Finance REDD+
Biodiversity offsets
Conservation trust funds (long term financing mechanisms for AHP)

Gunung Leuser National Park, Indonesia

Restoration of
Natural Habitats



NbS now in practice



→ Peatland Rewetting and
reforestation in peat
swamp margins

→ Rainforest restoration using native
dipterocarps in illegal-logging scars

→ Ecotourism with
community revenue-
sharing

NbS potential

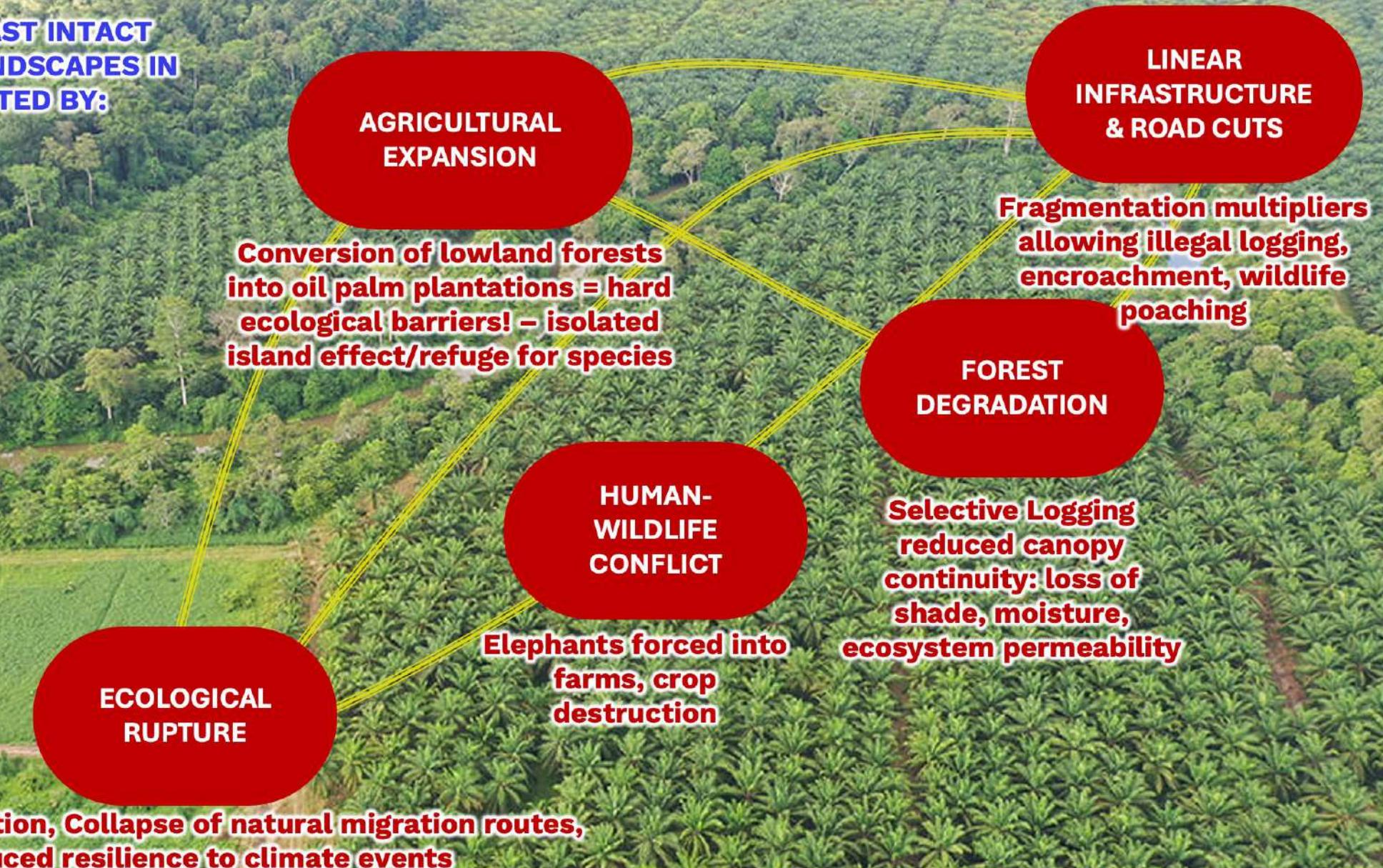


→ Riparian NbS in Aceh's river systems to reduce
