



GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET



EXPERIENCES FROM SGP:

Protecting International Waters

THROUGH CLIMATE RESILIENT
AND COMMUNITY-BASED ACTIONS





Acknowledgements

This publication highlights the work of the GEF Small Grants Programme (SGP) in the international waters focal area that not only generates global environmental benefits through community-based management approach to international waters issues, while assisting communities to increase their resilience and adapt to climate change.

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Foreword





Monique Barbut
CEO and Chairperson
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Faced by mounting global climate change challenges, the entire world is struggling to find valid and effective solutions. Climate change impacts on every aspect of human society and ecological systems, with the possibility to undermine development and environmental protection efforts undertaken so far. There is no other more urgent time than now do we need concrete and practical solutions to environmental and developmental challenges, coupled with climate change threats. Hence, we are delighted to present in this publication the GEF Small Grants Programme's approach and good practices in managing and protecting the world's water systems, while enhancing adaptive and resilient capacity to cope with climatic variability and change at the community level.

GEF Small Grants Programme (SGP) is GEF's window for small-scale activities at the community level to address global environmental issues including biodiversity, climate change, international waters, land degradation and persistent organic pollutants. SGP is a GEF corporate programme, implemented by the United Nations Development Programme, on behalf of GEF's implementing and executing agencies.

This report highlights the successes of the GEF Small Grants Programme in the international waters focal area. Special emphasis has been placed on the global benefits provided by international waters management and adaptive management techniques. It offers a community-based approach in international waters management that generates not only global environmental benefits but also increases adaptive capacity for communities and ecological systems. The publication provides a snapshot of successes pulled from the nearly 600 projects in the SGP international waters portfolio. From the study of the portfolio, it is clear that international waters resource management approaches and tools that are environmentally sound and sustainable can be also utilized as adaptive management mechanisms with intended or unintended adaptation benefits demonstrated by case studies taken from a variety of geographical areas.

We consider this publication a valid and timely contribution to accumulating good practices, knowledge and understanding on managing international waters, while adapting to climate variability and change. We hope it reaches the widest possible audience and inspires more innovative practices at the community level to address the global environmental challenges, and leverage new political and financial support to promote environmental protection and sustainable management for the poor and vulnerable communities.

An aerial photograph of a massive, multi-tiered waterfall cascading down a lush green mountain. The water flows in numerous streams and pools, creating a misty atmosphere at the base. The surrounding landscape is densely forested with vibrant green vegetation. A semi-transparent green rectangular box is overlaid on the right side of the image, containing the word "Preface" in white text.

Preface



Yannick Glemarec
Executive Coordinator
UNDP Global Environment
Facility Unit

Launched in 1992, SGP has implemented more than 12,000 projects at the community level to protect the global environment. This publication captures the lessons and experiences that have emerged from the SGP's portfolio of over 600 projects in the international waters focal area, with a particular perspective in dealing with climatic variability and change.. The portfolio review with selected case studies brings to light a deeper understanding of the community-based approach to international waters management, its potential adaptation benefits and overall how the community-based activities have generated global environmental benefits with development impact.

Climatic variability and change pose great challenges to the global environmental protection efforts. In the international waters area, communities reliant on trans-boundary waterbodies for their livelihoods and wellbeing are particularly susceptible to the impacts of climate change and other environmental threats which are often exacerbated by a changing climate . As the case studies in the publication show, SGP is helping local communities around the world respond to a variety of environmental threats and development challenges.

This publication assesses the impact of climatic variability and change on various waterbody types in which SGP operates, including rivers, regional seas and coastal waters, lakes and inland seas and demonstrates that sound international waters management can also have the added potential benefit of increasing community resilience to climate change. Through these community-based activities, many of these projects have the added benefit of increasing community resilience to climate change.

The SGP hopes that this publication will interest the development community involved in environmental management and sustainable development, and will demonstrate to practitioners, decision-makers and local communities the importance of utilizing international waters management tools and techniques for future use in adaptation, and inspire more innovation and good practices on the ground. It is also apparent that community efforts must be supported and implemented effectively in order to achieve resilience among the world's most vulnerable communities.



Introduction

CLIMATE CHANGE, INTERNATIONAL WATERS MANAGEMENT AND POTENTIAL ADAPTATION MEASURES

The world is currently at its warmest in this interglacial period which spans 12,000 years. Scientists proved the four previous periods of Earth's warming all correlated with increased levels of CO₂. This fifth period exceeds natural increased CO₂ levels due to anthropogenic influences. Greenhouse gases like methane and ozone have contributed to the problem but CO₂ has been the greatest cause, leading to an average global temperature rise of .7 degrees Celsius in the 20th century. Changes in the hydrologic cycle, from the effects of increased temperatures, will affect each region differently. Some countries will experience increased drought while others will need to adapt to increased flooding and salinization. Many water ecosystems will be transformed, putting biodiversity at risk, as many species, both plants and animals, and especially vulnerable communities, are unable to adapt quickly enough.

The Global Environment Facility's international waters (IW) focal area focuses on transboundary waters systems, such as river basins that have water that flows from one country to another, or other sources of water and marine ecosystems bounded by more than one nation. Transboundary waters include both fresh and saline ecosystems, including rivers, lakes, coastal waters, and groundwater. Oceans and saline lakes comprise 97.6% of the Earth's water while the remaining 2.4% is fresh water². These bodies of water all rely on the hydrologic cycle for replenishment. Replenishment varies by climate and region and may take days or thousands of years. Mankind relies on the

1 UNDP. *Human Development Report 2007/2008*. New York, NY: UNDP 2008, 31.

2 Cunningham, William and Mary Ann Cunningham, "Principles of Environmental Science: Inquiry and Applications, 2nd Ed," New York, NY: McGraw-Hill 2003, 227.

hydrologic cycle for fisheries, agriculture, food, drinking water and transportation.

Climatic variability and potential changes pose new challenges and dimensions to international waters resources management, which typically addresses direct human-induced threats to transboundary waterbodies. Natural variability, changes and threats resulting from or exacerbated by climate change prove to be more intimidating due to the scale and fundamental and persistent impacts on eco-systems. With a temperature rise of 3–4 degrees Celsius, rising sea levels from melting glaciers will cause flooding, displacing 330 million³ people worldwide with small island nations suffering the most. The melting glaciers will temporarily increase river flows and will then be followed by a decline in discharge. Warmer air temperatures warm oceans, may intensify storms like hurricanes, and cause faster surface water evaporation. All bodies of water will experience changes in aquatic food chains due to consequences on the structure of aquatic predator populations.

These changes have been taking place in many of the water bodies in which the SGP operates, including:

- Regional seas such as the South Pacific, the Indian Ocean, the Red Sea, and the Caribbean Sea among others;
 - Rivers and river basins such as the Mekong River, Nile River, Amazon River, Senegal River, Niger River, Danube River, Jordan River, and Volta River Basin, among others; and
 - Lakes and inland seas such as Lake Victoria, Lake Jipe, Lake Baikal, Lake Chad, the Aral Sea, Caspian Sea, and Dead Sea.
- Climate change can precipitate or compound a number of environmental and water resource challenges in international waters including:
- Hydrologic changes and stream flow timing changes that result in downstream effects;
 - Reduction in the quality and availability of fresh water supplies;
 - Potential for increased competition of water resources in transboundary basins;
 - Degradation of coastal waters and wetlands;
 - Intensified shoreline changes, such as coastal erosion;
 - Changes in fisheries habitats;
 - Increased levels of pollutants in depleted water supplies;
 - Spread of invasive species;
 - Acceleration of the retreat and loss of glaciers

Approaches to Address Climate Risks

The 2001 Assessment Report by the IPCC emphasized that climate change adaptation is a necessary strategy to be used with mitigation, and that it must gain a permanent place on the international policy agenda.

While mitigation deals primarily with strategies to reduce greenhouse gases, adaptation is defined as: “adjustments in human and natural systems, in response to actual or expected climate stimuli or their effects that moderate harm or exploit beneficial opportunities”.⁴ Adaptation strategies aim to enhance the resilience of ecosystems to the effects of climate change in a manner that is cost effective and feasible. A critical goal of adaptation is to reduce vulnerability and save lives while reducing future economic, social, and environmental costs, increasing the efficiency and effectiveness of development activities.

In addition to a changing climate, communities must struggle with climatic variability that has always existed. While droughts and floods have been ignored many times in development assistance, the GEF international waters areas has provided countries with opportunities to apply adaptive management principles to address climatic variability, and these experiences have potential application for adaptation purposes.

Two basic approaches exist in addressing adaptation to climate change: increasing ecosystem resilience and reducing ecosystem vulnerability through ecosystem-based adaptation. These approaches are mutually re-enforcing and can be undertaken simultaneously to address not only climatic variability but also challenges by climate change.

Reducing threats to international waters such as overharvesting, pollution and invasive species create healthier and more resilient ecosystems. Coral reef rehabilitation through improved fishing practices and reduced coastal pollution increases their ability to survive warming waters, bleaching⁵ and acidification. Reductions in pollution relieve the strain put on the coral’s immune system to continually clean itself. Meanwhile, better management of ecosystems reduces their vulnerability (and that of those who rely on them).

In addition, to be successful, adaptation on-the-ground must be coupled with support and change within

3 UNDP. *Human Development Report 2007/2008*. New York, NY: UNDP 2008, 9.

4 IPCC. “Chapter 18: Adaptation to Climate Change in the Context of Sustainable Development and Equity,” *Climate Change 2001: Impacts, Adaptation and Vulnerability*, Working Group II Contribution to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge: Cambridge University Press, 2001, 877–912.

5 Environment Department. “Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change.” Washington, DC: The World Bank 2009, 49.

government systems. Communities cannot have the ability to adapt to climate change without improved governance, management and infrastructure at various levels.

Potential Mechanisms for Adaptation

Combined with increased responsibility on mitigation effort in the upcoming decades, adaptation is a cost-effective solution, as well as an emergency for countries in development needs. In addition to other environmental and development threats, including manmade threats such as poor water management, overfishing and deforestation, hydrological variability is expected to increase worldwide poverty by 11 million⁶ people and poorer vulnerable communities that depend on their ecosystems for livelihoods will need to adjust and adapt to avoid conflict and maintain biodiversity.

REDUCTION IN VULNERABILITY: ECOSYSTEM-BASED ADAPTATION

Ecosystems and societies have become vulnerable to the forces of climate change beyond climatic variability through a climate-induced reduction in resources and unsustainable resource use. As both short-term carbon stores and much longer-term sinks, it is important to maintain the integrity of ecosystems so they can function as both an instrument of mitigation and be used sustainably to support human life. Maintaining the size and integrity of these ecosystems through techniques such as restoration, improved farming and fishing techniques and reforestation enable them to withstand some climate effects, maintain biodiversity, and reduce water shortages. These changes can prevent erosion and influence rainfall patterns. Enhancing or rehabilitating natural ecosystems such as coastal mangroves through ecosystem-based adaptation can replace expensive infrastructure and protect coastal, lake, and river communities from climatic events and other environmental threats.⁷

Through the sustainable management of watersheds, forests, wetlands, coastal ecosystems and protection of ecosystem services and natural resources upon which local communities depend, such as timber, fisheries and water, ecosystem-based adaptation provides social, economic,

and environmental benefits that can enhance local livelihoods, further reducing vulnerability.⁸ Improved ecosystem management enhances resilience, protects carbon stores and helps communities adapt to climate change.

