



Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security

Region-wide Early Action Plan for Climate Change Adaptation

**for the Nearshore Marine and Coastal Environment
and Small Island Ecosystems (REAP-CCA)**



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Cover Photo: Bajo Fishing Community, Wakatobi, Indonesia
Photo Credit: Stacey Tighe

Region-wide Early Action Plan for Climate Change Adaptation for the Nearshore Marine and Coastal Environment (REAP-CCA)

October 2011

Preface

The *Coral Triangle Initiative for Coral Reefs, Fisheries and Food Security (CTI-CFF)* is a multilateral partnership founded on the commitment of the six Coral Triangle countries (CT6): Indonesia, Malaysia, Papua New Guinea, the Philippines, Timor-Leste, and the Solomon Islands, to accelerate efforts to safeguard coastal and marine resources and communities. In May 2009, the leaders of these six countries committed to implementing a CTI-CFF Regional Plan of Action. With the added support of our founding partners, the Asian Development Bank, the government of Australia the government of the United States of America, and the conservation organizations of Conservation International, The Nature Conservancy and the World Wide Fund for Nature, an immediate effort was launched to define the regional efforts needed to support the goals of the CTI-CFF Regional Plan of Action.

The fourth Goal of the CTI-CFF Regional Plan of Action, *Climate Change Adaptation Measures Achieved*, is considered particularly urgent. Climate change will dramatically affect coastal communities and ecosystems in the Coral Triangle. Understanding the extent of these changes and their impacts and identifying early adaptation actions is essential to protecting communities and marine and coastal resources.

This CTI Region-wide Early Action Plan for Climate Change Adaptation (CTI REAP-CCA) sets forth urgent and immediate actions that need to be taken across the Coral Triangle to build coastal community and ecological resilience to climate change. Through the efforts of two Regional Exchanges, one in Indonesia (Ancol, Jakarta October 2010) and one in the Solomon Islands (Honiara, April 2011), representatives from the six Coral Triangle countries and partners came together to develop the CTI REAP-CCA. We thank the United States Agency for International Development through the US CTI Support Program for providing technical and logistical support to enable the CT6 to work together to develop this important policy document.

Thank you to all involved in developing this CTI REAP-CCA in a collaborative and efficient process. Congratulations and good luck in applying its guidance.



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1.0 Introduction

The Coral Triangle encompasses almost six million square kilometers of ocean and coastal waters surrounding Indonesia, Malaysia, Philippines, Papua New Guinea, Solomon Islands and Timor-Leste (Figure 1). It is considered the global epicenter of marine biodiversity—home to over 500 species of reef-building corals and 3,000 species of fish. The cumulative impacts of unplanned coastal development, over-fishing, habitat degradation, and climate change threaten the health and welfare, food security, and livelihoods of over 120 million people that live in coastal zone.



Increasing carbon dioxide and other greenhouse gases in the atmosphere are driving change in the physical and chemical characteristics of marine and coastal environments in Coral Triangle (Hoegh-Guldberg et al. 2009). Warming and acidifying oceans may eliminate coral dominated reefs, decimate mangrove systems, and eliminate seagrass beds. These changes will dramatically affect coastal communities and ecosystems in the Coral Triangle.

This Region-wide Early Action Plan for Climate Change Adaptation (REAP-CCA) sets forth urgent and immediate actions that need to be taken across the Coral Triangle to build coastal community resilience to climate change. The REAP-CCA is organized in the following eight sections:

1. An introduction that provides a description the purpose and development of the REAP-CCA and background on the Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF)
2. An overview of the approach to building coastal community resilience to climate change adopted in the REAP-CCA that includes resilience as an integrating framework for local implementation, vulnerability assessment to identify risks and prioritize early actions, and resilience-building best practices
3. A description of eight priority climate change adaptation issues defined by the six Coral Triangle countries
4. A list of early actions identified by the six Coral Triangle countries to address each priority climate change adaptation issue
5. A summary of institutional arrangements to support implementation of the REAP-CCA
6. A summary of financing opportunities to support implementation of the REAP-CCA
7. A summary of regional capacity development needs to support implementation of the REAP-CCA
8. A description of benchmarks and indicators to track progress and report results of REAP-CCA implementation



Figure 1. Location of the Coral Triangle: Dotted line defines the scientific boundary of the Coral Triangle (Veron et al, 2009). The Coral Triangle Initiative encompasses the national jurisdictions of the six countries (Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste).

1.1 Purpose

The REAP-CCA serves as a major step toward implementing climate change adaptation under the UN Framework Convention on Climate Change for the six Coral Triangle countries. Two overall objectives of the REAP-CCA are to:

- Maintain marine and coastal ecosystem structure, function, and services critical to livelihoods and food security of coastal communities; and
- Support diversification strategies that build coastal community resilience to climate change

The REAP-CCA draws on ecological and social resilience models to define priority climate adaptation measures that need to be taken in the *short-term*, by 2015, and over medium- and long-term time horizons to address climate change even in the face of scientific uncertainties associated with future climate change impacts. Building both ecological and social resilience is vital to building community resilience to climate change in the Coral Triangle.

Regional collaborative actions and country-specific actions identified by the Coral Triangle countries cover a range of management scales and frameworks including transboundary seascape management and integrated coastal zone management plans for districts, provinces, and single-country seascapes.

The REAP-CCA serves as a framework for building coastal community resilience by:

- Providing a regional outlook on climate change issues and early actions to guide national and sub-national planning and implementation
- Promoting an integrated approach to climate change adaptation that achieves the dual objectives of sustainable development and risk reduction
- Supporting collaboration among institutions to share data and knowledge and to report on progress
- Identifying possible financing mechanisms to support implementation of early actions

1.2 Background

To avert the risks threatening the Coral Triangle's marine ecosystems, the six Coral Triangle countries came together in 2007 to form The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security (CTI-CFF)—a multilateral partnership that aims to safeguard the marine and coastal resources of the Coral Triangle region. The CTI-CFF Regional Plan of Action (RPOA) launched in 2009 by the leaders of the six Coral Triangle countries sets forth the achievement of climate change adaptation measures as one of five long-term goals for regional action. The five goals are: (1) strengthening management of seascapes; (2) application of ecosystem approach to fisheries management; (3) developing and strengthening the management of marine protected areas; (4) implementing climate change adaptation measures; and (5) protecting threatened marine species. These goals are supported by clear sets of actions and timelines to specifically address regional marine resource conservation and sustainability priorities.

CTI-CFF Regional Priorities for Climate Change Adaptation

Goal 4 on climate change adaptation has two targets. The development and full implementation of this *Region-wide Early Action Plan for Climate Change Adaptation for the Near-shore Marine and Coastal Environment* (REAP-CCA) was identified as a Target #1 for 2015 as an important first step in catalyzing early actions to achieve this goal.

To support implementation of the REAP-CCA as well as longer term adaptation projects, a second target was identified as the establishment of a network of national centers of excellence on climate change adaptation.

Towards achieving these targets, representatives from the six Coral Triangle country and partners convened in October 2010 and April 2011 to identify priority climate change issues and to share experiences and challenges in addressing climate impacts in the Coral Triangle. Participants of these two

Regional Exchanges developed the draft REAP-CCA framework and early actions for climate change adaptation. A regional writing team continued to work on the REAP-CCA and developed a final draft that will be reviewed and adopted by the CTI National Coordinating Committees and Senior Officials Meeting for adoption at the next CTI Ministerial Meeting.



Coral Triangle representatives at the first Regional Exchange on Climate Change Adaptation.

This document represents the latest working draft for review and amendment by the CTI CCA Technical Working Group prior to its submission to the Senior Officials' Meeting.