flood impacts and sedimentation

→ Forest buffers
protecting the
interface with palm-
oil plantations

Gunung Leuser National Park, Indonesia

ONE OF THE LAST INTACT
RAINFOREST LANDSCAPES IN
SEA, AFFECTED BY:



Gunung Leuser National Park, Indonesia



**The Approach: Avoid a
"Corridor = Forest Strip"
Mindset !**

Identify ECOLOGICAL LINKAGES: River corridors, ridgelines, elephant movement routes

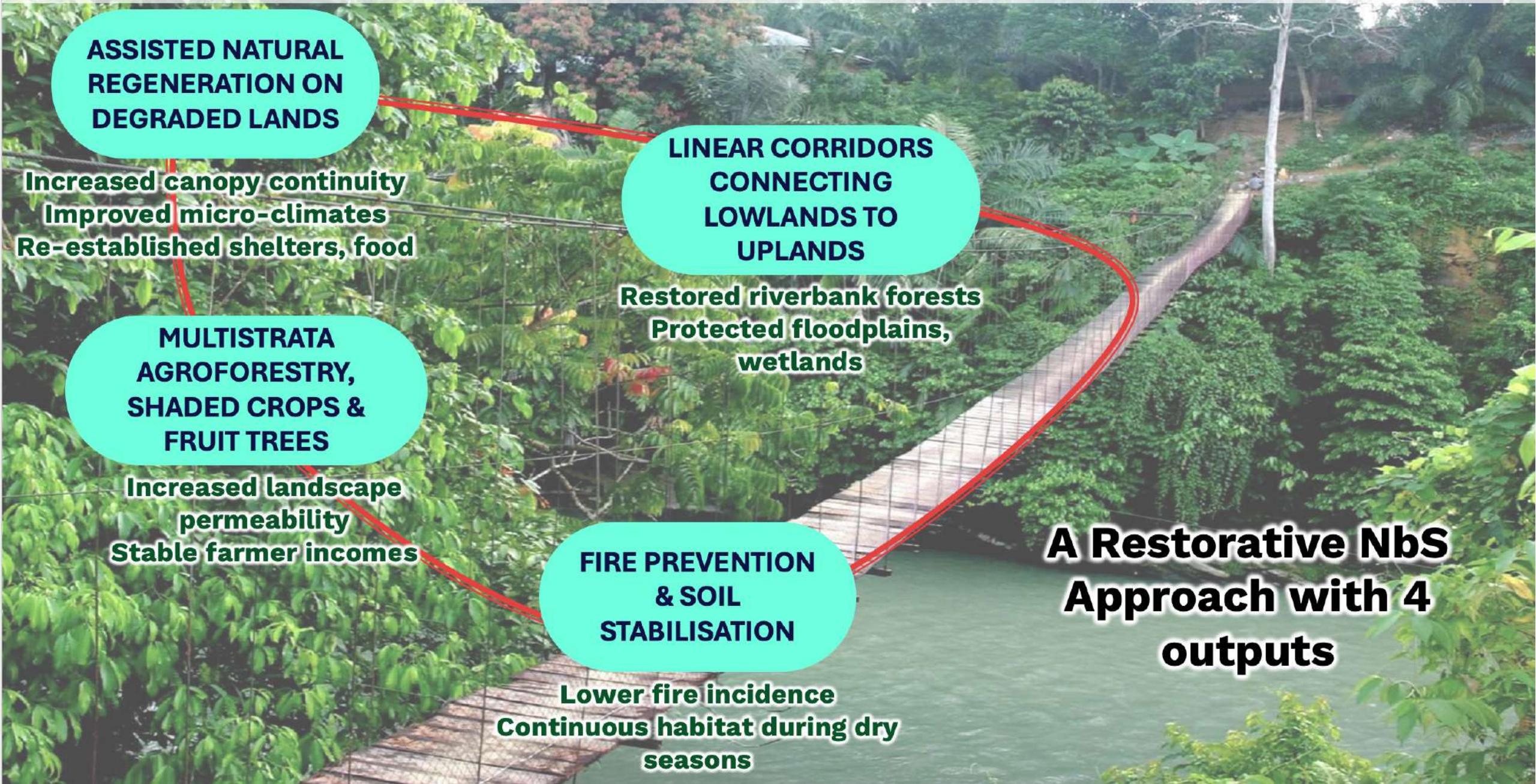
Functional Zoning: Core-Buffer-Corridor Mosaic