INCREASING IN RESILIENCE: INTEGRATED WATER RESOURCES AND INTEGRATED COASTAL MANAGEMENT

Climate variability and change impacts every aspect of international waters management, and affects related multiple sectors and activities, including water supply, agriculture, food security and disaster management. Unequal distribution already forces water-stressed countries like Yemen to create stricter water policies than in regions like Latin America.⁹ Predictions of drier climates and warmer temperatures are predicted to lead to food access troubles. Soil will have moisture retention problems from higher rates of evaporation, causing crop failure. Changes in crop evapotranspiration, or the sum of evaporation and transpiration,¹⁰ can be an additional consequence of a changing climate, decreasing water resources availability. Plant transpiration also moves large amounts of evaporated water into the atmosphere and so, more irrigation is required to maintain crop yields.

Changes in water distribution mark a growing trend of competition among nations and communities sharing water sources as populations expand and water demand increases. Access to water provides national security by sustaining the agricultural sector, increasing development and reducing poverty. Adaptive management is imperative to overcome the effects of climatic variability and change and the conflicts that may arise from competition over scarce water resources.

Resilient ecosystems are able to better return to their original size, diversity and state after being strained, altered or damaged. Used sustainably, these ecosystems maximize their resilience and are then better able to cope with environmental changes. Sustainable management of resilient water-based ecosystems requires integration of various levels of interventions across sectors, in the form of integrated water resources management, coastal management, and sound management of transboundary river basins.

6 UNDP. *Human Development Report 2006*. New York, NY: UNDP 2006, 157.

7 Environment Department. "Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change." Washington, DC: The World Bank 2009, 10.

8 Environment Department. "Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change." Washington, DC: The World Bank 2009, 21.

9 UNDP. *Human Development Report 2006*. New York, NY: UNDP 2006, 135.

10 USGS. "The Water Cycle: Evapotranspiration." USGS, 5 October 2009. <http://ga.water.usgs.gov/edu/watercycleevapotranspiration.html> Accessed 12 August 2009.

It has become a necessity to integrate and coordinate interventions at different levels across various sectors with new climate information in managing international waters. The Integrated Water Resources Management (IWRM) and integrated coastal management (ICM) tools are not only useful in protecting transboundary waterbodies, but also provide measures in adapting to climatic variability and change. IWRM is a process of sustainable development and management of water resources that supports social, economic and environmental objectives, without compromising sustainability of critical ecosystems.¹¹ Increased evaporation, reduced stream flow due to climate change, irrigation demands and polluted drainage are contaminating and causing a shortage of drinking and municipal water, which threatens ecosystems. Unmanaged or unregulated use of scarce water resources is unsustainable.¹² IWRM requires integrating multiple levels of interventions and coordinating various sectors, agencies and institutions for concerted efforts in addressing ecosystem management, which proves most effective in addressing such issues. Similarly, the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Reports referred to ICM as the most appropriate process to deal with climate change, sea level rise and other current and long-term coastal challenges.¹³ However, combining interventions at different governmental levels (regional, national, and local) involving multi-sectoral agencies (including those in charge of water, agriculture, land, and forestry among others) for both watershed and coastal management can be challenging.

DEVELOPMENT: A STRATEGY FOR INCREASING RESILIENCE TO CLIMATE RISKS

Development projects often have the added benefit of making communities more resilient to the effects of climatic variability and change in international waters and can help communities adapt more effectively to environmental threats and a changing climate.

The main premise of the theory is that development activities that reduce poverty, improve nutrition, education and infrastructure, and protect the environment can fortify adaptation effectiveness.¹⁴

By adding special emphasis to incorporating climate risks into the development process, attention can be given to climate vulnerability and in some instances, can improve development activities and livelihoods. Taking into account climate risks at the onset of a project can help communities tailor their strategies to the threats that impact their particular ecosystem or waterbody. Knowledge of environmental, anthropogenic and climate conditions and data can assist communities in strengthening factors that address climate short-term and long term risks.¹⁵

For instance, in agricultural projects or development activities, climate concerns such as drought or flooding, should be carefully explored and addressed, so that irrigation process can be designed in such a way to account for these conditions, both current and future.¹⁶

Sustainable development in societies and communities that are highly vulnerable to climate risks, where special climate considerations are taken into account, can support the



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- 11 Water Sanitation and Health Division, "Health through integrated water resources management." World Health Organization, 2010. http://www.who.int/water_sanitation_health/mdg2/en/index.html Accessed 2 October 2009.
 - 12 Cap-Net. "Capacity Building for Integrated Water Resources Management." UNDP. <http://cap-net.org>, Accessed 5 October 2009.
 - 13 NOWPAP. "Philippines, East Asian Region Prepare Declaration on ICM and Climate Change." UNEP 2008. <http://www.nowpap.org/news/PEMSEA/since08.php> Accessed 8 October 2009.
 - 14 Organisation for Economic Cooperation and Development (OECD). "Integrating Climate Change Adaptation into Development Cooperation." OECD 2009, 53.
 - 15 Huq, Saleemul and Hannah Reid, "Community-based adaptation: An IIED briefing". International Institute for Environment and Development, 2007. <http://www.iied.org/pubs/pdfs/17005IIED.pdf>, Accessed 11 October 2009.
 - 16 Organisation for Economic Cooperation and Development (OECD), "Integrating Climate Change Adaptation into Development Cooperation," OECD 2009, 53.



Millennium Development Goals¹⁷ (MDGs) and can increase the adaptive capacity of societies and communities to reduce immediate and long-term vulnerability.

INCREASING HUMAN CAPACITY FOR ADAPTATION

The success of development and adaptation activities depends on human capacity of these communities to carry out these activities. Capacity building, increased awareness, education and community participation are key components, essential to success. Two-way knowledge sharing between international, regional, national authorities and agencies with local communities allow climate data, environmental information, tools and strategies to be provided to communities by these entities to assist them in achieving their development and adaptation goals, while local communities serve as the earth's eyes and ears, being the first ones to experience environmental threats and the effects of climate change. This data is critical for decision makers to understand how policies need to be tailored to these conditions and what tools are needed on the ground.

Since this publication concerns transboundary international waters, it is also imperative that transboundary cooperation be instituted for further effectiveness. Knowledge sharing across waterbodies, for instance, among fisherman along the same transboundary river for instance, can enhance their effectiveness, and allow for information exchange and joint efforts.

In addition, successful development and adaptive management to climate risks can only be sustained through sound management, monitoring, governance, and infrastructure.

Lastly, local development and adaptation need to be taken into account in international and national policy so that local communities can get the recognition and support that they need.

Adapting to Climate Risks for Global Environmental Benefits

It is well known that climatic variability and change can impact and modify ecological characteristics and patterns of international waters systems, resulting in higher variability and vulnerabilities of these systems. Climate variability can cause abrupt disruptions, such as floods, droughts, or tropical storms to international water management projects and activities, and fundamentally change a project's context and baselines based on which international waters management projects are designed and implemented. While local communities are already feeling the impacts of these conditions and responding accordingly to reduce threats to their communities and livelihoods, resilience can be enhanced when such information is incorporated into project design.

While communities can contribute to concerted global efforts through climate mitigation, it appears that climate change cannot be reversed within a short period of time, hence adaptation activities and mechanisms should be incorporated in international waters management to ensure sustainability of global environmental benefits. Adaptation activities contribute to achieving global environmental benefits directly and indirectly in the following ways:

- **Increasing ecosystem resilience and reducing ecosystem vulnerability result in direct global environmental benefits by protecting the global environment and maintaining ecosystem integrity.** For instance, projects such as mangrove restoration and coral reef restoration increase the resilience of ecosystems and also serve to physically reduce the vulnerability of coastal communities and those that depend on the natural and ecosystem services of these marine ecosystems. International water resources management activities that lead to global environmental benefits can also help ecosystems rehabilitate and recover to adapt to climate change;

17 Ayers, Jessica and Saleemul Huq, "Supporting Adaptation to Climate Change: What role for Official Development Assistance?" International Institute for Environment and Development, 2008. <http://www.iied.org/climate-change/key-issues/evaluating-adaptation/supporting-adaptation-climate-change-what-role-for-official-development-assistan> Accessed 17 September 2009.

■ **Adaptation to climate risks builds human capacity and reduce social vulnerability indirectly contributing to global environmental benefits.** Climatic variability and change can have potentially devastating effects on the well-being of people and local communities already living on the edge of poverty, who often have limited financial and technical capacity, yet are dependent on climate sensitive sectors for their life and livelihoods. In these circumstances, vulnerable communities obtain the ability and resources to adapt and survive in constantly changing conditions induced by climate concerns. Financial, technical and human capacity ultimately determines project success and enhances impact of international waters management.

Adaptative management and increasing resilience is a necessary part of addressing climate change globally. While climate risks are generally understood in a larger context of increased global temperatures and a shift in climate patterns, the direct impacts manifest locally where communities experience hotter temperatures, water shortages, vulnerability, reduced stream flow or stronger storms, directly impacting their ability to maintain or improve their livelihoods, and in some cases, their ability to survive.¹⁸ Climate change will impact communities in international waters ecosystems in different ways, thus adaptation mechanisms will be contextual when implemented at the community level. While there is no “fix all or prevent all” strategy for local communities to adapt, communities can increase their capacity and chances of success through ecosystem-based adaptation, increased resilience through IWRM and ICM and tailored development activities.

There are however challenges to introducing adaptive management among local communities because to some extent, it entails future results and prevention strategies as opposed to real-time quantifiable outcomes and measurable results.¹⁹ Given the difficulty in measuring results, this may present a challenge to future adaptation funding, despite the critical need for support of these activities. Notwithstanding lack of precise information, the more resilient an ecosystem becomes and the stronger a community’s capability to withstand the effects of climate, the stronger the community’s development capabilities and ability to contribute to global environmental benefits and our earth’s climate changes and local communities are the front line are faced with these changes.

GEF Small Grants Programme: Community-Based Approach to International Waters Management and Adaptative Management

Since 1992, the GEF Small Grants Programme has supported nearly 600 international waters projects in water bodies across 65 countries, including countries in Asia and the Pacific, Africa, Europe and the CIS, Latin America and the Caribbean and Arab States. The SGP has supported thousands of additional projects that address biodiversity conservation, land degradation, climate change, and persistent organic pollutants (POPs), which have cross-cutting themes and are also located on or near international waters. Climate conditions impact all of these communities. Development and adaptive management strategies are needed across the spectrum. While success is already apparent among many of these communities, more support is needed.

SGP grants for international waters projects typically support techniques which prevent or reduce transboundary water pollution, sustainably manage coastal habitats, enhance water utilization efficiency, or promote IWRM or ICM on a small scale, aspiring to make change at the regional or community level. Many of these projects have also reduced vulnerability and increased ecosystem resilience. These international waters projects incorporate interventions that increase resilience to the adverse impacts expected from climate change on vulnerable countries, sectors and communities.

Community-based activities in international waters funded by the GEF Small Grants Programme such as reforestation; restoration of fisheries; rehabilitation of critical ecosystems such as coral reefs, mangroves and seagrasses; fresh water conservation; and a widening of flow channels and strengthening of river banks are ways that communities can reduce their vulnerability, increase ecosystem resilience, improve livelihoods and achieve development goals.

The next few chapters in this publication specifically explore how climate risks can exacerbate environmental threats in three specific types of international waterbodies, and cite practical community experiences in combining international waters management with adaptative management activities. Combined, these efforts are addressing priority environmental threats and climate risks at the local level worldwide, leading to local and global environmental benefits.

18 Organisation for Economic Cooperation and Development (OECD), “Integrating Climate Change Adaptation into Development Cooperation,” OECD 2009, 140.