CTI ON CORAL REEFS, FISHERIES, AND FOOD SECURITY REGIONAL PLAN OF ACTION

Goal 4: Climate Change Adaptation Measures Achieved

Target #1: Region-wide Early Action Plan for Climate Change Adaptation for the Nearshore Marine and Coastal Environment and Small Island Ecosystems developed and implemented by 2015

Regional Action 1: Identify the most important and immediate adaptation measures that should be taken across all Coral Triangle countries, based primarily on analyses using existing model by 2011

Regional Action 2: Identify the most important and immediate adaptation measures that could be taken in each CT country by 2011.

Regional Action 3: Complete and implement a Region-wide Early Action Plan for Climate Change Adaptation by 2015

Regional Action 4: Conduct capacity-needs assessments and develop capacity building programs on climate change adaptation measures by 2011

Regional Action 5: Mobilize financial resources to implement Region wide Early Action Plan for Climate Change Adaptation by 2011

Target #2: Networked national centers of excellence on climate change adaptation for marine and coastal environments are established and in full operation

Regional Action 1: Collaborate around the design and implementation of a Pilot Phase for National Centers of Excellence

(CTI-CFF RPOA 2009)

Coral Triangle Country Priorities for Climate Change Adaptation

Country-specific priorities for climate change adaptation are embodied in National Plans of Action (NPOA) and Climate Change National Adaptation Programs of Action (NAPA). Early actions in the REAP-CCA are aligned with these national plans and programs.

Indonesia

1. Research and monitor climate change phenomenon :
 - a. Strengthen baseline data, including collecting and sharing of information
 - b. Vulnerabilities assessment on coastal zones and small islands
2. Formulate regulations, policies, and institutional capacities for adaptation to climate change :
 - a. Planning for Coastal Zone and Small Islands at district level



Scientists measure coral reef cover in Wakatobi, Indonesia

Photo credit: CI/WWF

- b. Produce national guidelines for adaptation measures to the potential of climate change impacts on marine and coastal ecosystem and communities
- 3. Develop and Strengthen Program Activities :
 - a. Rehabilitation and Conservation in coastal area
 - b. Manage settlements in the coastal zone
 - c. Development of Coastal Resilient Village
 - d. Profile of coastal resources at the village level
 - e. Environmentally sound physical engineering (e.g., coastal structures with environmental consideration)
- 4. Build capacity in education, research, and information systems on climate change issues, related consequences and adaptation measures.

Malaysia

- 1. Contribute to the development of a fully functional Region-wide Coral Triangle MPA System.
- 2. Strengthen coordination amongst the Sabah Environment Education Network (SEEN) (comprising policy- makers, practitioners, planners, and trainers from government agencies, NGOs, and private sector) to undertake Environmental Education efforts in Sabah.
- 3. Complete the Malaysian Climate Change Coastal Adaptation Plan, with a focus on sustainable management of fisheries and livelihood diversification.
- 4. Protect multiple representatives of resilient habitats covering a range of physiographic conditions within the Malaysian CTI area, with priority given to areas that have physiographic characteristics that make them inherently resilient to climate change.



Papua New Guinea

- 1. Develop warning and protection of flood-prone coastal communities
 - a. Develop coastal early warning system
 - b. Establish community-based mangrove planting
 - c. Employ coastal engineering protection measures
- 2. Conduct ongoing provincial consultation and awareness raising on climate change
- 3. Establish resilient marine protected areas
 - a. Establish data base for species within an MPA in the priority geographies
 - b. Conduct rapid assessment of MPAs/LMMAs
 - c. Develop MPA policy addressing climate change adaptation

- d. Develop action plans for each MPA/LMMA on sustainable financing and resilience to counter impacts of climate change
- 4. Develop ecosystem approach to fisheries management
 - a. Strengthen the Ridge to Reef approach to fisheries management
 - b. Develop partnerships with land based industries
 - c. Develop management strategies to address impacts of land based pollution
 - d. Memorandum of Agreements between NGOs (WWF, TNC, WCS, CI), universities and government
- 5. Protect threatened species
 - a. Establish data on threatened species and impacts of climate change on species
 - b. Strategies to address impacts/minimize impacts on threatened species
 - c. Develop plans/legislation to protect threatened species
 - d. Develop good governance strategies
 - e. Develop standard operating procedures



Fishermen in Manus, Papua New Guinea

Philippines

1. Establish networks of marine protected areas
2. Update information on the distribution and status of coastal and marine ecosystem including the conduct of vulnerability assessments, and assessment of the management effectiveness of marine protected areas,
3. Reforest degraded mangrove areas and critical watersheds
4. Adopt the National Climate Change Action Plan (NCCAP)
5. Improve capacity on climate scenario modeling and forecasting
6. Conduct baseline studies on resource accounting in coastal communities, etc which would be helpful if we want to determine costs of action or inaction in addressing climate change impacts
7. Strengthen knowledge management and capacity building on climate change and disaster risk reduction targeting coastal communities, government agencies, local government units, and civil society organizations.



Fishermen carry fish cages in Cebu, Philippines

Solomon Islands

1. Review NAPA (marine and coastal fisheries sector) to develop a Solomon Islands NEAP for marine and coastal sector CCA early action measures
2. Continue vulnerability and adaptation assessments in priority sites and identified 'most vulnerable' sites including vulnerability and adaptation mapping
3. Continue with the development of standard guideline and criteria of conducting vulnerability and adaptation for marine and coastal sector including developing comprehensive baseline survey of coral reefs and socio-economic indicators
4. Conduct national, provincial and community-level education and awareness of climate change issues. Create communication linkages for climate change news and updates at all levels –national, provincial and community.
5. Explore options to stream-line data (sea level rise, storminess, temperature, rainfall, cyclones etc) from disaster management, meteorology, climate change, fisheries and conservation activities for CCA efforts.
6. Identify and develop simple CCA measures for community livelihood options
7. Explore options to align or integrate CCA and Disaster Risk Reduction efforts within MECDM.



Photo credit: Mags Quiblian

Fallen tree due to coastal erosion in Njari, Solomon Islands

Timor-Leste

1. Continue coastal rehabilitation program to anticipate climate change impacts. Priority will be given to mangrove rehabilitation in Ulmera, Tibar, Manatuto, and Hera.
2. Start a comprehensive baseline survey of coral reefs and socio-economic indicators to be used to evaluate performance of climate change adaptation investments (along 295 km of the southern coastline).
3. Implement a range of interventions to increase the adaptive capacity of communities in Atauro and Batugede demonstration sites (located on the north coast).
4. Conduct vulnerability and adaptation assessments of urban centers and reef-dependent rural communities (north and south coast).



Photo credit: Matthew Abbot

A young fisherman at the Nino Konis Santana National Park in Timor-Leste

2.0 Building Coastal Community Resilience to Climate Change



A Bajo community in Wakatobi, Indonesia

Photo credit: Stacey Tighe

Building coastal community resilience has emerged as one framework for understanding and managing complex social and ecological systems, especially coral reef ecosystems (Marshall et al. 2010; Plummer and Armitage 2007; Tompkins and Adger 2005). Resilience provides a holistic and practical approach to climate change adaptation as it recognizes that change is a necessary characteristic of ecosystems and societies that depend on the broad range of services that ecosystem provide (US IOTWS 2007; Nelson et al. 2007; Berkes and Folke 1998; Levin et al. 1998; Ludwig et al. 1997;).

Common characteristics of resilient systems include redundancy, diversity, efficiency, autonomy, strength, interdependence, adaptability, and collaboration (Godschalk 2003). When a social or ecological system loses resilience, it becomes vulnerable to disturbances that previously could have been absorbed (Kasperson and Kasperson 2001). In a resilient system, disturbance has the potential to create opportunity for development, novelty, and innovation. In a vulnerable system, even small disturbances can be devastating. The following section outlines the approach that the six Coral Triangle countries propose for integrating climate change adaptation into policies, plans, and programs.

