An Introduction to Ecosystem-based Adaptation Technologies and Practices to address climate change challenges

CTCN webinar

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19 August 2015
The Climate Technology Centre and Network (CTCN)

- Operational arm of the UNFCCC Technology Mechanism
- Consortium of organizations from all regions
- Mission to stimulate technology cooperation and enhance the development and deployment of technologies in developing countries
- Technologies include any equipment, technique, knowledge and skill needed for reducing greenhouse gas emissions and for adapting to climate change effects
- Core services include:
  - Technical assistance to developing countries
  - Knowledge platform on climate technologies
  - Support to collaboration and partnerships
CTCN Technical Assistance

**Fast and short (3 pages) application process for countries**

**Provided:**
- To developing countries upon their request
- Free of charge (value up to 250,000 USD)
- State of the art and locally relevant expertise
- To academic, public, NGO, or private entities
- For a broad range of adaptation and mitigation technologies

**At all stages of the technology cycle:**
- From identification of needs;
- policy assessments;
- selection and piloting technology solutions;
- to assistance that supports technology customization and widespread deployment
CTCN Webinar Series

An introduction to climate technologies...

- Cities
- Coastal management
- Disaster and early warning
- Poverty
- Waste
- Forestry
- Industry
- Energy
- Building
- Agriculture
- Transport
- Water
- Ecosystem based technologies
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Objectives

Gain an understanding of:

• Ecosystems, their services and impacts of CC
• What is meant by ‘ecosystem adaptation’ and ‘ecosystem-based adaptation’
• The techniques used to identify vulnerability
• The actions that can be taken to reduce the impact of climate change on ecosystems
• Co-benefits of and barriers to EbA strategies
Outline

• Ecosystems
• Natural and human-dominated ecosystems
• Ecosystem services
• Climate change and ecosystems
• Ecosystem adaptation
• Ecosystem-based adaptation
• Ecosystem vulnerability
Outline (continued)

• Ecosystem-based adaptation activities
• Case studies
• Co-benefits of EbA
• Barriers to EbA
• Financing mechanisms
• Question-answer time
What is an ecosystem?

An ecosystem is a **functional unit** consisting of living organisms, their non-living environment, and the interactions within and between them.

IPCC 5AR WG2 definition
Near-natural ecosystems

Examples of near-natural ecosystems are forests, wetlands, rivers, rangelands, coral reefs, open oceans...and many more.
Some ecosystems are dominated by people, such as croplands, plantation forests, urban areas. They are still ecosystems!
Ecosystem Services

Ecological processes or functions having monetary or non-monetary value to individuals or society at large.
Ecosystem Services
What Nature provides us for free

SUPPORTING
- Soil Formation
- Photosynthesis
- Biodiversity
- Habitat
- Stewardship
- Aesthetic
- Recreation
- Education

PROVISIONING
- Food
- Clean Water
- Fish
- Wood
- Pollination
- Cool Temperatures
- Control Flooding
- Purify Water

REGULATING
- Clean Air
- Store Carbon

CULTURAL
- Recreation
- Education
- Clean Air
- Store Carbon
How climate change affects ecosystems

Direct Effects
• Climate controls where ecosystems occur and how they perform
• Climate change beyond an ecosystem’s adaptive capacity alters the type of ecosystem and its services

Indirect Effects
• Climate can alter the disturbance regime of ecosystems
63 years of climate change

Source: NASA - Link
Climate change impacts:
Hydrology and water resources

Retreating glaciers
Decrease/shifts in annual stream flow/timing
Falling lake levels in closed lake systems
Decrease in available moisture
Decrease in wetlands, which impacts
  – Flow of ground water recharge
  – Opportunities for flood control
  – Potential for water filtration (improved water quality)
  – Plant and animal species dependent on wetlands
Climate change impacts: Impacts on fauna and flora

- Shifts in phenology
- Vegetation zones shifting
- Animal range changes
- Changes in tree and shrub cover
Range shifts as a response to warming

Source: http://www.earthgauge.net
Range shifts along an elevation

Breshears D D et al. PNAS 2008;105:11591-11592

©2008 by National Academy of Sciences
Climate change impacts:
Changes to disturbance regimes

- Increase in extreme weather events
  - Rain/Floods
  - Wind
  - Drought
- Increase in insect outbreaks
- Increase in invasive species
- Changes in fire timing and intensity
Potential for adaptation

Ecosystems have an inherent adaptive capacity.

Ecosystems may adapt in various ways.

Strongly social-ecological systems such as agriculture also adapt.
Ecosystem response...