19 Ayers, Jessica and Tim Forsyth, “Community-Based Adaptation to Climate Change: Strengthening Resilience through Development”. *Environment Magazine*. July – August 2009. <http://www.environmentmagazine.org/Archives/Back%20Issues/July-August%202009/Ayers-Forsyth-abstract.html> Accessed 28 October 2009.



Rivers

TRANSBOUNDARY RIVER MANAGEMENT AND COMMUNITY ADAPTATION

Climatic variability and change directly impacts trans-boundary rivers and river basin management, threatening its effectiveness. Take for instance, the Niger River, the principal river of West Africa and third longest river in Africa after the Congo and the Nile, begins in the Guinea Highlands, extends nearly 4180 km (2600 miles) in a unique boomerang shape through Mali, Niger, Benin and Nigeria and discharges into the marsh-filled Niger Delta into the Gulf of Guinea and Atlantic Ocean.²⁰ Since the 1970's, average annual West African river water flow and discharge has already reduced by 40 percent due to recent drought, population increase and perhaps climate change and the flow of the Niger River is projected to decrease by an additional 33 percent²¹ by the year XXXX Flow reduction of the Niger River will endanger the livelihoods of ten developing nations which rely on the River for agriculture and some predict that the river will dry up altogether.²²

Glaciers that feed great rivers such as the Brahmaputra, Ganges, Indus, Mekong, and Yangtze Rivers, are melting at faster rates due to climate change. The Himalayas, which alone provide 180 billion cubic meters of water per year²³

20 UNDP-GEF. "Reversing Land and Water Degradation Trends in the Niger River Basin." UNDP 21 February 2008. http://www.undp.org/gef/portfolio/writeups/iw/niger_riverbasin.html Accessed 30 August 2009.

21 UNDP. *Human Development Report 2006*. New York, NY: UNDP 2006, 165.

22 UNDP-GEF. "Reversing Land and Water Degradation Trends in the Niger River Basin." UNDP 21 February 2008. http://www.undp.org/gef/portfolio/writeups/iw/niger_riverbasin.html Accessed August 30, 2009.

23 Briscoe, John and Usman Qamar "Pakistan's Water Economy: Running Dry". The World Bank, 2005. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2008/06/25/000333037_20080625013311/Rendered/PDF/443750PUB0PKOW1Box0327398B01PUBLIC1.pdf Accessed 10 October 2009.

for the rivers, are predicted to produce increased river flow and flash flooding, followed by increased drought by the middle of the 21st century. Increased river flow will likely cause damage to irrigation drainage and increase the risk of catastrophic floods, while in the longer-term lack of water will affect food supply and security. Fast moving water will affect which types of species can thrive. Aquatic plants may no longer be able to establish roots in quick currents. Riverbeds are suffering erosion. Silt will be carried downriver choking certain aquatic species and ending up in seas, oceans, or lakes. Two billion people who rely on the rivers fed by these glaciers will be put at risk.

Rising sea levels are causing salt intrusion into some of the most prosperous rivers and deltas. Areas affected are Bangladesh, Egypt, Nigeria, and Thailand where many people live and thrive in delta areas, where the majority of agricultural activities often take place. In some of these areas, such as Egypt in the Nile basin, delta degradation is being exacerbated by upstream dams which have curtailed sediment replenishment of the deltas. Communities in this area will have increased problems with access to clean drinking water with increased salinization of groundwater. Biodiversity in delta regions will also be affected as most aquatic organisms cannot readily switch from fresh to salt water.

Groundwater, precipitation and snowmelt all represent important sources of river flow. Climate change is known to accelerate the rate at which the hydrological cycle functions. Increased temperatures mean greater evaporation so less water actually reaches and remains in the rivers and flows to areas of need. In arid regions, climate change will exacerbate river flow problems.

As local communities who rely on rivers for drinking water, irrigation, fish and other needs are faced with risks of increased flooding and drought due to climate change, adaptive management mechanisms are being used to reduce vulnerability and increase resilience. For instance, reforestation and planting vegetation along river banks helps to retain soil during floods and reduce siltation. Such activities also help to address pollution threats to international waters, help restore ecosystem health, water quality, survival of species, and contribute to carbon capture. There are, however, challenges. Human activities such as poor water management and deforestation can compound the problems. Planting fast-growing species, if non-native, can potentially



develop into ecosystem-disruptive invasive species, and so are not necessarily a viable short-term adaptation solution for soil erosion²⁴. The plants also provide a source of energy for locals who may use the timber and wood for fuel. If used as an energy source, the soil retaining forests are not able to properly establish themselves, allowing for diverse undergrowth. Not only does reforestation increase a community's natural resource base and provide environmental services, it reduces the amount of siltation that occurs in rivers, which can compromise aquatic life.

The GEF Small Grants Programme funds community-based projects in river ecosystems around the world that address threats to international waters while also serving to assist them in adapting to the threats of climate change. There are numerous ways that local communities can address threats to international rivers and river basins, while also adapting to climate change, as has been demonstrated by local communities, including, among others:

- Protection of forests and reforestation in river basins;
- Water resource management;
- Creation of alternative livelihoods to reduce pressure on fisheries and other natural resources;
- Knowledge generation and capacity building

24 Environment Department. "Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change." Washington, DC: The World Bank 2009, 28.

THAILAND

CASE STUDY 1: REFORESTATION IN SE BUY BASIN OF THE MOON RIVER AREA, MEKONG RIVER

PROJECT DATA

Name of the project: Community Capacity Building for Management of Se Buy Basin

Name of the executing NGO: Community Forest Network of Amnartcharoen Province – COFNA (Community Based Organization)

Start date: 1/2004

Completion date: 1/2006

SGP Grant Amount: US\$11,509.00

Se Buy Basin, Moon River area of the Mekong River: photo courtesy of SGP-Thailand



BACKGROUND

Deforestation is widely seen to be one of the key environmental concerns in tropical countries. The Mekong Region has experienced a particularly high level of deforestation in recent decades. Deforestation in catchments can be a key cause of increased rates of surface water run-off that increases the frequency and intensity of basin flooding. Rainfall pattern fluctuations and glacial melting attributable to climatic variability and change can exacerbate this runoff. Conflicts over surface water allocation as a result, have become critical in Thailand.²⁵

Due to the rich endowment of the Se Buy Basin in the Moon River area of the Mekong River, there have been schemes of natural resources overuse by public and private sectors which have led to conflict of use during past decades. The conflict has been the result of deforestation, dwindling numbers of water species and degrading quality of water from agricultural practices, causing conflict between communities, government and landlords.

PROJECT ACTIVITIES

Facing the threat of deforestation along the banks of the Moon River, communities addressed the exploitation of bordering natural resources and forests by launching a community management plan. The project resulted in a Community Forest Network of 24 forest areas and seven districts and a plan for sustainable development of the basin, including cultivation of degraded lands, regeneration of several ha of deforested areas, creation of a community nursery for native species and a 40% reduction on family expense of chemical fertilizer.

RESULTS AND LESSONS LEARNED

Community members filled their plots with native species and also grew a secondary forest of several ha which was allowed to re-generate. There was a demarcation of 90-ha conservation zone of plant species around the banks. An active nursery of native plants has been established, with forty families each planting 100 trees per year. There has been an emergence of environment and natural resources networks focusing on forest, land and water in Amnartcharoen Province.

Reforestation activities and the planting of native species have served to increase ecosystem resilience in the Se Buy Basin area of the Moon River in the Mekong River region. While the project successfully addressed these threats to international waters, the activities also serve to help the community to adapt to climate risks. Reforestation of native vegetation can help maintain soil and bank integrity during flooding, reduce the potential for increased competition over water and natural resources, preserve water quality, increase carbon capture capability, improve fisheries habitat, increase ecosystem resilience and reduce vulnerability and maintain health and resilience of the Moon River ecosystem. The project also demonstrates the ability of the local community to create an international waters management plan and a community network, increasing awareness and capacity to ensure continued results in the future in the community and ecosystem.

²⁵ International Center for Environmental Management. "Climate Change Adaptation in the Lower Mekong Basin Countries." ICEM 28 March 2009. http://www.icem.com.au/02_contents/01_homepage/documents/mrc_ccai_finalreport_march2009.pdf Accessed 2 September 2009.

SENEGAL

CASE STUDY 2: ENVIRONMENTAL RESTORATION THROUGH REHABILITATION OF NATURAL PONDS, SENEGAL RIVER

PROJECT DATA

Name of the project: Supporting Restoration of the Environment through Rehabilitation of Natural Ponds

Name of the executing NGO: Fédération des Paysans Organisés de Bakel (Federation of Organised Peasants of Bakel)

Start date: 10/1995

Completion date: 9/1997

SGP grant amount: US\$ 20,970.37

BACKGROUND

Climatic variability and change pose obstacles to the social and economic development of Sub-Saharan Africa, particularly the Sahel region, which has been affected by drought, deforestation and desertification, severely impacting water resource availability. There is concern that climate change may undermine years of progress towards the MDGs in the region.²⁶ The villages of Koungani and Manael, in Bakel, in Tambacounda Region, located near the zone of the Senegal River in the Soudanian field, are characterized by eight months of dry season and four months of rainy season, with a consistent rainfall deficit. The left bank of the river is characterized by temporary natural ponds which form an integral part of the Senegal River ecosystem where fishes were reproducing and where traditional fishing was organized.

Dryness and human factors such as agriculture, animal husbandry and wood-cutting for heating and housing caused degradation of surrounding vegetation and loss of biodiversity. For three decades, the majority of these ponds had not flooded due to persistent dryness and construction of the Manantali dam. This was particularly true in the case of the Samba Sélou de Koungani pond where collective fishing was replaced by rice cultivation by the women of the community. Due to dry conditions, several species of birds and fish which frequented the ponds had become rare or had disappeared from the site. The populations of Koungani subsequently had little access to fresh fish of quality.

PROJECT ACTIVITIES

The objectives of this project were to rehabilitate the Samba Sélou de Koungani natural pond, develop a community orchard to increase livelihoods, reinforce the organizational capacities of communities, safeguard the fish species which became rare in the zone, create an environment favorable to aquatic species and agricultural production and provide a model of restoration and management for all the ponds. Restoration of the ponds was achieved by a deepening of the channel that reaches them. The small captured fish were let into the Senegal River to enable them to develop and reproduce.

The Committee worked with the Chief of the Village to ensure the protection of the pond against tree cutting and bush fires and organized the collective fishing again. A book on "Fishes and fishing at the Senegal River" was published in French and in two local languages.

²⁶ Organisation for Economic Cooperation and Development (OECD), "Background Paper on Africa and Climate Change," *NEPAD Secretariat in consultation with the African Union Commission and UN Economic Commission for Africa*, 28 March 2008. <http://www.oecd.org/dataoecd/28/7/41084135.pdf> Accessed 27 January 2010.



Besides, training in poultry techniques was carried out for the benefit of a breeder in Kounghani. An orchard of mango trees, citrus fruits and papaw trees were planted and the seedlings developed.

RESULTS AND LESSONS LEARNED

The project provided a model of natural pond management and retention of water. As a result of the project, rare fish species like *Polypterus senegalensis*, *Hyperopisus bebe* and *Gymnarchus niloticus* were seen again in the ponds. The water birds, such as pelicans and ducks, as well as many migratory and terrestrial birds which had disappeared from the zone, reappeared. Reptiles (python, grass snake, and tortoise) and mammals (rodent, phacochère, jackal, monkey, patas) were also increased.