2.1 Resilience as an Integrating Framework

Resilience can serve as an integrating framework for achieving the goals of the CTI-CFF (Figure 2). Community development provides the enabling governance, socioeconomic, and cultural conditions for social resilience (CED 2000). Natural resource management provides the framework for managing human uses of natural resources and the coastal zone to maintain ecological resilience (White et al., 2005; Chua 1998; DENR 2001).

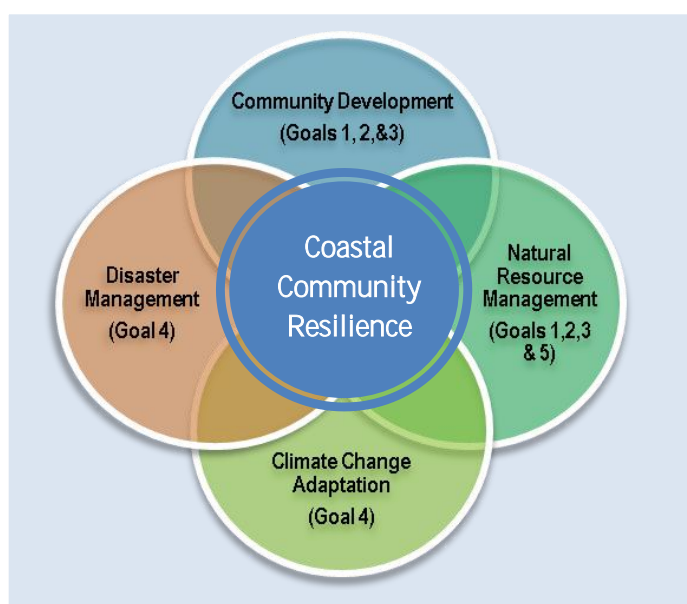


Figure 2. Coastal community resilience serves as an integrating framework for implementing CTI-CFF

Disaster preparedness, response, recovery and mitigation contribute to social resilience (ADPC 2005; 2004). The REAP-CCA employs an approach that contributes to both social and ecological resilience through the assessment of risk and implementation of anticipatory and reactive measures to adapt to changing conditions. Managing for resilience takes into account the multiple goals and actions that must be integrated at the local level to improve human health and welfare, food security, and the overall quality of life of the community.

2.2 Vulnerability Assessment to Identify Risks

Vulnerability assessment provides a basis for making informed decisions on adopting measures to reduce risk from climate change. Engaging coastal communities in understanding risks enables them to be better prepared to address the impacts of change. Early actions to address climate change adaptation highlight the need to assess vulnerability to climate hazards. Vulnerability is defined as a function of exposure, sensitivity, and adaptive capacity (Figure 4, see also Glossary). Adaptive capacity is the ability of the system to adjust to climate change. Building coastal community resilience to climate change means reducing vulnerability by decreasing potential impact and increasing social and ecological adaptive capacity. The REAP-CCA recommends the use of vulnerability assessments to further define priority actions.

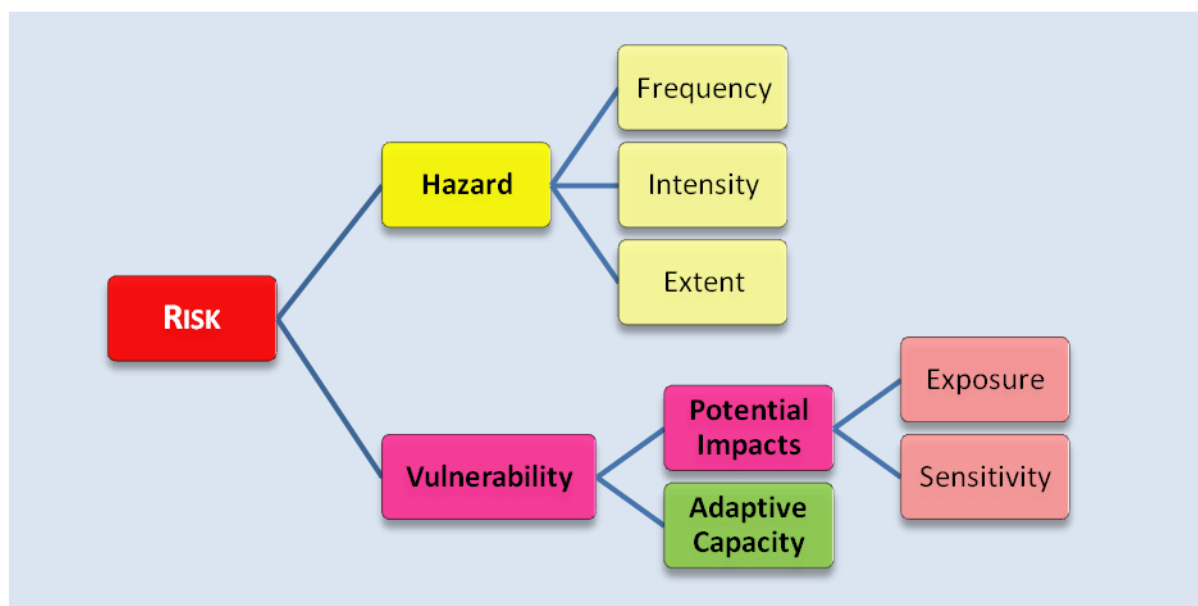


Figure 3. Vulnerability to Climate Change and Variability

2.3 Resilience-Building Best Practices

Early actions for climate change adaptation incorporated in the REAP-CCA target best practices that reduce risk and improve sustainability. Resilience-building best practices are designed to balance social, economic and environmental goals and to reduce risk to climate change and other hazards (Figure 4; National Disaster Preparedness Training Center 2011).

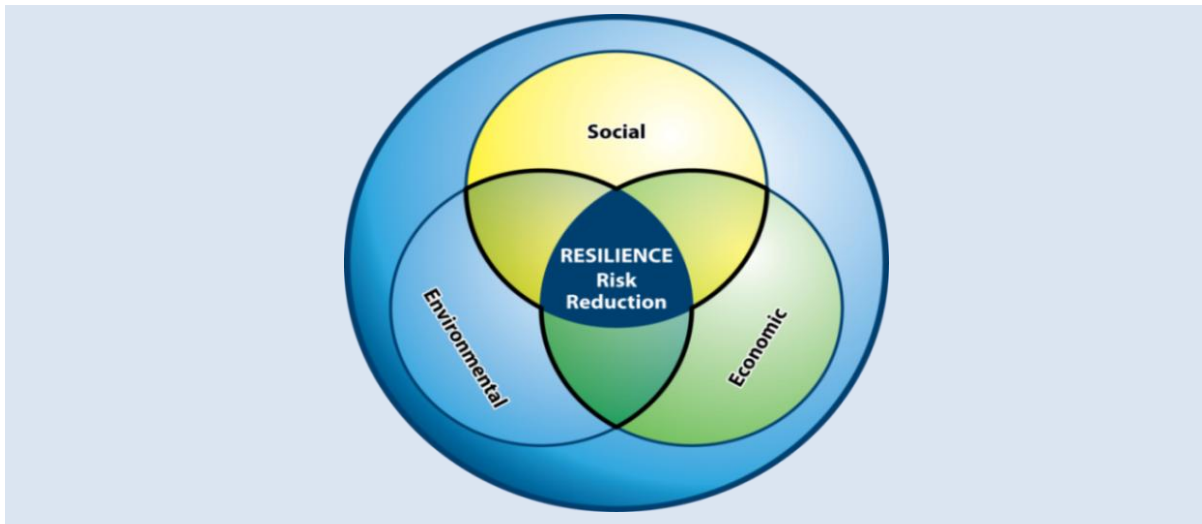


Figure 4. Resilience-building best practices are designed to balance social, economic, and environmental goals and to integrate risk reduction in all sectors (NDPTC 2011)

3.0 Defining the Issues for Climate Change Adaptation

Climate change is occurring in the Coral Triangle as evidenced by significant warming of the surface ocean (Hoegh-Guldberg et al. 2009). Projected climate hazards in the Coral Triangle include:

- Increasing sea temperatures – sea surface temperature projected to be 1-4°C warmer by the end of this century.
- Ocean acidification – conditions will become “marginal” for coral reef calcification within the period 2020-2050.
- Sea level rise – current projections suggest ~ 30-60 cm rise in sea level by 2100
- Longer and more intense floods and droughts – likely that rainfall events will become more extreme and that inter-annual variability of monsoon rainfall will increase.
- More intense cyclones and other storms – no clear consensus as to whether the location or frequency of tropical cyclones will change in a warming world but there is agreement that they will become more intense with greater maximum wind speed and heavier rainfall.



