Climate Change Adaptation:
A Freshwater Perspective

CONSERVATION INTERNATIONAL

The Challenge of Climate Change for Freshwater Resources

Climate change will significantly impact freshwater systems and the human and non-human communities that depend upon them for their survival.

Impacts vary across geographies and time-scales, but a number of trends for freshwater are becoming clearer as our understanding increases: glaciers and ice caps are melting, affecting human water supplies and reducing the productivity of riverine fisheries. Increased evaporation, drier soils and more unpredictable rainfall are increasing the risk of droughts, decreasing crop yields in some areas and threatening food security. Groundwater supplies are becoming increasingly affected by saltwater intrusion from sea level rise in coastal areas. Additionally, warmer water temperatures, combined with existing threats such as sedimentation, will exacerbate water quality issues for both human consumption and maintenance of freshwater biodiversity. Human migration and increased competition for resources threaten social stability, especially for the more than one billion people living in poverty.

Nearly two thirds of the world's people already face freshwater scarcity at a time where demand for freshwater is growing; climate change threatens to apply even more pressure on this essential resource. This vulnerability highlights the urgent need to consider the application of every available tool in our collective efforts to protect the planet's inhabitants from climate change.

Adaptation to Climate Change in the Freshwater Context

When a system is 'resilient' it means that it will generally continue to function despite disturbance. When faced with new pressures imposed by climate change, a resilient freshwater system will continue to reliably supply services such as drinking water, crop production, fisheries productivity and flood mitigation to meet the needs of the local community—and continue to provide necessary conditions for species survival.

In a freshwater system with low climate resilience, its capacity to continue to provide these services may be significantly reduced. In such cases, there are a range of alternative management responses that can help communities adapt to the new climatic conditions so that negative human development and biodiversity impacts can be minimized. There are three categories of adaptation responses that are relevant to the relationship between freshwater ecosystems and their dependents:

Species or Ecosystem Protection: This response seeks to improve the climatic resilience of species or ecosystems in a particularly vulnerable area. The USEPA (2008) suggests that such responses focus management protections on characteristics, organisms, or areas that represent important 'underpinnings' of the overall system (e.g. keystone species such as top predators). Some examples of these approaches include reducing anthropogenic stresses (minimizing localized human stressors) that hinder the ability of keystone species or ecosystems to withstand climatic events; restoring ecosystems that have been lost or compromised; and establishing refuges that are more resilient to climate change and can be used as sources of "propagules" for recovery or as destinations for climate-sensitive migrants.

Traditional Engineering and Planning Solutions: This response seeks to improve the climate resilience of human development activities that may have a negative impact on the resilience of local ecosystems, which may then jeopardize development gains in the long term. As identified by the World Bank (2009), infrastructure, in the form of dams or flood channels, that seeks to constrain natural, regular ecological cycles, invariably leads to habitat loss, thereby compromising the natural storage and recharge benefits of remaining forests and wetlands.

Ecosystem-based Adaptation: This response is when the natural provisioning and regulatory functions of ecosystems are harnessed to promote human adaptation to climate change, while minimizing environmental damage**.** Ecosystem-based adaptation recognizes the critical nature of the services that biodiversity and ecosystems provide to human communities and that help build resilience to climate change. Incorporating ecosystem-based adaptation into an integrated approach to climate change adaptation can provide longer term, more effective and more cost-efficient solutions that support human well-being and a healthy environment. This approach is particularly relevant to the freshwater context due to the complex and dynamic nature of these systems.

Conservation International's Approach

Conservation International is built on a strong foundation of science, partnership and field demonstration. Its mission is to empower societies to responsibly and sustainably care for nature for the well-being of humanity. In its more recent freshwater work, CI is conserving freshwater ecosystems which we expect will help build climate resilience for human communities. **We will build upon our experiences in species and ecosystem protection and apply lessons learned to support ecosystem-based adaptation.**

CI recognizes that adaptation responses can have 'winners' and 'losers' in relation to long-term development and conservation objectives. For example, building irrigation dams may increase water supply for agriculture yet jeopardize the provision of other important ecosystem services, such as regulation of sediment flows; and badly targeted species protection or poorly designed ecosystem-based adaptation approaches could exclude critical revenue-generation activities for local communities.

Responding to climate change requires collaborative approaches to pool expertise from local communities to international experts, and across sectors, to select the adaptation measures that will deliver the greatest concentration of benefits.