Through the restoration of natural ponds near the Senegal River which had run dry, ecosystem-based adaptation and resilience was demonstrated through a restored food chain and the return of fish, avian species, mammals and reptiles. Food security and livelihoods improved. The development of orchards provided additional food security and income. Along with natural vegetation, it provided a natural barrier against erosion of the river bank. The community created a plan to manage and protect the ponds. The communities reduced their vulnerability by reinstating natural pond systems, which reversed fishery damage, restarted bird migrations and reinforced the idea that ecosystem-based adaptation can help a community achieve their development goals and increase their resilience to environmental threats such as drought, reduced rainfall and damaged fisheries.

EGYPT

CASE STUDY 3: WATER CONSERVATION AND GREY WATER RECYCLING, NILE RIVER

PROJECT DATA

Name of the project: Protecting International Waters by Collecting and Recycling Used Water in Nasseria

Name of the executing NGO: Women Society of El Nasseria (WSN)

Start date: 6/2005

Completion date: 9/2006

SGP grant amount: US\$ 19,653.98

BACKGROUND

The impact of climatic variability and change on the Nile River is multi-dimensional. The Nile Delta in Northern Egypt where the River drains into the Mediterranean is under serious threat from climate change-related sea level rise. Recently, the Intergovernmental Panel on Climate Change (IPCC) declared Egypt's Nile Delta to be among the top three areas on the planet most vulnerable to sea level rise. The Delta region is home to millions and is responsible for more than 60% of Egypt's food supply. There is already a water deficit in Egypt, with an estimated 30% shortfall of the 1,000 cubic meters of water per person that the UN has indicated as the minimum needed for water security.

Inland along the Nile, climate risks include drought and water shortages. Under a GEF Small Grants Programme-funded project, local communities in Nasseria, Egypt responded to these shortages by conserving and recycling existing water resources. More efficient use of available resources and recycling of grey water will become more and more necessary as drought and evaporation become more prevalent in such regions due to climate change.

PROJECT ACTIVITIES

In Nasseria, Egypt, recognizing their vulnerability to water scarcity, local women from the community were able to reduce this vulnerability through improved water resources management and adaptive management at the local level. The Women Society of El Nasseria (WSN) is the only NGO in the village of El Nasseria, Bani Mazar centre, El Menia governorate. WSN assists in supplying freshwater and electricity to village homes, providing houses with toilets, promoting sustainable agricultural production, forestry, and raising awareness of the environmental threats.

One of the main activities of the Nasseria projects was the treatment and recycling of grey water. With limited or polluted fresh water resources along the Nile, coupled with increased scarcity due to poor management, drier conditions and other environmental and climatic conditions, water resources are becoming scarcer. As future climate change impacts the Nile River, communities will have to think of innovative conservation techniques, engage in integrated water resource management at the local level and reduce their vulnerability. In managing and treating large volumes of grey water, the Nasseria project helped to prevent waste water from mixing with vital fresh water resources and compromising water quality. The treated grey water was poured into designated drain to be recycled. Often grey water can be used for irrigation purposes, which will be increasingly important in the Nile region.

RESULTS AND LESSONS LEARNED

One premise of IWRM is that different uses of limited water resources are interdependent. Innovative conservation efforts and sustainable use of limited fresh water resources at the community-level in climate-affected areas can reduce vulnerability, competition and conflict, particularly as water resources become scarce due to reduced stream flow, altered rainfall patterns and unsustainable use.

Increased irrigation demands, combined with municipal, industrial and agricultural pollution means a polluted river ecosystem and less freshwater for drinking.²⁷ River pollution can further enhance water scarcity by reducing water usability downstream.²⁸ Management, treatment and re-use of existing sources of water, as exemplified by the Women of Nasseria, will be essential in climate affected areas where fresh water resources are scarce in order to reduce vulnerability to the effects of climate change in drier regions.

It is important to note that women are often particularly vulnerable to the effects of climate change and environmental degradation and it is therefore critical to support and acknowledge the role of women in livelihood and development activities and in the climate adaptation process.²⁹ In a river basin like the Nile, which is being impacted by climate risks in a variety of ways, knowledge sharing among communities can also help to fortify collective efforts and increase resilience.

27 Cap-Net. "Capacity Building for Integrated Water Resources Management." UNDP. <http://cap-net.org>, Accessed 5 October 2009.

28 Muller, Mike. "Policy Brief: Climate Change Adaptation and Integrated Water Resource Management", Global Water Partnership Technical Committee (TEC), International Development Research Center, http://www.idrc.ca/uploads/user-S/11912518411PolicyBrief_ClimateChangeAdaptation.pdf Accessed 29 September 2009.

29 Organisation for Economic Cooperation and Development (OECD), "Integrating Climate Change Adaptation into Development Cooperation," OECD, 2009. 141.



Grey water treatment and protection of fresh water sources, Nile River: photo courtesy of SGP-Egypt



Regional Seas and Coastal Waters

INTEGRATED COASTAL MANAGEMENT AND ADAPTATIVE MANAGEMENT

Coupled with overuse and the effects of climatic variability and change, coastal ecosystems such as mangroves and coral reefs and the resources they provide have experienced severe damage. Overfishing and deforestation are causing disruption to ecosystem integrity. Increased sea levels, flooding and storm intensity can threaten their survival. Mangroves, salt marshes, and coral reefs play an important role as buffers, protecting coastal areas during storms. Their natural role as barriers makes them increasingly vital in protecting local communities from these storm surges, while the natural resources and ecosystem services they provide can make them more resilient from a development standpoint, increasing food security and maintaining livelihoods.

Home to 95% of life in the oceans, the relatively shallow areas off of continents, as part of regional seas and islands known as coastal waters, are an important part of maintaining biodiversity. They supply nearly 95% of the world's fish stock³⁰. Coastal waters can be extensive, running hundreds of kilometers offshore, or fairly small depending on the size of the continental shelf. Due to their proximity to land, coastal waters are sensitive to tidal movements and runoff, more so than the open ocean.

Coastal waters are home to a variety of sensitive ecosystems like estuaries, wetlands and mangroves. These ecosystems are found in polar, temperate, and tropical areas and are subdivided into salt marshes and mangroves. They maintain fish stocks, support a large array of biodiversity, and support the agricultural, timber, and pharmaceutical

30 Thurman, Harold and Alan Trujillo. "Essentials of Oceanography, 7th Ed" Englewood Cliffs, N: Prentice Hall, 2002. 318.

sectors. Plant growth in these areas creates soil stability and slows runoff, allowing for greater water retention in aquifers. Marsh wetlands purify water by detoxifying waste which can reduce nitrate levels as much as 80 percent³¹. Peat deposits, formed by the accumulation of organic matter in wetlands, are important carbon sinks. Wetlands also buffer coastal areas against storms, floods, and other surges, protecting nearby habitats. With the IPCC predicting a rise in average global sea level of 20–60cm by the end of the 21st century, many wetlands and deltas are at great risk of flooding, and in worst case scenarios, disappearing. Economically vital fisheries like those in the Nile River will be further infiltrated with salinized waters, as well as plant species relying on freshwater. Without wetlands, the occurrence of toxic algal blooms will increase with associated oxygen depletion, causing the deaths of many marine animals.

Mangroves

Many mangroves are located between the tropics and subtropics, 30 degrees north and south of the equator and are important nurseries for fish. In Malaysia, a 400 km² area of managed mangrove supports a fishery worth \$100 million per year. Many developing nations rely on them as sources of energy and construction materials. Some communities use dyes from mangroves to treat textiles, nets, and fish traps. Depending on their use and location, mangrove goods and services have an average worth of \$900,000/km². Mangroves also indirectly aid other ecosystems like coral reefs, sea grass beds and the shoreline. Wave energy can be reduced up to 75% as a wave passes through 200 meters of mangrove forest.³² This is essential in preventing erosion especially as climate change intensifies storms, creating bigger waves.

Mangrove forests absorb wave energy and trap debris brought in from storms which cuts back on inland destruction. When a tsunami hit Sri Lanka in 2004, most people near mangrove forests survived while 6,000 people from the same villages, but living in areas without mangrove

protection, perished. Mangrove replanting like that done in Costa Rica Island in Ecuador have not only protected the shores against storms but also reestablished economically vital crab and mollusk stocks.³³

In addition, mangroves and coastal zones are known for their ability to capture carbon. Inshore waters up to 200 meters in depth where coral and sea grass ecosystems can be found, may be responsible for removing just over 0.2 Gt C per year. In addition, mangroves may accumulate around 0.038 Gt C per year worldwide, which suggests that they sequester carbon even faster than terrestrial forests.³⁴

Coral reefs

One of the most sensitive ecosystems to climate change, coral reefs currently experience the most sudden and extensive destruction. Coral reefs provide a home and protection for thousands of marine species and act as wave barriers. Reports on dying coral populations in the Seychelles suggest that wave energy in this region may have doubled³⁵. In areas that are predicted to receive heavier rains, faster river flow rates and flooding will increase erosion allowing for sediment suspension. Inshore corals will experience decreased levels of sunlight and choking from the particulate matter. In addition, runoff rich with phosphorus and nitrogen from agriculture enables seaweeds and other algae to out-compete³⁶ corals as they depend on nutrient poor waters. Coral bleaching will increase as surface ocean temperatures continue to climb under even the most optimistic climate change scenarios. As atmospheric levels of CO₂ rise, the additional CO₂ adds to the level of carbonic acid (H₂CO₃) in the ocean which is produced when the absorbed CO₂ molecules bond to water molecules. This increased acidity, by lowering levels of available carbonate (CO₃²⁻) ion, causes the binding networks of coral (CaCO₃) to disintegrate.

Increasing ocean temperatures threaten corals and other marine organisms. Corals specifically require waters between 25–29°C³⁷. When temperatures rise, the coral's

31 Millennium Ecosystem Assessment. "Ecosystems and Human Well-being: Desertification Synthesis." Washington, DC: World Resources Institute, 2005. 1.

32 UNEP. "Climate Threat to Pacific Ocean Mangroves," UNEP News Release 2006/35. <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=483&ArticleID=5312&l=en> Accessed 27 January 2010.

33 UNDP. *Human Development Report 2007/2008*. New York, NY: UNDP 2008, 191.

34 UNEP, "Investing in Carbon Capture and Storage Nature's Way," UNEP News Release 5 June 2009, <http://www.unep.org/Documents.Multilingual/Default.asp?DocumentID=589&ArticleID=6206&l=en&t=long> Accessed 24 September 2009.

35 Environment Department. "Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change." Washington, DC: The World Bank 2009, 32.

36 ARC Centre of Excellence. "Scientists Check the Health of Reef", Media Release 7 August 2006. http://www.coralcoe.org.au/news_stories/reefhealthcheck.html Accessed 29 June 2009.

37 Rehm Team, Yale University's School of Forestry and Environmental Studies. "The Effects of Land Use on Water Quality and Coral Reef on the Island of Roatan, Honduras". May 14, 1997. <http://www.yale.edu/roatan/soil.htm>. Accessed 14 July 2009.



defense mechanisms weaken along with the survival abilities of the symbiotic zooxanthellae. Different bacteria also flourish in the warmer waters.