These changing conditions increase the vulnerability of ecological and social systems in the Coral Triangle (Figure 5). Coastal communities are dependent on healthy coastal and marine ecosystems. This co-dependency means that their vulnerabilities are also connected (Marshall et al. 2010).

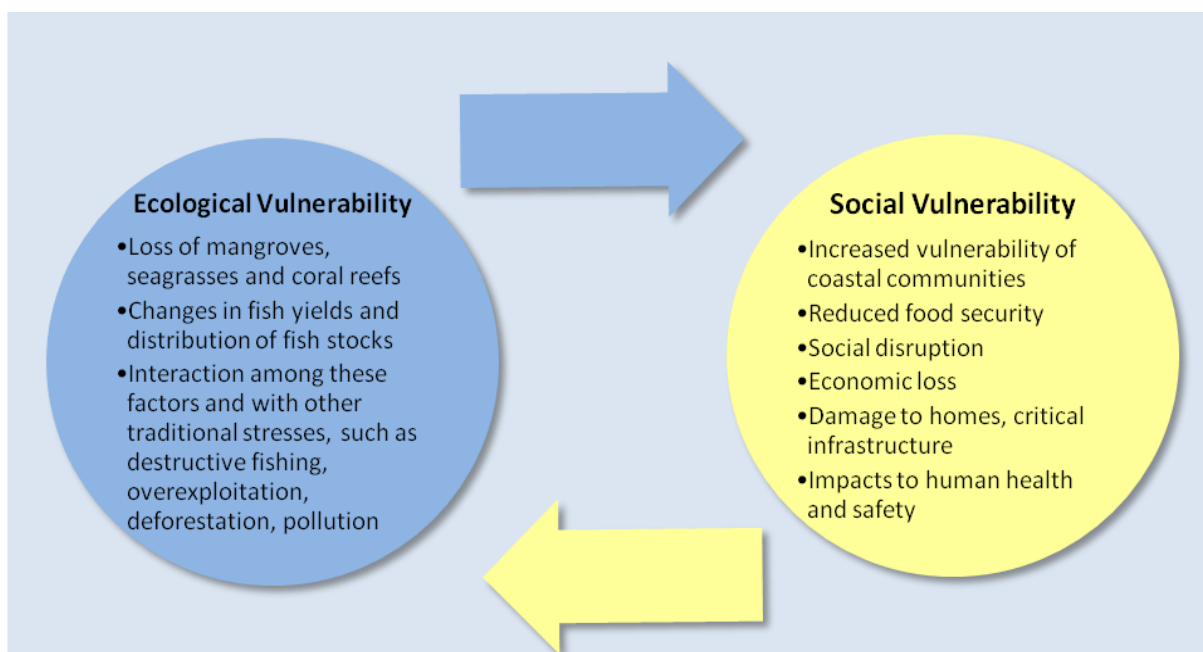


Figure 5. Key Climate Change Vulnerabilities in the Coral Triangle (adapted from Hoegh-Guldberg et al. 2009)

To reduce these linked vulnerabilities, climate change issues addressed by early actions in the REAP-CCA are framed around the following eight social and natural resources in the Coral Triangle. Each climate issue statement is written considering climate change impacts and non-climate threats to these eight resources.

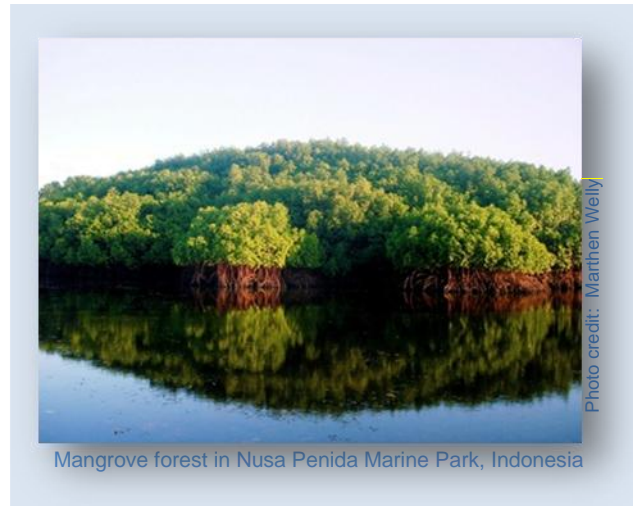
1. **Rivers and estuaries** are experiencing changes in ecosystem structure, function, and services due to siltation from upland logging and saltwater intrusion from sea level rise.
 - Food security and livelihoods are at risk from climate and non-climate impacts to fish spawning and nursery areas in river and estuarine habitats in the Coral Triangle.
 - Hydrology and geomorphology of rivers and estuarine systems will be altered by extreme weather events.
 - River bank erosion and flooding events threatens adjacent communities.
 - Rare freshwater mammals are at risk due to changes in food source and habitat.



A river within at the Nusa Penida Marine Park, Indonesia

2. **Mangroves** are experiencing changes in ecosystem structure, function, and services due to overexploitation from domestic use (firewood) and livelihoods (logging, boat building), exacerbated by increased temperature, sea level risk, and inundation events.

- Food security and livelihoods are at risk from climate and non-climate impacts to fish spawning and nursery grounds in the mangrove forests in the Coral Triangle.
- Changes in sea level, temperature, storm intensity, and inundation events are expected to impact mangroves (Gilman et al. 2008).
- Species composition, productivity, and distribution will be affected by increasing air and sea surface temperature (Ellison and Farnsworth 1997; Ellison 2008).
- Sea level rise represents the greatest threat to mangroves. Coastal development adjacent to mangrove areas will prevent the natural landward migration of mangroves adapting to sea level rise (Saintilan and Wilton 2001; Wilton 2002; Gilman et al. 2007).

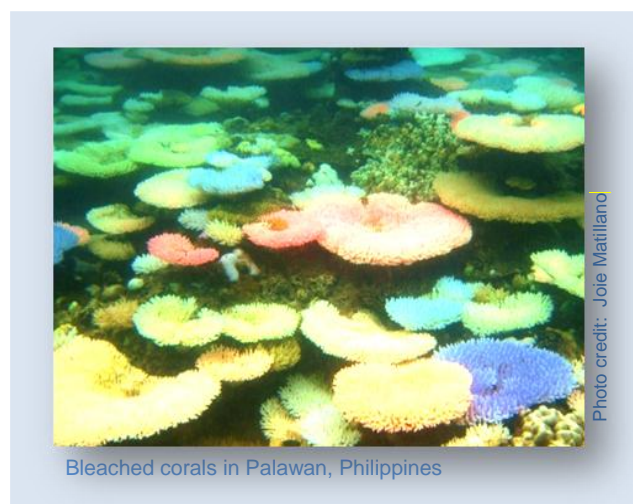


3. Bays and coves in rural and urban coastal areas are experiencing changes in ecosystem structure, function, and services due to increasing sedimentation and other land-based pollution from upland logging, industrial, maritime shipping and other human activities and due to severe storms.