Response of Biotic Communities as Climate Change Affects Individual Species (which adapt in place, move, or decline toward extinction), Changes in Species Interactions, and Ultimately the Structure and Composition of Communities and Ecosystems

Source: Running & Mill (2009)
Ecosystem adaptation looks at ways in which to assist ecosystems to maintain their composition, structure and function in the face of climate change.
Ecosystem-based adaptation (EbA) has a broader purpose – to assist people to adapt to climate change by strengthening the services they get from ecosystems. It has been promoted by the UNCBD and has gained significant traction in the UNFCCC.
Ecosystem-based adaptation...

Ecosystem-based Adaptation is defined by the Convention on Biological Diversity (CBD) as “the use of biodiversity and ecosystem services to help people adapt to the adverse effects of climate change”

As further elaborated by Decision X/33 on Climate Change and Biodiversity, this definition also includes the “sustainable management, conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account the multiple social, economic and cultural co-benefits for local communities”
How to determine which ecosystems are vulnerable, where, and in what way

1. Climate envelope analysis
2. Climate sensitivity of key processes
3. Changes to disturbance regime
4. Analysis of the functional attributes of species in the ecosystem
5. Dynamic (Global) Vegetation Models
Relationship between climatic stability and vegetation intactness

Source: Watson et al. (2013)
EbA technologies and practices

- Sustainable water management
- Disaster risk reduction
- Sustainable management of grasslands and rangelands
- Establishment of diverse agricultural systems
- Strategic management of shrublands and forests
- Establishing and effectively managing protected area systems
EbA technologies and practices...

- Reduce other stresses on the ecosystem
- Assist the dispersal of species
- Keep a representative sample

The best adaptation strategy for ecosystems is climate change mitigation
Case Studies

1. Chingaza Massif in the High Mountain Ecosystem of Colombia
2. Coastal habitat restoration in SE Asia
3. The Pangani River basin in Tanzania
4. Community-based fire management in Australia
5. Livelihood enhancement and diversification in Sri Lanka
6. Opportunities for ecosystem-based adaptation in Africa
7. Marine protected area design and management in Papua New Guinea
8. Agricultural practices for EbA
1. Chingaza Massif in the High Mountain Ecosystem of Colombia

• Problem
  – located above 2740 metres
  – very vulnerable to the anticipated impacts of climate change
  – 78% of glaciers and 56% of moorlands could disappear by 2050

• Impact
  – soil protection
  – food and water supply
    • 80% of the people living in the surrounding ecosystems rely on the water from here
  – water flow regulation
  – associated hydropower potential
1. Chingaza Massif in the High Mountain Ecosystem of Colombia

• Solution
  – Implementation of an Integrated National Adaptation Plan (INAP) using EbA technologies

• How?
  – Restoration of the high mountain ecosystems
  – Incorporation of EbA in land use planning
  – Improvement of productive agroecosystems
  – Assessment and dissemination of climate information
  – Water and carbon cycle modelling and monitoring

Image: © John van der Woude
1. Chingaza Massif in the High Mountain Ecosystem of Colombia

Key Message

Ecosystem-based Adaptation can be embedded into national, regional and local policy and practice by adopting an integrated, participatory and ecosystem-based approach to territorial planning.
2. Coastal habitat restoration in SE Asia

- **Problem**
  - Vulnerable coastal areas due to impacts of climate change
  - Tsunami affected areas: Indonesia, Sri Lanka, India, Thailand, and Malaysia

- **Impact**
  - Storms
  - Coastal flooding
  - Salt-water intrusion
  - Erosion
2. Coastal habitat restoration in SE Asia

• Solution
  – Rehabilitation through restoration and management of damaged coastal ecosystems – Green Coast

• How?
  – Coastal ecosystem rehabilitation by local communities
  – Building environmentally-sustainable livelihoods
  – Developing village regulations that support environmental conservation efforts
  – Environmental education campaigns

Image: flickr/IUCNweb
2. Coastal habitat restoration in SE Asia

Key Message

Restoring healthy coastal ecosystems, such as mangroves and coral reefs, helps protect coastal communities from some of the impacts of climate change including storms, associated coastal flooding, saltwater intrusion and erosion.
3. The Pangani River Basin in Tanzania

• **Problem**
  - Climate change to exacerbate water scarcity
  - Reduced basin flows
  - Shortage leading to tension between various water users
  - 80% people here depend on agricultural livelihoods
  - The Pangani Basin Water Board allocates water permits with little data

• **Impact**
  - Water scarcity driving conflict
  - Aquatic biodiversity declining
  - Loss of ecosystem services
  - Weakening livelihoods
  - CC vulnerability
3. The Pangani River Basin in Tanzania

• Solution
  – Pangani River Basin Management Project was initiated

• How?
  – Environmental flow assessment (EFA)
  – Multi-stakeholder consultation and legal reviews
    Establishing catchment forums
  – Climate change vulnerability assessments
    Implementation of climate adaptation strategies
  – Integrated Water Resource Management planning
3. The Pangani River Basin in Tanzania