The SGP funds community-based projects in regional seas and coastal waters around the world that simultaneously address threats of climatic variability to international waters and help communities adapt to future climate change. SGP has supported the following adaptive activities in managing coastal habitats:

- Rehabilitation of coral reefs, including construction of artificial coral reefs;
- Reforestation of mangroves;
- Conservation and sustainable management of seagrass habitats;
- Promotion of sustainable fisheries management
- Promotion of local livelihood
- Capacity building

IRAN

CASE STUDY 4: CORAL REEF REHABILITATION

PROJECT DATA

Name of the project: Pilot Project for Rehabilitation of Marine Resources of the Persian Gulf in Salakh Region (Qeshm Island)

Name of the executing NGO: Salakh Community Organization, Council of Salakh Village

Start date: 3/2002

Completion date: 1/2007

SGP grant amount: US\$ 25,000.00

BACKGROUND

With an area of 1,565km², Qeshm Island is the largest in the Persian Gulf and known for its salt caves, mangrove forests, turtles, and coral reefs. The area is recognized as a UNESCO National Heritage site. Twenty percent of the island's fishing, one of its main industries, occurs near the village of Salakh. Since the 1990s local fishermen from Salakh, located at the southern end of the island, noticed a drop in fish populations from coral damage and industrial fishing. Overfishing and an eight-year drought caused eight local fish species populations to drop by 16 to 73 percent in 5 years. The fish residing in nearby coral habitats have also been impacted by pollution increase, perhaps climate change, and overharvesting.

Changes in storm intensity have been noted in the Persian Gulf. On June 4th, 2007 the area experienced its strongest storm recorded. Super-Cyclone Gonu produced winds with speeds of 240km/hour. It ended up delaying the South-West Monsoon which helps with upwelling deep nutrient-rich waters to the coast. Large storms, like the cyclones, cause immense damage to coral. Immediate physical damage is also followed by challenges for re-growth from erosion or burial by sand of rocky platforms they use to grow³⁸. Maintaining coral populations depends on the coral's ability to successfully breed and establish themselves on rocky platforms.

PROJECT ACTIVITIES

The village council managed this coral reef restoration project with the participation of 30 fishermen and local communities during project development. To aid coral growth, they constructed artificial reefs using modern design techniques along with local knowledge and technology.

³⁸ *Science Daily*. "Coral Reefs Face Increasing Difficulties Recovering from Storm Damage," *Science Daily News Release*, 4 August 4 2009. <http://www.sciencedaily.com/releases/2009/06/090623112119.htm> Accessed 4 August 2009.

For the project, local fishermen met with a consultant to develop a project in order to rehabilitate the marine ecosystem and decided on a three panel reinforced concrete triangle. The design was easy to construct, inexpensive, and light. They were also designed to maximize space for coral settlement, fish, and other marine organisms. Strategically positioned holes in the concrete and the pyramid shape allow for proper water circulation so currents and waves would not displace the artificial reefs.

Positions within the sea floor were discussed and chosen by experts who were able to determine areas which would have the highest success rates. All pyramids were placed in areas shallower than 15m to ensure that floating nets used for large catch volume in deeper waters would not catch fish before rehabilitation occurred. A total of 150 pyramids were built and 80 of those were installed within the first six months. The additional 70 were installed later.

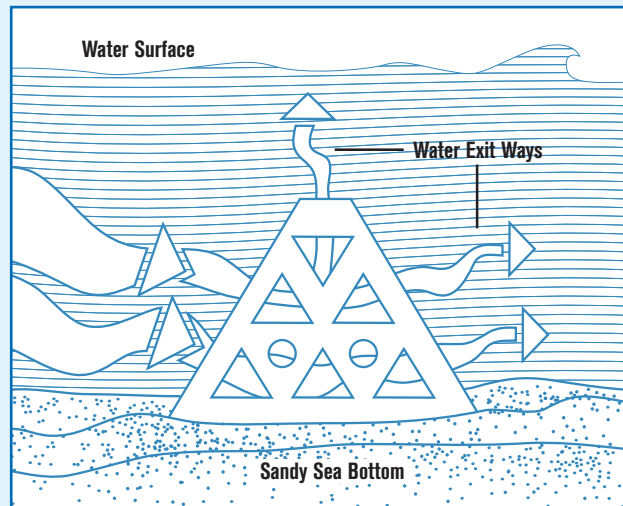
RESULTS AND LESSONS LEARNED

Maintaining corals is an important part of securing economic stability through sustainable fishing and ecotourism. The project was able to accomplish its goals of developing corals which acted as breeding grounds for fish, leading to a revitalization of the fishery. The area was declared a no-fishing zone and locals were put in charge of enforcing the law. It is now used as study area and an important reproductive bank for the rehabilitation of certain species. Immediately, there were increases in non-immigrant fish like grouper.

A few years after completion, a water assessment showed vast improvements in water quality and greater numbers in overall fish stocks. Lace coral began developing on the pyramids along with other marine organisms. By collaborating with local fishermen, the project used their wisdom and gave them a product they were proud of and wanted to protect. Success was mainly due to the fact that locals were able to contribute to the design, construction, installation, and monitoring of the artificial reefs. In coming years, the local community and fishermen will decide whether to keep the area as protected reproductive grounds or open it for fishing.

This pilot project has so much success that the Iranian Fishery Organization (IFO) wanted to replicate it and applied for additional SGP funding. The project got the UNDP Resident Representative's Innovation Award in 2006.

As a local and community-driven process in which local fisherman took pride, the communities of Qeshm Island were able to successfully address overfishing and coral reef damage and contribute to their food security and poverty reduction as development goals. The community increased their resilience by combining outside expertise with indigenous knowledge to achieve ecosystem resilience. With monitoring and intervention at the international level (UNESCO and UNDP), coupled with national involvement (IFO), and the involvement, pride, capacity, knowledge and monitoring capability of local communities, this project is a model example of increasing resilience and building human capacity to address environmental threats and changing climatic conditions in international waters.



Artificial reef design which incorporates holes within the structure and a proper thickness to maximize sturdiness and promote fish and coral growth: Diagram, courtesy of Mr. Sharif Ranjbar



Artificial reef construction — locals poured concrete into models to create triangular pieces (above) which were weighted to the sea floor and later became the perfect habitat for corals (below), photos courtesy of Mr. Sharif Ranjbar.



ECUADOR

CASE STUDY 5: MANGROVE RESTORATION

PROJECT DATA

Name of the project: Integrated management of mangrove swamp forest and reforestation in the Island of Costa Rica

Name of the executing NGO: Costa Rica's Fishermen Association

Start date: 12/2001

Completion date: 12/2003

SGP Grant Amount: US\$ 28,124.00

BACKGROUND

Costa Rica Island is a small area off the coast of Ecuador and near the Peruvian border. The island is part of the El Oro province located from 80° 05' to 80° 16' West longitude and 3° 12' to 3° 26' South latitude. It is home to 60 families who typically make a living as fishermen in the surrounding mangrove forests. The province also supports banana farming and shrimp aquaculture. From December to May temperatures range from 32°C to 34°C and around 20°C from June to November. This warm climate supports red, white, and black mangroves. Mangroves serve as an important home for many terrestrial animals like snakes, iguanas, and numerous birds.

Mangrove cutting begun in 1975 has depleted the work of crab fisherman or cangrejeros, and others who use the area. The cutting destroyed not only the region around the roots of the mangroves, but also left the coastal zones exposed to the onslaughts of storms and sediment deposits. Since the mid-1980s the area had been committed to using natural resources cautiously and in a sustainable way by means of common self-management. However, problems still remained like environmental degradation from trash, continued use of poor fishing techniques, and pollution from motor oil. A study conducted in 1988 revealed that the mangroves in the province would disappear in a period of 12 years, if something was not done. The shrimp industry had also suffered from the White spot virus which also affects mollusks and crustaceans. The local organization which was established to protect the mangroves and surrounding ecosystems wasn't enough to help the problem.

Mangrove forests are especially important in the battle against climate change. They have an immense capacity to store carbon and they also help against storm surges and prevent erosion which is especially important in the case of Costa Rica, Ecuador. Islands are the most vulnerable areas to climate change (low elevation). In order to boost the effects and secure mangrove ecosystems, scientists suggest reducing pollution from land-based sources so mangroves remain resilient and healthy and also restoring destroyed mangroves. Restoring mangroves also contributes to near shore fishery productions on which the community relies.



Restored mollusk populations. Both the *Anadara Tuberculosa* (left) and *Anadara Similis* (right) populations were controlled by allowing populations to grow in corrals and not be collected until certain sizes were reached: photo from: National Biological Information Infrastructure, Ecuador.



Fishing off Costa Rica Island, photo courtesy of SGP-Ecuador



Protection of mangrove swamp: photo courtesy of SGP-Ecuador

PROJECT ACTIVITIES

The goal of the project was to protect 519.79 hectares of mangrove swamp through reforestation. Personnel taking care of the area were fed and lodged by the community. They monitored reforestation and supported the work of organizations and universities in the area. The protection of the area was fulfilled by watching the diurnal schedule according to tide fluctuations. Forty partners of the Association specifically monitored the mangrove swamp. The community reforested 30 hectares of mangrove swamp in one sector and afforested 20 hectares in front of the Island. Once mangrove seeds were selected and collected, the community used direct sowing techniques to reestablish the area. In addition to rehabilitating the area, the community of Costa Rica Island constructed lodging to add value to the land from eco-tourism.

The Association was encouraged to develop a business model so that they monitor young mollusks and crabs, allowing them to develop, and then leading to improvements in income for the local inhabitants. They came to agreements with nearby shrimp fishers on ways to protect the area. Mollusk populations increased as agreements were arranged that monitored size. Collection of mollusks smaller than 45mm, a size established by sexual maturity studies under the National Fishing Institute (INP), was prohibited. Crab harvesting was divided into specific zones which changed from month to month and harvesting was limited to males with shells greater than 55mm. Corrals were constructed by local women to establish zone areas and repopulate crab species. Within the corrals, 22 shells with a measurement of 30mm were placed in every square meter. The corrals were placed in repopulation areas in front of houses with small mangroves. Women regularly clean the corrals to control and prevent diseases. Participants are allowed to extract shells of large enough size.

RESULTS & LESSONS LEARNED

The project changed the lives of community members in many ways. Women were given a role managing mangrove ecosystem integrity and even important positions within the Association. The original goal of reforesting 70 hectares was surpassed by an additional 10 hectares. The mangrove area is now fully protected by the Commission of Protection and Mangrove Management that uses a fiberglass motor boat to monitor the area and also support locals during reforestation days. Sustainable use of the area by ancestral community knowledge together with technical and scientific knowledge has allowed biodiversity to flourish. New practices conserve mangroves and even generate income, improving quality of life. In 2000, the Program for Managing Coastal Resources (PMRC) established fish quotas in the Jambeli area and Muisine river estuary. Regulations enforcing quotas were established in 2001 and other areas outside the province actually followed with similar legislation.

The project was a success because it reestablished and rehabilitated a community that highly values marine and terrestrial diversity, resulting in species and ecosystem resilience and improvement of livelihoods. The project demonstrated a multitude of strategies to enhance ecosystem-based adaptation, including mangrove restoration, the creation of zones and corrals, community-based monitoring and capacity building, alternative livelihoods development, and interventions from local communities and outside experts.

Challenges remain in terms of controlling shrimp fishing but with the skills learned from the project, the local community may be able to lead others. Already, their 519.79 hectare mangrove ecosystem has improved deforestation conditions and will now be able to increase resilience to coastal surges and erosion exacerbated by climatic variability and change.