- Food security and livelihoods are at risk from climate and non-climate impacts to shellfish and fisheries that inhabit bays and coves in the Coral Triangle.
- Extreme storms will increase sedimentation and pollution from upland areas that can increase the incidence of toxic microalgae and shellfish poisoning in coastal areas.
- Increased sedimentation will smother coral reefs in adjacent coastal areas.

4. Coral reefs are experiencing changes in ecosystem structure, function, and services due to overexploitation from fishing and coral harvesting (lime production, roads); increasing sedimentation from logging (palm oil) and other land-based pollution; and coral bleaching and degradation from increasing sea surface temperature and ocean acidification.

- Food security, livelihoods, and coastal tourism are at risk from human use and climate impacts to coral reefs in the Coral Triangle.
- Mass coral bleaching occurs when symbiotic microalgae are ejected under thermal stress.
- Ocean acidification will have significant impacts on coral growth and reef accretion.



5. **Fisheries** are experiencing changes in species composition, distribution, and yield of fish and invertebrates due to overfishing, increasing sea surface temperature, and changes in ocean circulation.

- Foods security and livelihoods are at risk from human use and climate impacts to fisheries in the Coral Triangle.
- Changes in sea surface temperature and ocean circulation resulting from climate change are likely to impact fish yield and distribution (Allison et al. 2005; Allison et al. 2009).
- Climate change is affecting physiological processes and the seasonality of biological rhythms, altering food webs, and, consequently, fish production.
- Climate impacts to coral reefs, including coral bleaching and ocean acidification are likely to impact fisheries associated with these habitats.



6. **Coastal communities living on small islands and in low lying coastal areas** are experiencing increasing populations growth in low lying coastal areas that are increasing vulnerabilities to coastal erosion, flooding, and inundation caused by sea level rise and severe storms.

- Human health and safety, livelihoods, and economic development are at risk from climate impacts to villages and municipalities in the Coral Triangle.
- Increased severity and frequency of severe storms increase potential for disaster conditions in coastal communities.
- Coastal communities in small island environments have limited land area to accommodate sea level rise and chronic flooding

7. **Critical coastal infrastructure** is experiencing repetitive damages, loss, and disruption of services due to coastal erosion, flooding, and inundation caused by rising sea level and severe storms.

- Human health and safety, livelihoods, and economic development are at risk from climate and non-climate impacts.
- Transportation, power supply, water and sanitation, hospitals, ports, emergency services and other critical infrastructure may result in repetitive losses.
- Government staff, facilities, and public records may be impacted causing loss of basic services.

8. **Coastal livelihoods and local economies** are experiencing economic losses due to degradation of natural resources from overexploitation and due to flooding, storm surge, and strong winds from increased frequency and intensity of typhoons.

- Food security, livelihoods, and economic development are at serious risk from climate and non-climate impacts to fishing, aquaculture, tourism, and other coastal livelihoods and businesses in the Coral Triangle.

- Climate change impacts on coastal livelihoods and local economies will result from damaged fishing and coastal tourism infrastructure (Allison et al. 2005; Allison et al. 2009).
- Changes in distribution, species composition and habitats will require changes in fishing practices and aquaculture operations, as well as in the location of landing, farming and processing facilities.
- Extreme events will also impact on infrastructure, ranging from landing and farming sites to post-harvest facilities, transport routes and coastal tourism.
- Water stress and competition for water resources will affect aquaculture operations and inland fisheries production, and are likely to increase conflicts among water-dependent activities.
- Reduced livelihood options inside and outside the fishery sector will force occupational changes and may increase social pressures.

4.0 Implementing Early Actions and Tools

Early actions encompass a broad range of best practices designed to build coastal community resilience to climate change. Qualitative or quantitative risk and vulnerability assessment provides useful information to prioritize adaptation options and evaluate benefits and costs of adaptation options, and is an important tool for building coastal community resilience to climate change. Early actions may be initial steps such as compiling and analyzing information, or applying tools to improve the effectiveness of existing policies, capacity building or education programs, and of community level projects by incorporating awareness of climate impacts and integrating climate risk reduction measures.

TOOLS

- Risk & Vulnerability Assessment
- Benefit-cost Analysis
- Land Use Analysis
- Data and Information Management and Sharing
- Research & Technology
- Legislation/Policy Development and Enforcement
- Capacity Building and Training
- Education, Outreach, and Communication Tools

Below are proposed actions and resilience-building best practices that address the climate change issues described in Section 3.0. These actions are organized, in general, starting with actions that mostly likely would be initiated and completed by the year 2015 (see Goal 4, CTI-CFF RPOA) followed by actions that would be planned and initiated over a medium- and long-term timeframe.

4.1 River and Estuary Actions

- A. Assess vulnerability of river and estuarine systems to flooding and sea level rise to assess vulnerability of adjacent communities
- B. Develop visualization tools including inundation maps for river banks, estuaries, adjacent settlements and agricultural areas to support planning that leads to reduced risk to existing and new coastal settlements
- C. Develop river and estuarine buffer zones and then restrict development
- D. Reinforce river banks to protect communities from flooding

- E. Dredge rivers in areas with heavy siltation to minimize flooding during extreme climate events
- F. Relocate agriculture and aquaculture to areas less prone to flooding and other climate impacts
- G. Identify agriculture and aquaculture products that are less prone to climate impacts
- H. Replant vegetation and reforest upland areas to stabilize land and minimize sedimentation to rivers and estuaries

4.2 Mangrove Actions

- A. Assess vulnerability of mangrove forests to sea level rise and other climate hazards
- B. Monitor sea level rise especially in mangrove forests where some changes are already occurring
- C. Establish landward buffer areas to allow retreat of mangrove ecosystems based on sea level rise projections
- D. Support good engineering designs (e. g. culverts and trestle bridges) which would have minimal impact on the tidal hydrology of coastal ecosystems.
- E. Preserve pristine mangrove forests to maintain ecological balance in the coastal ecosystem, for educational and research purposes and as genetic reservoirs
- F. Strengthen community-based natural resource management to sustainably manage mangroves and other natural resources
- G. Rehabilitate mangrove areas to buffer coastal communities from storm surge and other hazards, serve as nursery grounds to increase fishery production, protect coral reefs from sedimentation from upland sources, and sequester carbon to support climate mitigation
- H. Establish mangrove protection zones on the banks of river mouths fronting the sea.
- I. Protect mangrove mother trees as sources of seed and propagules for planting
- J. Establish a minimum protective zone of mangrove forest of greater than 100m along open coast, greater than 25m along river banks and lagoons, and greater than 10m along inland banks, creeks and channels
- K. Protect mangroves areas near or



A mangrove inspection in Bali, Indonesia

Photo credit: Marthen Welly



Volunteers plant 10,000 mangrove seedlings at the Verde Island Passage, Philippines

Photo credit: Cheryl Ventura

adjacent to known areas of abundant fish, mollusk, and crustacean fishing to ensure life history stages are connected.