Human-Wildlife Coexistence as a Design Requirement:
early warning for elephants, land use agreements

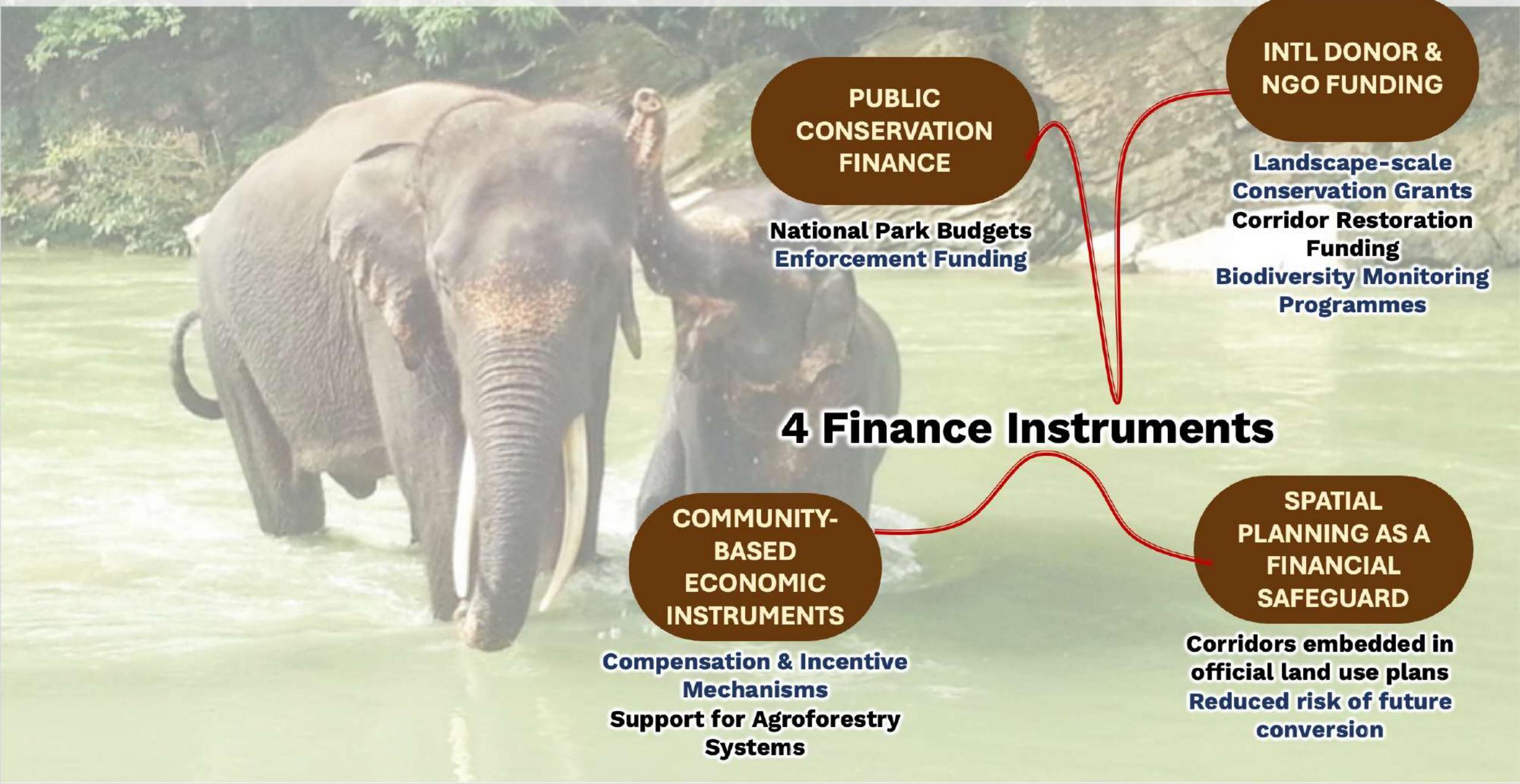
Institutional & Spatial Planning Integration