SRI LANKA

CASE STUDY 6: CORAL REPLANTING

PROJECT DATA

Name of the project: Coral reef Restoration, Conservation and Monitoring Programme at Rumassala, Galle

Name of the Executing NGO: Nature Conservation Group

Start date: 11/2003

Completion date: 5/2005

SGP Grant Amount: US\$ 31,995.20

BACKGROUND

Coastal coral reefs in Southern and Western Sri Lanka have seen unprecedented levels of mortality and degradation due to the 1998 El Niño-related coral bleaching and a reef die-off event which destroyed nearly 50% of the Sri Lankan reef in one year coupled with damage to the coral reef caused by widespread storms in 2000 as well as human activity. This resulted in reef degradation, outbreaks of coral disease and reef infestation. The Rumassala reef in Galle, Sri Lanka, rich in marine biodiversity, has taken special importance in reef conservation as it was the only shallow water reef to survive the 1998 coral bleaching mass mortality event with a significant part of its bio-diversity and live coral cover intact.

PROJECT ACTIVITIES

The Nature Conservation Group initiated work in Rumassala via a reef health improvement and live coral restoration and conservation project. Coral nurseries were developed and damaged reef surfaces were stabilized through replanting and promotion of reef restoration training. The program developed efficient, simple, low cost and effective techniques of restoring coral cover and increasing the speed of re-colonizing degraded reefs. It also developed a program to monitor and manage invasive reef organisms that threaten the survival of reef corals. The project proved effective in training and building local capacity to undertake reef restoration activities including rescuing broken corals and replanting and re-colonizing degraded reef environments. Low-cost cementing techniques were used to re-attach rescued coral back on to the reef substrates and have created a significant advantage over earlier wire tie systems.

The technique to re-attach the rescued coral onto the reef substrates was innovative and the mortality among replanted corals in the restoration process was estimated to be less than 1%. Most of the selected areas carried 0% to less than 10% surviving coral cover. Replanting aimed to increase living coral cover of the selected rocks up to 30% of the surface initially and subsequently to double or triple the restoration potential to recover lost habitat functions of the reef. Under-water nurseries housed rescued coral material in transit to be replanted back onto the reef to help increase the survival of rescued rarer coral species.

Reef cleaning and maintenance carried out under the project worked to maintain reef health and survival of corals. Rescue of broken coral and coral nursery maintenance contributed to coral survival and to the development of techniques used to re-fragment the corals into smaller units which were then potted into cement blocks and raised in the nursery to propagate a larger number of coral propagates. This resulted in the increased availability of coral material that could be used to restore a larger reef area. Eighteen new coral nursery units were added to replace the older nurseries that were in the process of being removed after harvesting the propagated coral material.

RESULTS AND LESSONS LEARNED

The community team members after receiving additional training in SCUBA diving, reef ecology, coral replanting and reef health management, are now in a position to undertake most of the reef restoration work at Rumassala themselves, sustaining the project. During the period between December 2008 and April 2009, team members replanted 2000 coral units onto the Rumassala reef using underwater cementing techniques. This amounts to a doubling of the replanting rate of the past year and with more experiences it may be possible to further double the current replanting rate as well. Most replanting was carried out in clusters where natural regeneration possibilities are low. A second reef restoration site has also been initiated at Unawatuna reef, where two locations are being developed as restoration areas.

This project has increased the community's ability to respond to natural environmental events, human threats to the environment and climate risks. In addition to responding to climate-precipitated or exacerbated impacts on coral reefs including bleaching and damage from storms, the communities at Rumassala have not only addressed their physical vulnerability and problems such as invasive species, but have increased the resilience of their coral and coastal ecosystems. A restored and replanted coral reef ecosystem means increased marine life, a healthier fish population and improved wave barrier to storm threats and surges which may be exacerbated by climate change. From a human capacity standpoint, after receiving training such as SCUBA diving and cementing techniques, the communities who run the project are now able to continue these efforts on the ground. The project is now being replicated in other reefs in the same coastal ecosystem, further enhancing ecosystem resilience, contributing to integrated coastal management in the region and global environment benefits.



Community coral restoration and replanting (top and above), Sri Lanka: photo courtesy of the SGP-Sri Lanka



Coral replanting: photo courtesy of the SGP-Sri Lanka

CAMBODIA

CASE STUDY 7: SEA GRASS AND MANGROVE REHABILITATION

PROJECT DATA

Name of the project: Mangrove and Seagrass rehabilitation, protection and conservation for livelihood improvements

Name of the executing NGO: Natural Resource Community Coalition of Koh Kapi, Koh Sralao, and Chrouy Pros (NRCC)

Start date: 1/2006

Completion date: 6/2007

SGP Contribution: US\$ 21,500.00

BACKGROUND

Funded by SGP, the Federation of Community Coastal Natural Resources Management committee was created in 2006. To date, they have implemented community-based activities in three coastal communities, Koh Kapi, Koh Sralao and Chrouy Pros in Koh Kong province. All three communities have a total number of approximately 970 families. Peam Krasop Wildlife Sanctuary in Koh Kong province in the South-West of Cambodia is a forested area that is home to five villages. Before the area became a sanctuary, villagers benefited from abundant coastal resources. The area was then heavily exploited, including the depletion of large areas of mangrove forests and seagrass areas.

PROJECT ACTIVITIES

The Mangrove and Seagrass Rehabilitation, Protection and Conservation for Livelihood Improvements Project in Cambodia, supports sustainable community-based activities in Peam Krasop wildlife sanctuary, including planting mangrove trees on 40 ha of degraded land and protecting the remaining mangrove trees. The project addressed the conservation and sustainable use of natural resources, mainly fisheries and mangrove resources in areas under increasing human pressure by organizing women saving and self-help groups to create community-based alternatives livelihoods. Specific activities of the project included: 1) Increasing mangrove forest cover for biodiversity conservation and prevention of natural disasters 2) Control of illegal fishing, especially push boats that are damaging seagrasses 3) Increasing the livelihood of community members for poor families and women headed households 4) Encouraging participation in protection and conservation of mangroves and seagrasses.

RESULTS AND LESSONS LEARNED

The project achieved what it set out to do and more, including the planting of mangrove trees over 40 ha of degraded coastal habitat with protection and conservation of larger areas of existing mangroves; the protection and conservation of 116ha of sea grass in Chrouy Pros Bay. The project ensured that the target areas were sustainably managed and used. Subsequent to the project, there was an increase in fish catch from mangrove and sea grass protected areas of 50%. Sustainable use and management of the ecology system in the project target areas has been guaranteed by the community-based organization.

Local livelihood has improved for nearly 600 poor fishers, who access to mangrove areas for their livelihood. 90% of Small Scale fishers kept their fishing gear, the loss of which is usually caused by big pushing boats, trawlers and coastal nets. Illegal fishing was reduced by 80%. 95% of poor fishers and women headed households received direct benefits from participating in planting mangrove trees and seagrasses. They continue to look after and monitor young trees and conduct regular patrolling, producing and setting up concrete poles to demarcate the seagrass protected areas.

Communities continue to actively participate in the dissemination of information on the importance of conservation of the seagrasses and mangrove resources to people outside the target communities. There has been increase in community knowledge of coastal natural resources management through project implementation and learning by doing. The project provided three technical trainings to community committee members and to conduct an in-country study tour for women savings group and community committee members to learn from other women groups.

When the mangrove trees and seagrasses are well protected and managed, they provide a more sustainable habitat for fish and species. Community members, especially poor fishers and women headed households, can now catch more fish in the conservation area during all seasons to support their daily living as well as small income generation, resulting in increased food security. This is a prime example of how development can reduce a community's vulnerability to flooding, diminishing rainfall, siltation or diminishing fisheries.

The project used the power of the community to increase the resilience of their mangrove ecosystem and improve their livelihoods and development capacity by restoring and replanting mangroves, subsequently leading to increased fish catch, improved food security and increased income. The communities took and continue to take an active role in monitoring progress and patrolling the project. Community knowledge and capacity has increased to sustain the project, as the community is now aware of the environmental and financial benefits of mangrove restoration. The restored mangrove also has the effect of physical protect and carbon capture.



Mangrove and seagrass rehabilitation, protection, and conservation for livelihood improvements, Cambodia: photo courtesy of the SGP- Cambodia

A person wearing a wide-brimmed hat is seen from behind, rowing a boat on a calm lake. The sky is a soft, hazy blue, suggesting a sunset or sunrise. The water reflects the light, creating a serene atmosphere.

Lakes and Inland Seas

LAKE AND INLAND SEA MANAGEMENT TO ADDRESS CLIMATE RISKS

Climatic variability and change combine to increase environmental threats in transboundary lakes and inland seas worldwide. The largest and most biologically diverse lakes in the world, such as Lake Baikal in Russia, could face an entire collapse of its food chain due to climate change. The lake depends on microscopic algae, which blooms in the spring under ice. As the base of the food chain, the algae require ice cover as part of their reproduction, making them vulnerable to warming temperatures³⁹. As the climate in the region has become milder, ice-free seasons have increased. Premature ice melt could also harm the only freshwater seal in the world which breeds on Baikal's ice cover. Other effects from climate change such as greater nutrient inputs and industrial pollution from melting permafrost will disrupt the natural balance of the lake's cycles and organisms. Rising temperatures change water turnover and nutrient exchange.

Lakes in semi-tropical and tropical regions also face the risk of shrinkage from drought. One of the largest freshwater lakes in the world, Lake Chad has shrunk to 1/20 of its original size⁴⁰. Around 25 million people rely on the Lake as a source of income through fishing and farming.

Lake revival can occur by rerouting or blocking irrigation canals, ensuring tributaries maintain their flow, and clearing out invasive species. For societies that rely on lakes for

39 CNN. "Climate Change Threatens Lake Baikal's Unique Ecosystem," CNN. 1 May 2009. <http://www.cnn.com/2009/TECH/science/05/01/eco.lakebaikal/index.html> Accessed 19 July 2009.

40 Ogbodo, Dele. "Nigeria: Water Management, Climate Change Threaten Lake Chad," AllAfrica.com, 8 July 2009. <http://allafrica.com/stories/200907080564.html> Accessed 20 July 2009.

their economic value through fishing and irrigation, measures such as water conservation, reforestation, sustainable fisheries and sustainable agricultural sector must be used for adaptation.

From SGP's experiences in lake management, the following activities have improved lake ecosystem management and reduced risks from climate change:

- Sustainable agriculture and management of irrigation canals
 - Reforestation
 - Fisheries management
 - Land-based pollution reduction
- Water source management, e.g. tributary river and underground water management



KENYA

CASE STUDY 8: SAVING LAKE JIPE

PROJECT DATA

Name of the project: Rehabilitation of Lake Jipe Ecosystem: Protection & Conservation of Njoro Springs

Name of the Executing NGO: Reu Reu Environmental CBO (RR)

Start date: 10/2004

Completion date: 2/2006

SGP Grant Amount: US\$ 33,610.00

BACKGROUND

Shared by Tanzania and Kenya, Lake Jipe is a small and shallow ecosystem with a length of 12km, area of 28km² and an average depth of 3 meters. Mt. Kilimanjaro feeds the lake by means of the River Lumi. Other temporary streams originating from the Pare Mountains also act as water sources. The River Ruvu is the only outflow, located in Tanzania.

In the 1960's the lake had a thriving fishing industry providing fish for both Tanzania and Kenya. Residents considered the fishery the most important resource the lake provided. After years of overfishing, the industry collapsed and native fish species like the *O. Jipe* almost disappeared. Over the years, residents in the lake region also reported receding water levels. Multiple causes, including climatic variability, increased upstream irrigation diversion for water use, and perhaps climate change have led to the falling water levels. In the past 10 years the lake has lost 50% of its water. Cattail populations now boom along the southern and eastern shorelines, inhibiting the growth of water lettuce and other aquatic plants. Increases in salinity in near-shore waters caused hippo and crocodile populations to move upstream to fresher waters. Biodiversity in the area is severely threatened. The collapses of the fishing industry and changing ecosystem have been blamed on water quality and quantity. Salinization and siltation occurred by increased local activity around the lake and a reduction of inflow waters. The siltation, coupled with receding waters, has caused the expansion of the cattail species overtaking everything.