- L. Provide alternative fuel sources for communities to minimize loss of mangroves
- M. Provide environmentally friendly alternative livelihoods for communities associated with mangroves such as bee-keeping, crab fattening, and other non-extractive livelihoods
- N. Conduct environmental impact analysis for all activities that would change coastal land use, and build capacity for environmental impact assessment and monitoring with local government and communities

4.3 Bay and Cove Actions



Community members propagate seedlings at reforestation project in Wakatobi, Indonesia

Photo credit: Stacey Tighe

- A. Adopt a ridge-to-reef approach to analyze and manage cumulative impacts of land- and sea-based activities on marine and coastal ecosystems
- B. Review and update national legislation on utilization and management of forests and water quality to enable effective enforcement
- C. Empower communities to report water quality violations
- D. Recognize the green practices of industries

- E. Conduct environmental impact analysis for all activities that would change coastal land use, and build capacity for environmental impact assessment and monitoring with local government and communities
- F. Implement spatial zoning to control land-based pollution
- G. Strengthen enforcement of pollution control laws in priority areas
- H. Reforest mangrove areas to control sediment transport
- I. Reforest hillsides to reduce sedimentation
- J. Relocate communities away from waterways to reduce water contamination

4.4 Coral Reef Actions

- A. Conduct baseline studies and monitor the condition of coral reefs, especially the incidence of coral bleaching
- B. Protect coral reef habitats, including associated mangrove and seagrass beds through effective management of a resilient network of Marine Protected Areas (MPAs)



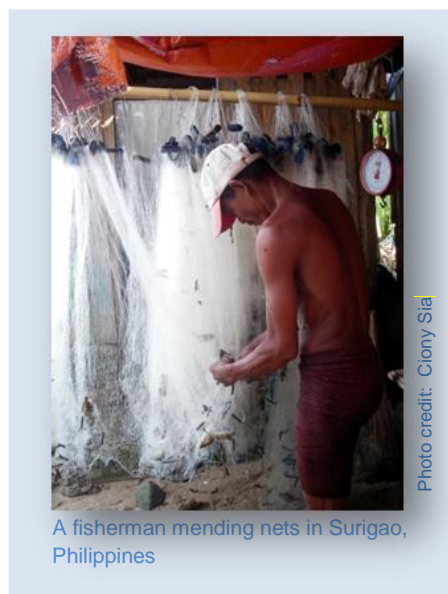
A community-based coral reef monitoring activity in Bohol, Philippines

Photo credit: Mohamad Saupi

- C. Prohibit coral harvesting
- D. Develop and promote use of alternatives to coral for lime production
- E. Strengthen enforcement of fisheries laws and regulations to minimize impacts on habitats and to maintain key species (herbivores)
- F. Establish special courts for fisheries enforcement
- G. Develop alternative livelihood to collecting coral
- H. Strengthen enforcement of habitat protection laws and regulations
- I. Develop sustainable coral farming
- J. Rehabilitate coral reef areas by establishing a coral nursery and re-planting corals

4.5 Fisheries Actions

- A. Conduct fisheries and habitat baseline assessment
- B. Develop and adopt comprehensive fisheries management plan including gear-specific management measures and zoning
- C. Establish registration and licensing system for fishers, boats, and fishing gears
- D. Improve coastal law enforcement
- E. Protect habitats, including mangroves, seagrass beds, and coral reefs through effective management of a resilient network of MPAs



A fisherman mending nets in Surigao, Philippines

4.6 Coastal Community Actions

- A. Conduct vulnerability assessments of coastal communities to climate change
- B. Conduct outreach and education to increase community awareness of climate change impacts and vulnerability
- C. Monitor coastal erosion rates and assess the cost of eroded coastlines to facilitate cost benefit analysis for adaptation
- D. Rehabilitate mangrove areas to buffer coastal communities from storm surge and other hazards
- E. Develop and improve household water harvesting systems
- F. Promote household gardens to diversify food source
- G. Integrate climate change adaptation measures to reduce risk into existing local development policies and plans
- H. Establish and strengthen early warning system for all hazards, natural and climate change-related



A community-based climate change adaptation workshop in Palawan, Philippines

- I. Prohibit sand mining in small islands
- J. Identify areas suitable for reclamation activities for eroding islands
- K. Identify coastal areas appropriate for protection using seawalls and offshore buffers
- L. Protect coastal areas with buffers such as boulders and other means that are not too destructive to break-up wave energy
- M. Diversify food supply to include climate-resilient plants and fisheries
- N. Develop relocation strategy for highly vulnerable communities
- O. Mainstream climate change adaptation in other sectors (for urban areas, transport, etc.)



Photo credit: William Jatulan

Community leaders from the Solomon Islands and Papua New Guinea learn how to measure sea level rise at a climate change adaptation training in Port Moresby

4.7 Critical Coastal Infrastructure Actions

- A. Assess vulnerability of critical infrastructure in the coastal zone including ports and harbors, fire and police stations, roadways, etc. to sea level rise, storm surge, and other climate impacts
- B. Develop building codes for climate-resilient infrastructure
- C. Establish coastal set-backs for new construction of critical infrastructure
- D. Design and site infrastructure to be climate-compatible
- E. Build seawalls and place gabions to protect critical infrastructure if cost effective when no other option, such as relocation, is available



Road damaged by the tsunami in Aceh, Indonesia

4.8 Coastal Livelihood and Local Economy Actions



Photo credit: Lory Tani

Local women earn alternative income from seaweed farming in Tawi-Tawi, Philippines

- A. Assess vulnerability of coastal livelihoods and business, including coastal tourism, fishing, and aquaculture, to sea level rise, storm surge, and other climate impacts
- B. Establish coastal set-backs for new economic development
- C. Adopt international greening programs to enhance sustainable development
- D. Establish greenbelts to protect businesses along the coastal zone
- E. Develop alternate incomes and livelihoods
- F. Develop specific laws to regulate aquaculture development in risk-prone areas

5.0 Strengthening Institutional Arrangements to Support Implementation

Collaboration among organizations and institutions around the Coral Triangle is essential for full implementation of the REAP-CCA. CTI-based regional institutional arrangements for REAP-CCA implementation include Ministerial Meetings, Senior Official Meetings, CCA and other Working Groups, and the Regional Secretariat. National institutional arrangements for REAP-CCA implementation include the National Coordinating Committee (NCC), as well as national working groups, departments, or divisions focused on climate change adaptation. As each of the six CT countries is already engaged in developing their government's capacity to address climate change under various international mandates and opportunities, many of the CTI CCA players are drawn from those organizations. Although still in development, the general description of the role and related activities of the CTI organizations and structures are summarized below.

Nationally, all six countries include climate change adaptation as a priority in their CTI NPOAs, and their CTI National Coordination Committees (NCCs) have developed linkages to their National Climate Change Councils or equivalent bodies to harmonize policies and actions between CTI, which focuses on the marine and coastal issues, and their terrestrial and general national programs. These early conversations between the marine and terrestrial issues national bodies identified a lack of understanding of the issues or relevance of the importance of the marine climate change impacts and needed adaptation planning. In general, the participants of the CCA Regional Exchanges identify two actions that can improve national implementation of adaptation:

- To apply integrated coastal management/ecosystem-based management approaches to the CTI and to climate change adaptation in particular. This can avoid unforeseen cross-sectoral impacts of policies and actions, and enable development of sounder programs to address climate change impacts; and
- To share and discuss mechanisms and lessons learned to address national implementation of climate change implementation with their CT6 counterparts and partners.

Early steps are already underway in most countries, including establishing national CCA Technical Working Groups or Teams under their NCCs that have representatives from multiple sectoral and agencies and partners such as non-governmental organizations, universities and the private sector. Other steps to build capacity for implementation include targeting local governments and using learning teams to develop and disseminate skills and knowledge and proposing a Learning Team to connect the CTI Organizations (NCCs, TWGs, SOM) to strengthen technical understanding and coordination (see Section 7 below for more details).

Regionally, the emerging CTI CCA Technical Working Group is the focus for coordination and for strengthening implementation of climate change implementation under the RPOA and NPOAs. The six Coral Triangle governments and partners will likely help oversee regional implementation grants, develop and disseminate CTI CCA priority needs and recommended approaches within the Coral Triangle region and outside, guide the building of capacity at the regional level, and coordinate, as requested by the six Coral Triangle countries, regional actions.

As needed, the CTI CCA Technical Working Group will request guidance from the Senior Officials Meetings, and report progress towards the RPOA targets. The Ministerial Meetings are an excellent forum for aligning a political “block” from the CT6 countries in international policy fora (already utilized through delivery of CTI Communiqués at the events linked to the 15th and 16th UN FCC Convention of the Parties). In addition, the Ministers can confer, share and return home with renewed conviction, directions and possibly opportunities for national implementation of CCA actions. At present, the CTI Regional Secretariat supports this coordination through administration of regional activities (meetings), facilitation of activities and events, and reporting to the various meetings and forums on the progress and approaches of the CTI.