Conservation Strategies

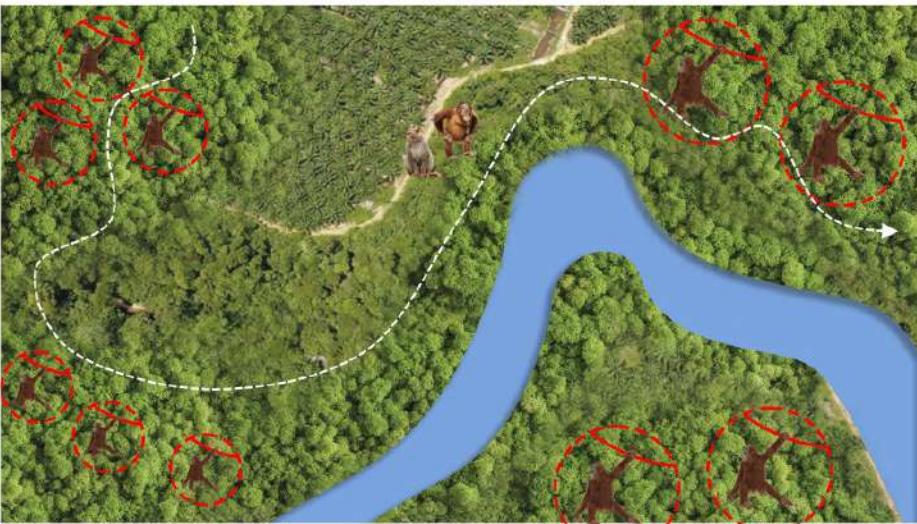
Gunung Leuser National Park, Indonesia



Gunung Leuser National Park, Indonesia



NbS-59: WILDLIFE MOBILITY LINKAGES



Mobility patterns of male orangutans in corridors passing across oil palm cultures



Overpasses for gibbons (India, Thailand)

PROJECT'S CHALLENGES & RISKS

- ❖ **Initial Costs and Maintenance:** Establishing rainforestation sites can be costly due to the need for native seedlings, technical training, and labour for site preparation.
- ❖ **Timeframe for Benefits:** Unlike fast-growing monocultures, native trees take longer to grow and produce economic returns, which may deter smallholder farmers who need short-term income.
- ❖ **Complexity of Implementation:** Successful implementation requires expertise in native species selection, site-specific ecosystem restoration, and sustainable farming practices.
- ❖ **Competition for Land:** Competition with other land uses like monoculture plantations or housing, especially in areas with high population pressure.

NbS co-BENEFITS AND THEIR INDICATORS

Biodiversity Restoration

Increase in native tree species richness per hectare by 50%-70% within 5 years.

Soil stabilisation and erosion control

Reduction in soil erosion rates by up to 60% on reforested slopes within 3 years.

Carbon Sequestration

Annual sequestration of 5-10 tons of CO₂ equivalent per hectare in mixed agroforestry systems.

COST ANALYSIS

● Direct Costs

Establishment costs of \$1,500-\$3,000 per hectare, including planting materials, labour, and training.

● Indirect Costs

\$500-\$1,000/ha annually for maintenance, monitoring, and opportunity costs of initial land-use changes.