Climate variability and change are said to affect this part of Kenya, putting the country at risk due to its dependence on agriculture, threatening food security and poverty reduction goals in Africa. Increased intensity of droughts like the one associated with La Nina in 1999 and 2000 cost around 275 billion US dollars in damages. In 2001 the lake dried up. Strong El Nino rains swept soils downstream, blocking major canals and the



Lake Jipe before and after restoration activities: photos courtesy of SGP-Kenya
Before the project (left), Lake Jipe was drying up and inundated with cattails. Rehabilitation through SGP supported projects raised water levels (right).

River Lumi. The banks of the River also faced destruction from farming (clearing vegetation). Siltation caused water from River Lumi to be diverted into the River Ruvu, cutting off the important tributary to Lake Jipe.

PROJECT ACTIVITIES

The lake is now an important watering and feeding resource for the animals at the Tsavo West National Park in Kenya and the Mkomazi Game Reserve in Tanzania, but residents would like it to regain its economic and biologic significance. By increasing river inflow to the lake from its source, it was hoped to restore the livelihood of ecosystem.

Underground waters emerge from Mt. Kilimanjaro forming the Njoro Springs and flowing directly into the River Lumi. To rehabilitate the springs, the project called for the creation of contracts for contractors to erect an office, store, and toilet in the area along with a 270m dyke for protection. Together with contractors, the local community fixed the existing dyke and built the office and toilets. The local community also worked with local experts to build a fence around the catchments, help de-silt, plant trees to start agro-forestry, and develop beehives as a means of future income. A nursery was setup to in Njoro Kubwa to supply seedlings to plant trees within the catchment area. Sixteen beehives along with modern bee keeping equipment and a 9-frame centrifugal machine were brought to a member's farm. In order to establish the bee industry, the group received proper bee keeping training from GTZ. The project included bringing local communities together to hold meetings discussing lake use in order to avoid conflict.

Downstream, the River Lumi required restoration and de-siltation by removing illegal abstraction canals and appropriate fishing techniques. Raising endemic and other fish species in the surrounding ponds created sustainable fishing through the use of appropriate sized nets, giving hope that the fishing industry may once again flourish.

RESULTS & LESSONS LEARNED

Lake Jipe had reduced almost to the point that it dried up. However, a project funded by the SGP cleared out the River Lumi, its main tributary, which was partially clogged and diverted by irrigation canals. Water levels returned to normal levels, along with fish stocks which strengthened the resilience of the ecosystem.

The community-building approach to the project allowed locals to learn about techniques to protect the water ecosystems and use them in a sustainable manner. By manually digging out the River Lumi, inflow to Lake Jipe increased. The Njoro Springs were also restored by construction of the dyke, protecting it from siltation and ensuring that the River Lumi will continue to flow. Decreasing the direct effects of pollution and overuse enabled locals to increase Lake Jipe's volume, helping them adapt so climate change's effects won't dry out the Lake. Now that water levels in Lake Jipe are increasing, the fishing industry is slowly recovering. Fishermen from 3 different fishing villages can continue making a living off the Tilapia, Sardines, and Clarias fish. The project has increased income in the fishing industry, improved quality of life, and reduced poverty levels in the surrounding areas. Members of the local group working on the project were also trained in on-farm tree nursery establishment. Locals became active in advocating and governing the use of their water ecosystems. This is an important step toward reestablishing a key ecosystem between Kenya and Tanzania.

Working to address challenges including overfishing, farming and reduced water levels due to poor management and drier climate conditions, the community engaged in ecosystem-based adaptation by working to restore the Lake Jipe ecosystem through increased inflow. With a critically-situated transboundary lake losing 50% of its water supply, local communities were highly vulnerable. Through the collaboration of local communities and outside experts and contractors, protected catchment zones were created to help restore the lake ecosystem. Until the fisheries are restored further, alternative means of livelihoods and development have been introduced, including agro-forestry and beehive development, further reducing this community's vulnerability to the effects of water mismanagement as well as climatic variability and change.

This was one of seven projects funded by the SGP and known as the Lake Jipe Restoration Initiative. Together, all the completed projects successfully reestablished the vital ecosystem through sustainable use, environmental education and advocacy, and de-silting techniques. Reforestation, de-siltation techniques, digging a deeper channel to address reduced flow and falling water levels helped to reduce water shortages, increase ecosystem resilience and improved fisheries, contributing to international, national and local development goals.

KAZAKHSTAN

CASE STUDY 9: FISHERY RESTORATION IN THE ARAL SEA

PROJECT DATA

Name of the project: Conservation of the genetic fund of the Aral Sea barbel and the Turkestan barbel for further restoration of its population in the Small Aral Sea

Name of the Executing NGO: Shartken Ata NGO

Start date: 4/2004

Completion date: 8/2006

SGP Grant Amount: US\$ 44,812.00

BACKGROUND

The Aral Sea, shared by Kazakhstan and Uzbekistan used to be the world's fourth largest freshwater inland lake. It has since shrunk by 70% in recent decades due to the widespread diversion of rivers, poor water management, and consequential desertification.⁴¹ Shrinkage of the Aral Sea principally from over-irrigation and diversions has caused the dividing of its waters into the Bolshoi (Large) Aral Sea in the South and the Maly (Small) Aral Sea in the North, altering their hydro-geological and hydro chemical cycles, which now occur independently. Bolshoi Aral has become so shallow and salty that in 2003, its salinity in the north-east gulfs was 45 parts per thousand (compare to seawater at 35 ppt) and even the flow of Syr Darya River into it could not prevent this.

The Aral Sea has been depleted to such an extent that 40,000 sq km zone of dry salt terrain has been left, known as the Aral Karakum Desert, which is now a source of annual sandstorms that pick up thousands of tons of salt, pesticides and sand from the desert and transport it across the region, impacting agriculture, causing severe health problems and altering seasonal temperatures. In an attempt to mitigate desertification, vegetation that thrives in dry saline conditions has been planted,⁴² however the Aral Sea's entire southern section is expected to dry out completely by 2020 so efforts are now concentrated on trying to save the northern part.⁴³

In October 2002 the Government of the Republic of Kazakhstan signed the Agreement on funding the project concerning regulation of Syr Darya River and Northern Part of Aral Sea with the World Bank. This was for construction of the Kok-Aral dividing dam on the Small (North) Aral Sea, to restore this water space, reduce its salinity and restore the numbers of valuable fresh-water species.

Spiny sturgeon and barbel have been always considered as the most valuable representatives of Aral Sea fish fauna. Since 1978, the harvesting of barbel in the Aral Sea has almost stopped due to severely depleted numbers, due to a poor reproductive environment, which has deemed to have been caused by the poor regulation of the hydrological regime of Syr Darya River and the increased salinity of the Aral Sea.

PROJECT ACTIVITIES

Artificial reproduction of barbel is essential to preserve this valuable and unique species of Kazakhstan fish fauna. Construction of the dam in the desalted part of Maly (Small) Aral Sea created favorable conditions for the reproductive environment, feeding migration and fishing value of indigenous fish fauna, including the Aral Sea barbell. In order to increase and improve the number of Aral Sea indigenous fish species and the parent stock of the Aral and Turkestan barbell, local community of Amautkel village implemented a system of fish farming and artificial breeding of these species to stock the fresh offshore waters of Maly Aral Sea.

Under this project, fish farming of the parent stocks of two rare species was initiated through artificial breeding to stock the offshore waters of Maly Aral Sea. Efficiency was increased by saving young fish coming to the irrigation systems of the rice-producing farms downstream of Syr Darya River. Activities also increased the overall ecological consciousness of the local residents through their active involvement in solving the issues of

41 UN News Centre, "Climate factors, international cooperation key to saving Aral Sea, Ban says", 28 April 2009. <http://www.un.org/apps/news/story.asp?NewsID=30619&Cr=climate+change&Cr1=> Accessed 15 November 2009.

42 *Science Daily*. "Declining Aral Sea: Satellite Images Highlight Dramatic Retreat," ScienceDaily News Release, 12 July 2009. <http://www.sciencedaily.com/releases/2008/10/081021120918.htm> Accessed 18 November 2009.

43 *Science Daily*. "Declining Aral Sea: Satellite Images Highlight Dramatic Retreat," ScienceDaily News Release, 12 July 2009. <http://www.sciencedaily.com/releases/2008/10/081021120918.htm> Accessed 18 November 2009.



JULY – SEPTEMBER, 1989



OCTOBER 5, 2008

The Aral Sea: photo courtesy of the National Aeronautics and Space Administration (NASA)

preservation and maintaining the number of the valuable species of Aral Sea fish fauna and develop fish breeding as the effective addition and partial alternative to fishery in this region.

RESULTS AND LESSONS LEARNED

As part of this project, methods were tested and biological standards were created with regard to saving young fish of indigenous species from irrigation systems of the rice-producing farms. Transportation methods of young Aral and Turkestan barbel for long distances and their pond fish farming were developed. Furthermore, the first fish farm engaged in restoration of the commercial stocks of barbels in the Aral region was created in Kazakhstan. The parent stock of Aral and Turkestan barbel was restored for artificial reproduction and restoration of valuable fish reserves of these valuable fish species in Maly Aral Sea.

As a result, food security and the commercial value of indigenous fish increased and ecosystem health was improved. The local community was involved in the project and trained about the technology needed to duplicate the same experience among other communities in the region. Fisheries are the economic basis of local community livelihoods in the Aral Sea Basin. Revival of fishing resulted in improvement of social and economic livelihoods of the local population, while increased fish manufacturing and fish-breeding facilities created new workplaces for local residents. In response to the water diversions, poor water management and climate-caused desertification and drying of the Aral Sea, local communities were able to work with national and international partners on the larger dam project, while working on the ground to improve food security, promote traditional and sustainable livelihoods and improve the resilience of the ecosystem through fish farming, artificial breeding and conserving young fish found in irrigation channels. The project has reduced the community's vulnerability and has served as a replicable model for community adaptation to depleted water supplies in the region.



Conclusions and Lessons Learnt

INCORPORATING ADAPTATIVE MANAGEMENT TO CLIMATIC VARIABILITY AND CHANGE INTO GEF INTERNATIONAL WATERS INITIATIVES

As local communities confront the impacts of glacial melting, rainfall fluctuation, flooding and drought, they will need support to strengthen their capacity to withstand these changes and increase their resilience to the effects of a changing climate on international waters. Rivers, lakes and coastal ecosystems are increasingly being impacted by deforestation, land degradation, poor water management, and aquatic species loss as well as changes in fisheries habitats, water scarcity and floods or droughts precipitated or exacerbated by climate change, making communities more socially, economically and physically vulnerable.

Local communities have shown, through ecosystem restoration, integrated water resources and coastal management and development that these activities can help communities associated with international waters increase their resilience to climatic variability and future effects of climate change. While in some cases it may be too early to gauge the adaptation success of local projects since it may entail preparing for future climate events and impacts, this publication provides some examples of how communities have successfully conserved their resources, restored their ecosystems, reduced their vulnerability and improved their livelihoods and increased their resilience to environmental threats and climate change in international waters.