Adaptation strategies and policies must therefore allow for the inevitable changes caused by climate change in a way that supports biodiversity and human well-being and incorporates the traditional adaptation practices of local communities. CI already partners with many of the essential parties needed to effectively address adaptation: communities, development organizations, governments, industry, research institutions and other non-governmental organizations—and so is well placed to help coordinate and participate in 'on the ground' adaptation efforts.

CI's freshwater program is helping to build resilience to climate change by:

Applying the best available science and managing uncertainty. CI is identifying likely climate change impacts, vulnerabilities and response options for both people and species in the places where we work. Because there is often too little scientific certainty to develop precise adaptation responses, we are identifying adaptation measures that target a broad range of potential climate change impacts

Working with and building local capacities. Most societies have traditional and non-traditional knowledge and institutions to manage all manner of environmental and other changes such as long-standing climatic and hydrological variability. Local practices to respond to changes in

water supply, droughts and floods for example, are often effective, flexible and robust measures that need to be maintained to reduce vulnerability to climate change.

Mainstreaming climate adaptation responses. CI is working with government and non-government partners to build climate resilience into CI's and their partner's projects in areas of high climate vulnerability, acknowledging that climate change has the potential to undermine both the conservation and development objectives particularly in relation to water security of projects in these high-risk areas.

Applying multi-disciplinary approaches. CI is combining its biodiversity conservation, ecosystem management and socio-economic expertise to inform development and conservation decision-making. We are supporting decision-makers in their efforts to weigh the life-cycle costs and benefits of soft versus hard management infrastructure, identifying areas of high water services concentration for conservation, and enhancing community decision making to manage local natural resources.

Monitoring and adaptive management. Given the uncertainties inherent in projecting climate change impacts and therefore in the effectiveness of our management responses, freshwater activities need to be structured so that tactical adjustments can be made by local decision-makers to respond to new information derived from monitoring the on-going impacts related to climate change.

Conservation International in Action:

Intact and functioning ecosystems increase the food, water, health and livelihood securities of all people living within their vicinity. The Millennium Ecosystem Assessment (2005) links ecosystems to human well being as follows:

Provisioning Services: food, freshwater, fiber and fuel, biochemical, and genetic materials.
Regulating Services: climate, water, water purification and waste treatment, erosion, natural hazard and pollination.
Cultural Services: spiritual and inspirational, recreational, aesthetic and educational.

The following CI case study summaries use these ecosystem service categories to offer examples of existing work that links climate resilience and livelihood benefits through the protection of ecosystem services:

Cambodia

In 2008, CI and its partners secured Cambodian Government approval to triple the area covered by fish sanctuaries in the Tonle Sap Lake to 50,000 hectares (123,553 acres), to cover key floodplain forests and dry season ponds. Work is also underway to remove illegally set fishing equipment and promote sustainable harvesting practices. Dry season pond refuges for fish are being conserved, including the addition of artificial reefs to shelter fish and disrupt illegal fishing practices. The critical floodplain forest ecosystems are also being conserved, and work has commenced to replant 1,000 hectares (2,471

acres) of illegally logged forest. These interventions are expected to increase populations of fish and threatened wildlife species and thereby maintain both livelihood and food security and biodiversity of the region.

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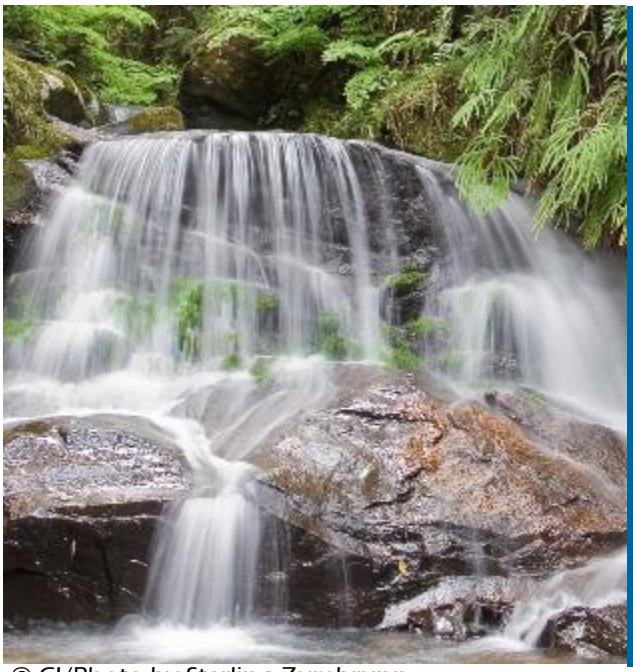
Provisioning Services	Regulating Services	Cultural Services
-Fisheries conserved -Fibers and fuel wood secured -Hydropower generation extended -Agriculture supported with less erosion and a more stable water supply -Genetic materials conserved	-Forest watersheds guard against extreme events, and reduce erosion and other pollutants -Resilience of water sources enhanced -Avoided deforestation sequesters carbon -Pollinators conserved	-Enhanced local self-determination -Education services extended -Buddhist society engaged