● Time Horizon

20-30 years with a discount rate of 5%-7%, considering long-term ecological and livelihood benefits.

● Food Security Enhancement

Annual yield of agroforestry crops (e.g., coffee, cacao, or root crops) contributing to 20%-30% of household income within 3 years.

● Improved Watershed Protection

Reduction in peak runoff volume by up to 40% during heavy rains, improving downstream water quality.

● Community Resilience and Livelihood Support

30%-50% increase in income diversification among participating households due to tree products and agroforestry crops.

● Direct Benefits

\$2,000-\$4,000 per hectare annually from agroforestry yields like fruits, timber, and crops after 3-5 years.

● Indirect Benefits

Ecosystem services valued at \$5,000-\$7,000/ha annually, including carbon sequestration, water regulation, and biodiversity conservation.

● Risk Assessment

Medium risk due to potential challenges like invasive species, market access, and community buy-in.

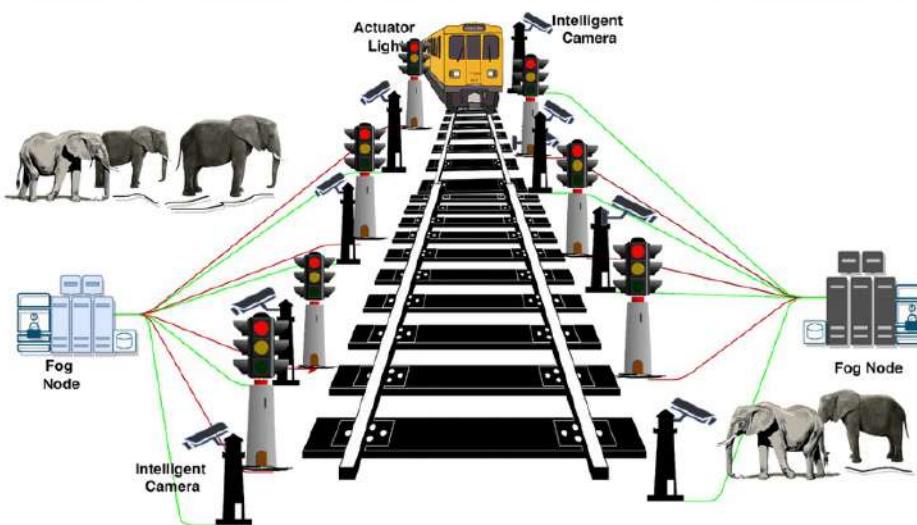
REFERENCES:

Mount Pangasugan, Leyte Rainforestation Initiative, the Philippines
Gunung Kidul Regency Forest Landscape Restoration, Java, Indonesia
Mae Chaem Watershed Agroforestry, Thailand

IMPLEMENTATION OPPORTUNITIES:

Timor Leste: Maubisse Highlands
Hilly areas of Quang Nam Province, Vietnam
Cardamom Mountains in Cambodia: agroforestry crops like durian and rambutan

NbS-61: ECO-SENSITIVE RAILWAY INFRASTRUCTURE



Design and Development of a Fog-Assisted Elephant Corridor over a Railway Track. Source: Manash Kumar Mondal, Riman Mondal, Sourav Banerjee

PROJECT'S CHALLENGES & RISKS

- ❖ **High Initial Costs:** Significant upfront investment for wildlife crossings, drainage systems, and vegetation restoration, which can strain project budgets.
- ❖ **Land Use Conflicts:** Acquiring land for eco-friendly designs, such as wildlife corridors, may face opposition from local communities or compete with agricultural and development needs.
- ❖ **Maintenance Complexity:** Ensuring long-term functionality of crossings, culverts requires regular monitoring and maintenance, which can be resource-intensive.
- ❖ **Wildlife Adaptation Challenges:** Some species may not immediately use the provided crossings due to poor placement or design choices.

NbS co-BENEFITS AND THEIR INDICATORS

● Soil Erosion Control

Reduced soil erosion rates, measured through sediment deposition and soil loss assessments.

● Flood Mitigation

Decreased surface runoff, evaluated by water retention capacity and reduced flood frequency in adjacent areas.