6.0 Financing Climate Change Adaptation

Financing actions identified in the REAP-CCA can be supported by international, regional, national, and sub-national mechanisms. The ability to receive financing from any of the available funding sources for climate change adaptation actions typically depends upon a clear articulation of likely climate impacts and on a clear proposal of adaptation measures that will reduce vulnerability. Some financing mechanisms are more applicable to longer-term CCA programs and projects, therefore national and sub-national budgets and existing donor programs should be tapped to support implementation of early actions in the REAP-CCA. A number of financing options are available or emerging including:

- The Adaptation Fund, established by the Parties to the UN Framework Convention on Climate Change (UNFCCC) to finance concrete adaptation projects and programmes in developing countries that are Parties to the Kyoto Protocol and to allow direct access to the Fund by those Parties.
- The Asia Climate Change Adaptation Project Preparation Facility (ADAPT), a project of the United States Agency for International Development to address capacity and information needs of eligible governments in the Asia region in accessing climate change adaptation funds and accelerating investments in initiatives that increase resilience to the negative impacts of climate change.

National agencies are integrating climate change adaptation into policies and programs as part of their commitment to their CTI-CFF NPOA as well as NAPA. Many donors are integrating climate change adaptation into existing and future programs and projects. Local governments are beginning to integrate climate change adaptation and are allocating a portion of their budget to adaptation projects. These investments would demonstrate the commitment of local government to building coastal community resilience to climate change, potentially improving the ability to access international financing.

Public-private partnerships can serve as an important mechanism for funding climate change adaptation. Early actions can be integrated with existing public-private partnerships or new partnerships can be formed to support climate adaptation.

7.0 Addressing Regional Capacity Development Needs

Regional capacity development and training for climate change adaptation should target several key audiences:

- Practitioners to replicate cost-effective and efficient delivery of training and technical assistance
- Local government leaders and planning offices to begin assess vulnerability and integrate climate adaptation in local development policies, plans, and programs
- Public and private managers of natural resources to assess vulnerability and integrate adaptation measures into their resource management plans
- Sector planners and decision-makers in key positions to mainstream climate concerns into policies, programs, projects, and plans
- Private sector leaders to build their awareness of climate impacts and vulnerabilities, in the context of key supply chains

Key areas for capacity development include:

- Technical assistance and training on integrating climate change adaptation into sectoral plans, such as fisheries management, coastal infrastructure, and rural economic and livelihood development planning,
- Training to assist governments in developing proposals that meet the eligibility requirements of the major international CCA funds
- Building regional, national, and local capacity to support data and information management

7.1 Local Governments

Local governments in CT countries are also at the front-line in terms of experiencing climate change impacts and will have the critical responsibility of implementation of many of the early actions in the REAP-CCA, including consideration of climate change vulnerability into local development plans and policies. Towards achieving both regional and national CTI-CFF goals, local government leaders from the six Coral Triangle countries – Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor Leste – gathered during the 1st CTI Mayors Round Table in May 2011 in Wakatobi, Southeast Sulawesi, Indonesia to share challenges and opportunities in coastal management.



Coral Triangle mayors at the signing of an agreement to advocate for stronger policies that protect marine resources, promote awareness of the Coral Triangle.

Photo credit: Deenisa

A key output of the meeting was a signed joint communiqué announcing their commitment to advocate for stronger policies that protect marine resources, and promote awareness of the CTI-CFF,

and to share experiences and best practices that could enhance their roles as good caretakers of their environment. The CTI Mayors Roundtable marks the next step in establishing the CTI Local Governance Network, an expanding group of local government leaders and associations across the Coral Triangle advocating for strengthened local environmental governance, sustainable coastal management, and coastal community resiliency within the Coral Triangle. This regional network has great potential to be a critical implementation tool towards achieving the CTI's CCA early plan and targets.

7.2 Coral Triangle Atlas and Data Sharing

A key requirement for many climate change adaptation actions is information. An early review of national and regional data sources indicates that there is a wealth of some types of data that may not be very compatible in format, may be at the wrong scale, or may contain some gaps, and a lack of information of a specific key data type (for example bathymetric and topographical information, or sea-surface temperature, or local tidal fluctuations) in small or large areas of the Coral Triangle. In addition, institutions and governments share data very carefully, adding to the challenge of compiling or acquiring enough data to inform early actions or longer-term planning. However, several institutions have begun compiling spatial, ecological and social data for regional analysis and planning in a Coral Triangle Atlas.



Coral Triangle Atlas screenshot at <http://ctatlas.reefbase.org/>

In addition, global databases, some of which have open access offer opportunities for increasing quickly and simply available data for guiding early actions and planning. To this end, the CCA Regional Exchange convened in April 2011 explored with CT6 government officers, university and other partners the options and steps and types of information that might be assessable and whether the CT Atlas was a potential vehicle. The resulting recommendations include establishing a regional data team to compare and clarify data sharing agreements for specific critical types of data, exploring a relationship with and activity adding CCA data and analysis to the existing regional CT Atlas, and strengthening national centers such as government agencies and universities to manage and analyze the data in support of national decision-making, in particular for the CCA targets of the CTI Regional and National Plans of Action.

7.3 Climate Change Adaptation and other Learning Networks

Climate change and adaptation are still new topics for many globally and in the Coral Triangle, especially among slower evolving institutions such as government agencies and for general acceptance into a “community of practice”. Learning networks are one mechanism or institution that can facilitate a quick development and replication of new knowledge, models and practices. A learning network can be described as a group of individuals and/or organizations with a shared concern or interest who voluntarily contribute knowledge, experience or resources for shared learning, joint action or to achieve a shared purpose or goal.

In March 2011, the CT countries and partners gathered to discuss and plan the use of learning networks in the CTI and some specific proposed learning networks will be presented to the Senior Officials Meeting for recognition and endorsement as these networks will link with the CTI organizational structures, such as the technical working groups and National Coordination Committees to implement their activities. Climate change adaptation was noted to be a key component and beneficiary of some of the networks proposed, such as the Marine Protected Area, Sustainable Fisheries and Ecosystem-Based Management Learning Networks. In addition, during the April 2011 CCA Regional Exchange, a plan to strengthen CCA training for prioritized CCA implementers evolved that includes developing a pool of national trainers in the six countries and following up the first set of targeted trainees through sharing and mentoring their early actions, primarily vulnerability assessments.

This informal “learning team”, under the CTI CCA Technical Working Group or other regional organization, has the potential to become its own “CCA Learning Network”. As such it can address specific early actions of the REAP-CCA. In addition, the CCA Learning Network could then link with the other thematic learning networks inside or outside of CTI (such as CAKE and SERVIR)¹ to build networking skills, share successes, and discuss integrated actions across themes.

7.4 Climate Change Adaptation Centers of Excellence

The CTI-CFF RPOA has a target to develop a network of national centers of excellence on climate change adaptation for marine and coastal environments. This target has not been prioritized by the CT6 in earlier discussions, and so is not targeted specifically in this REAP-CCA as an early action. However, there are other climate change centers of excellence in the Southeast Asia and Pacific regions that could be serve as a resource for skills and knowledge in the short term, as well as numerous new United Nations, multi-lateral, bi-lateral and regional organizational programs and opportunities emerging regularly to address climate change in the region that the REAP-CCA can link to in order to achieve its targets. The CTI CCA Technical Working Group will likely be tasked with scouting for these opportunities and developing this Center of Excellence activity for the longer term, although some early steps (such as capacity and data needs assessments) are already underway in the actions proposed by this REAP-CCA.