Madagascar

In 2008, CI and its partners undertook an assessment of the climate risks to terrestrial and marine biodiversity, and to key livelihood sectors such as agriculture and fisheries in Madagascar. The study identified crucial adaptation measures including improved watershed management and ecological restoration, especially restoration that connects remaining fragile rainforest blocks and riverine forest corridors, with financing through payments for watershed services schemes. As riverine corridors have been vital for adaptation to past climate change,

particularly those that span altitudinal gradients, development of an action plan to maintain, restore and advance understanding of these key features was one of the principal recommendations.



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Provisioning Services	Regulating Services	Cultural Services
-Water supplies conserved -Fisheries conserved -Fibers and fuel wood secured -Agriculture supported with less erosion, more stable water supply -Genetic materials conserved in parks	-River corridors and forest watersheds guard against extreme events, aid specie movement, and reduce erosion and other pollutants -Resilience of water sources enhanced -Forest replanting and avoided deforestation sequester carbon -Pollinators conserved	-Local self-determination enhanced -Education services extended -Ecotourism developed

Colombia

In 2007, CI contributed to establishing Colombia's Ecosystem Services National Strategy, as a basis for widespread application of payment for ecosystem services schemes and Clean Development Mechanism projects targeting the Paramo, a neotropical ecosystem of peat bogs and wet grasslands intermingled with shrub lands and forest patches. CI has since helped establish the Fondo Patrimonio Natural - a non-profit Colombian foundation created to manage Clean Development Mechanism funds and oversee the work of CI and its partners to implement reforestation in the 560,000 hectare (1,383,790 acres) Sumapaz-Chingaza corridor and San Rafael watershed. The

Foundation's planned investment of 60 million US Dollars over ten years will also help diversify the local economy through employment in national parks, forestry, ecotourism, and sustainable agricultural production.

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Provisioning Services	Regulating Services	Cultural Services
-Urban water supplies secured -Hydropower generation extended -Genetic materials conserved in parks	-Forest watersheds guard against extreme events and reduce erosion and other pollutants -Resilience of water sources enhanced. -Forest replanting and avoided deforestation sequester carbon -Pollinators conserved	-Local self-determination enhanced -Ecotourism developed

The Way Forward

While climate impacts vary widely with geography there are a number of specific conservation practices that may help to build climatic resilience within the freshwater context that CI will begin to incorporate into our larger agenda on ecosystem-based adaptation. Based on the characteristics of a specific landscape, the climate

change resilience of a freshwater system may be increased when the following conservation practices are prioritized:

Preserving important tributary rivers, such as those that are free-flowing or those that contribute the most water, so as to sustain the health of a river-basin ecosystem and ensure long term provision of freshwater services for people.

Conservation and restoration of riverside habitats such as forests, as these areas provide nutrients needed by aquatic wildlife, filter out pollutants, reduce erosion, and shade the water to maintain temperatures preferred by aquatic species. These riverine corridors may also enable many species to adapt by allowing them to disperse through otherwise impermeable landscapes to suitable habitat in more climatically favorable regions.

Improved wetland management which can help to regulate water flows, enhance water quality and reduce the impacts of extreme events like floods. Under the right conditions mangroves can also migrate naturally to accommodate sea level rise.

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We invite you to join CI in promoting the actions needed to ensure that ecosystem-based adaptation conserves our planet's ecosystems and benefits people. We recommend the following activities be pursued through CI and partner work:

Promote ecosystem-based adaptation programs within the freshwater activities of their organizations and with their governments by applying the principles and practices described above;

Start a local freshwater adaptation program drawing on the adaptation methods described above.

Support CI's continuing work in linking freshwater conservation and climate change adaptation.

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