● Soil Fertility Restoration

Increased organic matter content and nutrient levels in the soil, measured by soil quality tests.

● Carbon Sequestration

Amount of carbon stored in vetiver biomass and soil, quantified through carbon sequestration assessments.

● Biodiversity Enhancement

Increased species diversity, tracked by monitoring the presence of native flora and fauna in areas integrated with VGS.

● Livelihood Improvement

Increase in local income, measured by sales of vetiver-based products or improved agricultural yields.

COST ANALYSIS

● Direct Costs

Vetiver grass system establishment costs (e.g., seedlings, planting, irrigation) range from \$500 to \$2,000 per ha.

● Indirect Costs

Costs related to monitoring, maintenance, and capacity building for local communities can amount to \$200 to \$500 annually per ha.

● Time Horizon

10-20 years time horizon with a discount rate of 5-10% to account for long-term benefits and costs.

● Direct Benefits

Increased agricultural productivity or reduced erosion.

● Indirect Benefits

Indirect benefits, such as carbon sequestration, improved water quality, and biodiversity enhancement, can yield estimated savings or gains of \$200 to \$1,000 per hectare annually.

● Risk Assessment

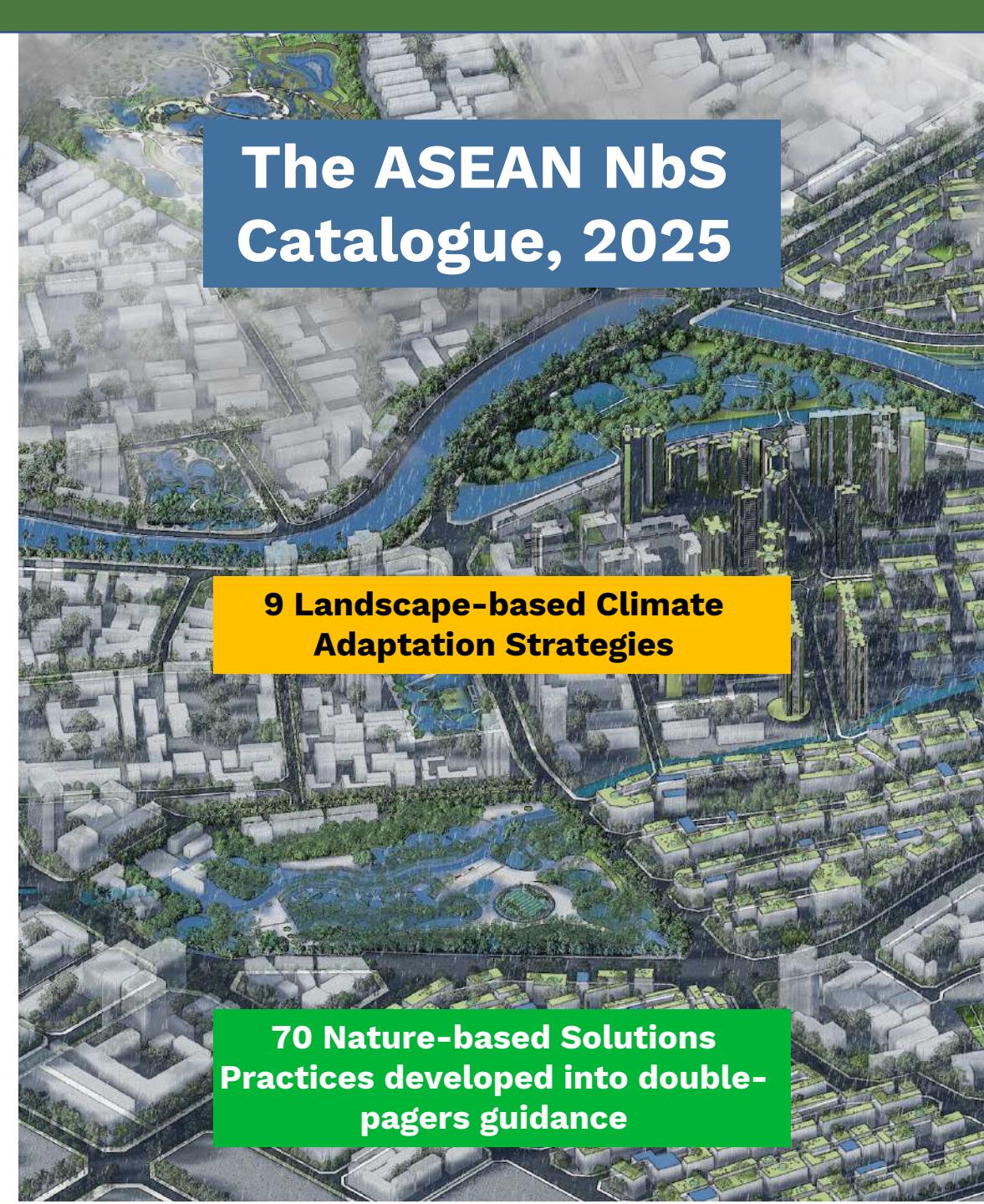
Risks include initial establishment failure, invasion by non-native species, or underperformance due to poor site selection.