The case studies in this publication highlight the international waters and adaptive management successes achieved on the ground in GEF Small Grants Programme's international waters portfolio, and

provide critical considerations for future community-based international waters management, including:

Proven international waters management approaches, with modifications to take into account climate risks, reduce vulnerability to climate-related risks and increase ecosystem and community resilience.

Community-based international waters management and development can have the added benefit of helping communities increase their resilience to climate change in addition to addressing mismanagement of water resources and climatic variability. An integrated approach in international waters management (IWRM and ICM) is still applicable and provides meaningful and effective mechanisms for international waters management, as well as climate change resilience. Practical community-based development activities as well as proven international waters management tools can achieve better project results and impacts by taking into consideration and actively addressing climate risks. Effectiveness of adaptive management can be further enhanced by incorporating climate risk considerations into project design and implementation at the outset.

Incorporating adaptive management activities in international waters projects can directly contribute to and sustain global environmental benefits.

Climatic variability and change threatens achievements and positive impacts achieved by international waters projects. Increasing adaptive capacity at the ecosystem and community level, taking climate risks into consideration, enhances the sustainability of global environmental benefits achieved through international waters projects. Some projects might have weak components to deal with climate change from the outset of the project, hence incorporating adaptation activities during project implementation require adaptive management and flexibility, as climate risks increase uncertainty and unpredictability in the on-the-ground management of project activities.

International waters management and adaptive management to climate risks become more effective while building local capacity, enhancing local livelihoods and furthering development goals.

SGP's experiences in international waters show that it is possible for communities to improve transboundary

waters management, increase resilience and reduce vulnerability while furthering development goals. While strengthening the resilience of species and rehabilitating river, lake and coastal ecosystems threatened by climate risks is essential, it should be noted that local development motivates community support and ownership of project activities and enhance local capacity for international waters management.

Adaptive management requires intensive engagement between local communities, regional, national and international authorities, along with the two-way transfer of knowledge. Government and international agencies can provide local communities with scientific and climate data and knowledge learning their needs and helping them to build capacity to address the challenges they face.

Effective mechanisms for adaptive management will depend on where communities are located and can be highly contextualized as international waters challenges manifest differently at the local level.

There is no one approach fits all in international waters management when it comes to address climate risks. Impacts from climatic variability and change are manifested differently in different localities, and even the same climate disaster can have different impacts on the ground depending on the ecological and social contexts at the local level. For example, a flood or typhoon causes different types and levels of damage to different communities, all depending on local contexts. Therefore, adaptive management tools must be widely promoted and applied.

Climate change resilience must be made a top priority of today's international waters management practices and policy development.

While community-based adaptation helps communities to address immediate climate impacts and prepare for future ones, it is also essential for these goals to be incorporated into larger policy-making processes and interventions.⁴⁴ Engaging local communities is an integral component of an effective global response to climate risks. Adaptive management activities can serve to help communities and countries fulfill climate change commitments while improving local livelihoods and enhancing global environmental benefits. Now that climate change issues have gained momentum on the international development stage, support must follow, including knowledge and data

47 Ayers, Jessica and Tim Forsyth, "Community-Based Adaptation to Climate Change: Strengthening Resilience through Development". Environment Magazine. July - August 2009. <http://www.environmentmagazine.org/Archives/Back%20Issues/July-August%202009/Ayers-Forsyth-abstract.html> Accessed 28 October 2009.

as well as financial and technical support to communities that are most vulnerable. The work piloted by the SGP for climatic variability and change can be utilized as adaptation measures for climate change.

Considerations for Adaptive Management to Climate Risks in International Waters

Development activities and international waters management have provided valuable lessons to show that ecosystem, community and climate risk resilience can be enhanced through these efforts. It is perhaps worth considering six lessons learnt from SGP, some are not new, for developing and implementing future climate change adaptation activities in international waters management at the community level:

1. Community participation and knowledge is key to achieving climate-resilient impact

As demonstrated by SGP-supported projects in Iran and Ecuador, local communities play key roles in increasing resilience to climate risks. As the effects of climate change are first experienced locally, local communities are the most immediate observers of climate impacts and are able to execute adaptive management activities and monitor them locally. Local communities are often able to combine their own indigenous and local knowledge with external knowledge and interventions to enhance the effectiveness of these activities.

2. Capacity building is an essential component of achieving effective climate resilience:

Capacity-building is an important component of successful ecosystem-based adaptation that leads to social, economic, and environmental benefits.⁴⁵ The SGP projects revealed that capacity building and training of local communities, whether it be teaching SCUBA diving, reef ecology, coral planting and cementing techniques in communities in Sri Lanka; bringing in experts to work with local fisherman in Iran to develop suitable artificial reef designs; or increasing capacity through awareness and education which results in increased environmental awareness in Senegal and Cambodia; capacity building is a necessary ingredient of community-based adaptation to climate risks and multiple causes of degradation. Capacity building and the provision of important data

also helps communities to continue the project long after intervention might discontinue.

Identifying and supporting community development that strengthens local capacity and involves local stakeholders not only helps to address climate risks associated with an increase in greenhouse gases, but also improves livelihoods and increases the overall development capacity of poorer, more vulnerable communities.⁴⁶ Given the attention it deserves, adaptive management in international waters can serve to address local community development needs and contribute to national, regional and global environmental benefits.

While building capacity locally, it is also essential to learn what capacity and local or indigenous knowledge is available. Not only are local communities the eyes and ears of climate change impacts that occur on-the-ground, they often have knowledge and understanding of how these threats may be addressed. For instance, indigenous territories often demonstrate characteristics of strong ecosystem resilience. Indigenous Peoples have also cultivated numerous genetic varieties of medicinal plants and bred animals that have increased resistance to climatic and ecological variability.⁴⁷

3. Climatic variability and change impact all aspects of development, thus adaptive management activities play an important role in improving livelihoods:

Climatic variability and change pose threats to biodiversity, accelerates land degradation, impacts water resource availability and quality, and thus impacts agriculture, forests, fisheries, food security and livelihoods. SGP projects in Lake Jipe, the Nile River and other lakes and inland seas show that how climate change can simultaneously affect these areas, undermine development progress and leave communities vulnerable. Community activities such as mangrove restoration in Cambodia reveal that successful development projects can help communities increase their resilience to climate change through improved ecosystems, improved community defenses against anthropogenic and climate-based environmental threats, and improve livelihoods. An integrated approach is essential in order to achieve true ecosystem resilience and a reduction in vulnerability.

45 Environment Department. "Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change." Washington, DC: The World Bank 2009, 21.

46 Ayers, Jessica and Tim Forsyth, "Community-Based Adaptation to Climate Change: Strengthening Resilience through Development". *Environment Magazine*. July – August 2009. <http://www.environmentmagazine.org/Archives/Back%20Issues/July-August%202009/Ayers-Forsyth-abstract.html> Accessed 28 October 2009.

Development success is enhanced when climate risks are taken into account. Development activities such as agricultural improvements can be more effective and sustainable if current and future climate change threats and impacts are taken into account. Agricultural activities and investments near lakes, rivers and coastal ecosystems will increasingly be impacted by a dearth in water resources or increase in flooding, which requiring that these issues be addressed through community-based adaptation. Fisheries management and development will need to take into account water scarcity, salinization, temperature changes, invasive species and other impacts of climate change. Coral reef restoration and food security can be enhanced if physical protection of coastal communities, temperature rise and other climate threats are taken into account.

4. Cooperation in transboundary waters management is essential for successful adaptation to climate change:

Cooperation in transboundary waters management is an important aspect of successful development and community-based adaptation in international waters. Whether located in Lake Jipe, which is situated between two countries, or whether on the Nile, which travels through ten countries, community-based adaptive management activities should take into account communities upstream and downstream that may be impacted and can strengthen their impact when implemented with the knowledge and contribution of other communities that share the same ecosystem and are subject to the same climate vulnerability and threats.

5. Integration of climate risks into international and national water management policy is key:

Integrating climate change adaptation into national and international development and policy agendas influences the way resources are allocated and utilized and allows climate change considerations to be included in all aspects of development at the local level. Climate policy and legislation is usually generally enacted nationally. Dialogue at the national level among stakeholders, donors and agencies



responsible for different areas impacted by climate change such as agriculture, fisheries, infrastructure or disaster management can improve collaboration and the effectiveness of adaptation mechanisms.⁴⁸ Additionally, climate risks cannot be seen in isolation from multiple drivers of degradation such as water and land mismanagement, and information from this dialogue can then be used to enhance activities at the local level through the provision of climate data, financing or assistance on the ground.

Vulnerability can be further reduced through cooperation and dialogue among local communities, national institutions, civil society, the media, the private sector, and the international community. Local communities can effectively contribute to ecosystem management plans or national or international priorities and policy agendas by on-the-ground observations and activities. National and international institutions can assist local communities in these adaptation mechanisms, furthering these goals, increasing their resilience, and increasing global environment benefits around the world.

47 Environment Department. "Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change." Washington, DC: The World Bank 2009, 53.

48 Organisation for Economic Cooperation and Development (OECD). "Integrating Climate Change Adaptation into Development Cooperation." OECD 2009, 70.

ABBREVIATIONS AND ACRONYMS

CBA	Community-Based Adaptation
CBO	Community-Based Organization
CIS	Commonwealth of Independent States
CO ₂	Carbon Dioxide
GEF	Global Environment Facility
GHG	Green House Gases
GT C	Gigaton of Carbon
GTZ	German Technical Cooperation
ha	Hectare
ICM	Integrated Coastal Management
IFO	Iranian Fishery Organization
IPCC	Intergovernmental Panel on Climate Change
INP	National Fishing Institute
IW	International Waters
IWM	International Waters Management
IWRM	Integrated Waters Resources Management
km	Kilometer
MDGs	Millennium Development Goals
NGO	Non-Government Organization
NC	National Coordinator
m	meter
PA	Program Assistant
POPs	Persistent Organic Pollutants
SGP	GEF Small Grants Programme
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNOPS	United Nations Office for Project Services
WSN	Women Society of El Nasseria

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ABOUT THE GLOBAL ENVIRONMENT FACILITY

The Global Environment Facility (GEF), a global partnership among 181 countries, international institutions, NGOs and the private sector, aims to address global environmental issues while supporting national sustainable development initiatives. It provides grants for projects related to six focal areas: biodiversity, climate change, international waters, land degradation, the ozone layer and persistent organic pollutants. The GEF is the largest multi-lateral funder of projects to improve the global environment.

ABOUT THE UNITED NATIONS DEVELOPMENT PROGRAMME

The United Nations Development Programme (UNDP), the UN's global development network, is an organization that advocates for change and connects countries throughout the world through knowledge, experience and resources. UNDP operates in 166 countries and works with communities to develop sustainable livelihoods while addressing social and environmental issues.

ABOUT THE GEF SMALL GRANTS PROGRAMME

Funded by the GEF as a corporate programme, GEF Small Grants Programme (SGP) is implemented by the United Nations Development Programme (UNDP) on behalf of the GEF, and is executed by the United Nations Office for Project Services (UNOPS). Launched in 1992, the SGP supports activities of non-governmental and community-based organizations in developing countries towards climate change abatement and adaptation, conservation of biodiversity, protection of international waters, reduction of the impact of persistent organic pollutants and prevention of land degradation, while generating sustainable livelihoods.

As part of the Global Environment Facility (GEF), the GEF Small Grants Program (SGP) provides funding up to \$50,000 per project for community actions. SGP is currently operational in 122 countries, and has channeled more than \$300 million to communities through more than 12,000 projects around the world, which have resulted in direct global environmental benefits and also influenced the formulation of national and local policies on sustainable environmental and development management.





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