¹ Climate Adaptation Knowledge Exchange (www.cakex.org/) is a joint project of [Island Press](#) and [EcoAdapt](#) aimed at building a shared knowledge base for managing natural systems in the face of rapid climate change.). The SERVIR initiative, a joint USAID and US National Aeronautics and Space Administration (NASA) program, integrates satellite observations, ground-based data and forecast models to monitor and forecast environmental changes and to improve response to natural disasters with geographic activity teams.

8.0 Tracking Progress and Reporting Results

Tracking progress of REAP-CCA implementation and reporting results under the CTI-CFF is essential for catalyzing and sustaining action and funding for climate change adaptation. Benchmarking local implementation and monitoring key indicators provide the mechanisms to track progress and report on results

8.1 Benchmarks for Local Implementation

Benchmarks can serve as a useful tool to catalyze and guide local implementation of climate change adaptation. Local governments in Coral Triangle countries are at the front-line of building communities resilient to climate change by balancing social, economic, and environmental goals while reducing risk to climate change. Indicative benchmarks to catalyze and guide local implementation of early actions by local governments in the Coral Triangle are provided in Table 1. Benchmarks are organized at three different levels; however, emphasize several common themes:

- Building collaborative relationships among different sectors at the local level and expanding these collaborative relationships to include adjacent local governments, as well as national, regional and international organizations.
- Assessing risks and integrating risk reduction measures into existing policies, plans, and programs to eventually mainstreaming measures that reduce risk from climate change
- Adopting resilience-building best practices that balance social, economic, and environmental goals and integrate risk reduction measures.

Although three levels of benchmarks are provided, it is anticipated early actions prioritized in this REAP-CCA target *Level 1 – Getting Started* (1st column in Table 1).

Table 1. Benchmarks for Local Implementation in the Coral Triangle

Level 1 – Getting Started	Level 2 – Laying a Solid Foundation	Level 3 – Responding to Changing Conditions
<p>Objective: Awareness of climate hazards and vulnerability with early adaptation actions initiated.</p>	<p>Objective: Climate adaptation measures integrated into plans and programs with regular funding allocated to sustain implementation of early adaptation actions with monitoring</p>	<p>Objective: Climate adaptation mainstreamed into policies, plans, programs and decision making processes across all sectors with monitoring, measured results, and positive returns.</p>
<ul style="list-style-type: none"> • CCA team organized and trained to facilitate local early action planning • Community outreach on climate change issues and early actions conducted • Local climate vulnerability assessment (qualitative) conducted 	<ul style="list-style-type: none"> • Local partnerships established to support adaptation • Stakeholder outreach local early adaptation plans on adaptation measures conducted • Local climate vulnerability assessment updated and refined (quantitative) 	<ul style="list-style-type: none"> • National, regional, and international partnerships established to support long term adaptation • CCA mainstreamed into policies, plans, and programs

Table 1. Benchmarks for Local Implementation in the Coral Triangle

Level 1 – Getting Started	Level 2 – Laying a Solid Foundation	Level 3 – Responding to Changing Conditions
<ul style="list-style-type: none"> Indicators (social and natural) of climate impacts and adaptation actions identified and baseline assessment conducted Timeline for implementation of early adaptation actions developed At least 2 early adaptation actions planned and initiated 	<ul style="list-style-type: none"> Early actions and timeline for implementation reviewed and updated Local early action plan results incorporated into plans and programs At least 4 early adaptation actions implemented with measured success Monitoring of climate impacts and adaptation strategies conducted 	<ul style="list-style-type: none"> At least 6 early adaptation actions implemented with measured success Monitoring of climate impacts and adaptation strategies conducted and to adapt and improve management
← Short Term →	← Medium Term →	← Long Term →

8.2 Indicators to Monitor REAP-CCA Implementation

Several selected indicators from local and national levels will be compiled to measure progress at a regional level. As an illustration of the types of indicators, those for mangrove resources, as one of the eight strategic natural resources for CCA, are proposed here. The indicators track developing and integrating climate risk knowledge, progress toward implementing early actions, and institutions strengthened to address climate issues.

- Hectares of mangrove restored
- Hectares of mangrove protected
- Number of climate risk and vulnerability assessments conducted
- Number of national and sub-national plans integrating climate risk reduction
- Number of early adaptation actions initiated, implemented, and monitored
- Number of regional, national, and local institutions with strengthened capacity to address new and emerging climate issues

Similar indicators for the other seven climate change adaptation strategic resources will be developed by the Technical Working Group in consultation with thematic experts and government representatives from the six Coral Triangle countries and will be appended to the REAP-CCA over time.

8.3 Reporting

At a national level, the NCCs will be primarily responsible for tracking progress on REAP-CCA implementation and reporting results as they would for any element of the CTI-CFF RPOA. The CTI CCA TWG will consolidate national progress reports for input to the CTI Annual Report and State of the Coral Triangle Report.

Glossary

Adaptation	Adaptation to climate change refers to adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.
Climate Change	Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the United Nations Framework Convention on Climate Change (UNFCCC), in its Article 1, defines “climate change” as: “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” The UNFCCC thus makes a distinction between “climate change” attributable to human activities altering the atmospheric composition, and “climate variability” attributable to natural causes.
Climate Prediction	A climate prediction or climate forecast is the result of an attempt to produce a most likely description or estimate of the actual evolution of the <i>climate</i> in the future (e.g., at seasonal, inter-annual, or long-term <i>time-scales</i>). See also <i>climate projection</i> and <i>climate (change) scenario</i> .
Climate Projection	A projection of the response of the climate system to emission or concentration scenarios of greenhouse gases and aerosols, or radiative forcing scenarios, often based upon simulations by climate models. Climate projections are distinguished from climate predictions in order to emphasize that climate projections depend upon the emission/concentration/radiative forcing scenario used, which are based on assumptions, concerning, for example, future socio-economic and technological developments that may or may not be realized, and are therefore subject to substantial uncertainty.
(Climate) Scenario	<p>A plausible and often simplified description of how the future may develop, based on a coherent and internally consistent set of assumptions about key driving forces (e.g., climate change, human activities) and relationships. Scenarios are neither predictions nor forecasts and sometimes may be based on a “narrative storyline.” Scenarios may be derived from <i>projections</i>, but are often based on additional information from other sources.</p> <p>A climate scenario is a plausible and often simplified representation of the future climate, based on an internally consistent set of climatological relationships that has been constructed for explicit use in investigating the potential consequences of anthropogenic climate change, often serving as input to impact models. Climate projections often serve as the raw material for constructing climate scenarios, but climate scenarios usually require additional information such as about the observed current climate. A</p>

	“climate change scenario” is the difference between a climate scenario and the current climate.
Climate Impacts	Consequences of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts. Potential impacts: All impacts that may occur given a projected change in climate, without considering adaptation. Residual impacts: The impacts of climate change that would occur after adaptation.
(Climate) Impact Assessment	The practice of identifying and evaluating the detrimental and beneficial consequences of climate change on natural and human systems.
Climate Variability	Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).
Hazard	A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Exposure	People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses
Resilience	Amount of change a system can undergo without changing state. Applied to coastal communities, the capacity to absorb shock, bounce back quickly, and adapt to change.
Risk	The combination of the probability of an event and its negative consequences.
Sea Level Rise	An increase in the mean level of the ocean. Eustatic sea-level rise is a change in global average sea level brought about by an alteration to the volume of the world ocean. <i>Relative sea-level</i> rise occurs where there is a net increase in the level of the ocean relative to local land movements. Climate modelers largely concentrate on estimating eustatic sea-level change. <i>Impact</i> researchers focus on relative sea-level change.
Sensitivity	Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate-related <i>stimuli</i> . The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to <i>sea-level rise</i>).
Vulnerability	The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. Climate vulnerability refers to the degree to which a system is susceptible to, or unable to cope with, adverse effects of <i>climate change</i> , including <i>climate variability</i> and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its <i>sensitivity</i> , and its <i>adaptive capacity</i> .

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