REFERENCES:

Sixiao-Xiaomengyang Expressway, Yunnan, **China**
Dohazari-Cox's Bazar Railway, **Bangladesh**
Northeast Frontier Railway, **India**

IMPLEMENTATION OPPORTUNITIES:

East Coast Rail Link (ECRL), **Malaysia**
Kanchanaburi "Death Railway", **Thailand**
Bukit Barisan Selatan National Park, **Indonesia (Sumatra)**



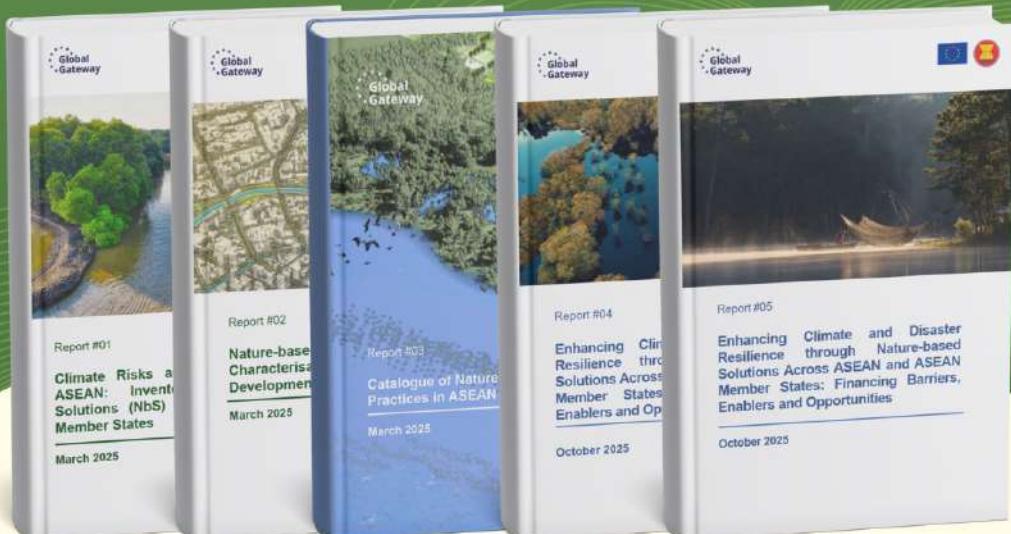
The ASEAN NbS Catalogue, 2025

9 Landscape-based Climate Adaptation Strategies

70 Nature-based Solutions Practices developed into double-pagers guidance

PUBLICATION SET

Nature-based Solution Studies in ASEAN Member States



Access reports here



Thank you for your attention!

Sebastien Goethals

Climate Adaptation & NbS Expert
Regenerative Landscape Planning & Design
sgoethals@citilinks-group.com

Asih Budiati

Team Leader TAF-GTEI
abud@niras.dk



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