Key Message

Water is at the centre of many climate change impacts, and is therefore key to many adaptation policies, planning and action. The allocation of water to sustain natural infrastructure, such as wetlands and estuary habitats, and the adoption of adaptive governance build adaptive capacity to respond to an uncertain future climate.
4. Community-based fire management in Australia

• Problem
  – A remote, tropical savanna region in Australia’s Northern Territory
  – Largely uninhabited and unmanaged
  – No fire management
  – Climate will increase size, intensity and frequency of wildfires

• Impact
  – Over tens of thousands of kms can burn at a time
  – Uncontrolled wildfires can threaten adjacent land managers
  – Damage to extensive patches of rainforest ecosystems
  – Threat to globally-significant rock art sites
4. Community-based fire management in Australia

• **Solution**
  – Incidence of wildfires in areas actively managed by Aboriginal people is markedly less
  – West Arnhem Land Fire Abatement Project started

• **How?**
  – Enabling Indigenous fire managers to work with the broader community to reduce unmanaged wildfires
  – Early dry-season burning
  – Less greenhouse gases (CO2, nitrous oxides and methane)
Community-based forest fire management is an example of ecosystem-based adaptation combined with mitigation efforts that generate multiple environmental, economic and social benefits. Strategic fire management needs to be repeated every year, so success is dependent upon ongoing ecosystem management.
5. Livelihood Enhancement and Diversification in Sri Lanka

• Problem
  – Rural fishing village highly dependent on the Bar Reef Marine Sanctuary
  – High marine biodiversity - over-fishing and illegal exploitation
  – Mass coral bleaching event in 1998
  – Remains vulnerable to the impacts of climate change

• Impact
  – Unsustainable exploitation and degradation
  – Natural resource dependent livelihoods under threat

Image: Sterling ZumBrunn/CI
5. Livelihood Enhancement and Diversification in Sri Lanka

• **Solution**
  – Sustainable Livelihoods Enhancement and Diversification (SLED) tool
    • Facilitate adaptation
    • Help communities make informed choices about their livelihood options

• **How?**
  – mapping existing livelihoods and understanding the community’s dependency
  – Assessed community aspirations, adaptive capacity and potential adaptation strategies
  – Implemented the adaptation strategies
    • Using local resources without over-extracting natural resources
5. Livelihood Enhancement and Diversification in Sri Lanka

Key Message

Livelihood enhancement and diversification can encourage people to move away from unsustainable exploitation and degradation of natural resources and thereby increase social & environmental resilience to climate change.

Image: Sterling ZumBrunn/CI
6. Ecosystem-based adaptation in East Africa

• Problem
  – Parts of Eastern and Southern Africa are already being affected by climate change
  – Will be hit hard by its impacts in the future

• Impact
  – Impacts on agriculture, water availability and quality, ecosystem services, biodiversity, and health
  – Especially the poorest part of the population
6. Ecosystem-based adaptation in Africa

• **Solution**
  – IUCN’s Climate Change and Development project
  – Ensure policies and strategies lead to adaptation activities

• **How?**
  – Risk screening and scoping of adaptation activities
  – Community level using participatory approaches
  – Assessments on different livelihood systems, in different ecological zones, faced with extreme climatic events using CRiSTAL

Image: flickr/IUCNweb
6. Ecosystem-based adaptation in East Africa

Key Message

Ecosystem management and restoration can significantly reduce community vulnerability to climate stress. Similarly, policies and development interventions that secure the local natural resource base can, in many cases, increase community resilience to a range of threats, including climate change.

Image: flickr/IUCNweb
7. Marine protected area design and management in Papua New Guinea

• Problem
  – Kimbe Bay: important habitats for marine resources
  – 100,000 people rely on resources for their livelihood
  – Population growth, destructive fishing, cash income decline
  – Climate change a further serious and increasing threat

• Impact
  – Predicted sea level rise
  – Observed coral bleaching
  – Increase in the vulnerability of the local community

Image: Coral Triangle Initiative
7. Marine protected area design and management in Papua New Guinea

• Solution
• How?
7. Marine protected area design and management in Papua New Guinea

Key Message

Marine protected areas can increase the resilience of vulnerable communities to climate change, provided that planning, analysis, and decision-making are undertaken with the full participation of relevant scientific, institutional, and community stakeholders.
8. Agricultural practices for EbA

- Problem
- Impact
8. Agricultural practices for EbA

• Solution
• How?
8. Agricultural practices for EbA

Key Message

The use of EbA practices in agriculture offers an important opportunity to help smallholder farmers adapt to climate change, while providing important livelihood and environmental co-benefits. It is critical that policy makers at all levels recognise and promote EbA technologies in agricultural development.
Co-benefits of EbA

- Disaster risk reduction
- Livelihood sustenance and food security
- Biodiversity conservation
- Carbon sequestration
- Sustainable water management
Co-benefits of EbA...

<table>
<thead>
<tr>
<th>Ecosystem-based Adaptation</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restoring fragmented or degraded natural areas</td>
<td>Enhances critical ecosystem services, such as water flow or food and fisheries provision</td>
</tr>
<tr>
<td>Protected groundwater recharge zones or restoration of floodplains</td>
<td>Secures water resources so that entire communities can cope with drought and flooding</td>
</tr>
<tr>
<td>Connecting expanses of forests, grasslands, reefs or other habitats</td>
<td>Enables people and biodiversity to move better to more viable habitats as the climate changes</td>
</tr>
<tr>
<td>Protecting or restoring natural infrastructure such as barrier beaches, mangroves, coral reefs, and forests</td>
<td>Buffers human communities from natural hazards, erosion and flooding</td>
</tr>
</tbody>
</table>

Source: Munang et al (2013)
## Co-benefits: other examples

<table>
<thead>
<tr>
<th>Natural hazard</th>
<th>Type of ecological protection</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landslide</td>
<td>Dense and deep-rooted vegetation helps to bind soil together, resisting slippage of surface layers.</td>
<td>China’s grain for green program bans logging and agriculture on steep slopes and prohibits forest clearing for shifting agriculture in the mountains of Southwest China. In exchange the local communities get grain provisions and cash subsidies, as well as resilience against flooding events.</td>
</tr>
<tr>
<td>Avalanche</td>
<td>Forests form a physical barrier against avalanches, and pin down the snow pack, reducing the chance of a slide beginning.</td>
<td>Re-forestation has been used for avalanche protection in Switzerland, complementing and in some cases substituting for engineered barriers.</td>
</tr>
</tbody>
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Source: MacKinnon et al. (2009)
## Barriers to adaptation and ways to overcome them

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate understanding or knowledge of the threat</td>
<td>Investment in research, technology transfer, learning and communication</td>
</tr>
<tr>
<td>Finance for adaptation actions, given that ‘environment’ in general, and biodiversity protection in particular, is often not seen as a critical economic sector</td>
<td>Base arguments to funding sources on ecosystem service value analysis rather than solely on ethical considerations Use ‘carbon market’, REDD+ etc</td>
</tr>
<tr>
<td>Uncertainty about future scenarios. This will persist even if our ecological knowledge increases</td>
<td>Use a portfolio approach (hedging your bets) and prioritise no-regrets options</td>
</tr>
<tr>
<td>Shared resource issues (fisheries, shared river basins, migratory species require international cooperation to address</td>
<td>Use international treaty mechanisms (UNCBD, UNCMS, Law of the Ocean) where appropriate, or develop bilateral or multilateral regional institutions</td>
</tr>
</tbody>
</table>
Financing mechanisms

1. The first source should be local and national governments, which have a responsibility for protecting their natural resource base.
2. ‘Additional’ expenses or actions with global benefits may be covered by GEF or similar benefit-transfer mechanisms.
3. Share the costs across all beneficiaries, not just the climate financial mechanisms.
4. The private sector is often willing to pay for carbon credits, especially if they have ecosystem and biodiversity co-benefits.
5. Philanthropic foundations and private donors often support work in this arena.
The Adaptation Fund

The Adaptation Fund was established to finance concrete adaptation projects and programmes in developing countries that are parties to the Kyoto Protocol and are particularly vulnerable to the adverse effects of climate change.

See: https://www.adaptation-fund.org/
Take-home messages

• **Ecosystems** and the species they contain are very sensitive to both the magnitude and rate of climate change

• Ecosystem impacts have consequences for human wellbeing; although often not immediately apparent in the formal economic statistics, these impacts can be very costly

• It is possible, within limits, to enhance the inherent adaptive capacity of ecosystems
Frequently-asked questions

• **Q**: Surely developing countries should prioritise people over nature? **A**: People, especially in developing countries, are not that easily separable from nature. Damaging natural capital is a loss of options for both the present and future.

• **Q**: Do we know enough to do the right thing? **A**: Not always, but we usually do know enough to avoid doing things that are definitely wrong.
Key readings


Contacts

1. World-Wide Fund for Nature  [www.wwf.org](http://www.wwf.org)
2. Int Union for the Conservation of Nature  [www.iucn.org](http://www.iucn.org)
3. UN Convention on Biological Diversity  [www.cbd.int](http://www.cbd.int)
4. Intergovernmental Panel on Climate Change (Working Group 2, Impacts and Adaptation)  [www.ipcc-wg2.gov](http://www.ipcc-wg2.gov)
Thank you!