UNDP Community Water Initiative

Fostering Water Security and Climate Change Mitigation and Adaptation

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GEF Small Grants Programme
United Nations Development Programme
304 East 45th Street, FF-912
New York, NY 10017
U.S.A.
http://sgp.undp.org
Sulan.Chen@undp.org

Foreword

Billions of people around the world are forced to deal with the effects of water stress in their everyday lives. For these people, gaining access to adequate supplies of quality water is a daily struggle. Women and children often carry the burden, walking long distances or waiting in lines to access water when they should be devoting their time to other activities that would improve their quality of life. When water is accessible, it is also often of poor quality. Family members must watch as their loved ones are afflicted with waterborne diseases. These diseases weaken the afflicted, limiting their ability to work or attend school and play, diminishing their prospects for a healthy and productive life.

Droughts and human-induced water shortages also affect the livelihoods of many people, especially in the developing world. Those dependent on farming and livestock, witness their crops shrivel and cattle perish. Cities are strained by growing populations, pollution, and finite water resources. As a result, competition and conflicts increasingly arise between groups over scarce water resources.

Climate change will exacerbate water stress in many places around the world. Local climates are already changing and will continue to in the future. The question is how much humans can limit this change, and how well we can adapt to the effects of climate change that are inevitable.

The UNDP Community Water Initiative has funded successful projects in some of the most vulnerable communities in Africa, South Asia, and Central America. Using a broad range of innovative approaches, these projects have helped increase the capacities of local people to participate in developing their own solutions to local water resource problems. By providing modest funds, CWI has helped generate large rewards for the communities in terms of water security, natural resources management, and social well being.

These activities not only provide current water security and community development benefits, but also help communities mitigate and adapt to climate change. By embracing a carbon-neutral approach in the design of projects and fostering adaptive capacity, they are reducing the threat of this global problem. The continuation of such efforts is vital for helping the most vulnerable develop and protect their water resources, and better deal with climate variability and change.

Delfin Ganapin
Global Manager
GEF Small Grants Programme

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George Ortsin, Ghana
Nancy Chege, Kenya
Oumar Salim M. Kaba, Mali
Amadou Ba, Mauritania
Katiella A. Mai Moussa, Niger
Oumar Wane, Senegal
Nehemiah K. Murusuri, Tanzania
Abu-baker Wandera, Uganda
Shireen Samarasuriya, Sri Lanka
Alejandro Santos, Guatemala

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Drafts of this document were developed by a consultant, Cody L. Knutson (National Drought Mitigation Center, University of Nebraska-Lincoln, USA) under the supervision of Sulan Chen, Programme Specialist, GEF Small Grants Programme, UNDP, New York, USA.

List of Acronyms

CWI	Community Water Initiative
GEF	Global Environmental Facility
GHG	Greenhouse Gas
ICRAF	World Agrofestry Centre
IPCC	International Panel on Climate Change
KVDC	Kailer Village Development Committee
KKC	Kikundi cha Kilimo, Chanyauru
SGP	GEF Small Grants Programme
STIAP	Syndicate of Independent Workers of Nueva Alianza, El Palmar
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Education Scientific and Cultural Organization
USEP	Uganda Association for Socio-Economic Progress

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Global Water Crisis

Water is a precious resource. However, it is not always available where and when we need it. Some regions are naturally water-scarce while others have over-used their available supplies creating chronic water shortages. Even where water is available, it is often of poor quality and people may lack the technical and financial means to fully utilize their existing resources.

Therefore, water shortages are a common problem around the world and are likely to be a growing concern in many regions during the 21st century. An estimated 1.1 billion people in developing countries (16% of the world population) lack access to adequate supplies of quality water, and 2.6 billion people (39% of the world population) lack access to adequate sanitation[1]. Every year, 1.8 million children die as a result of diarrhea and other diseases caused by unclean water and poor sanitation. These people have been left out of the development process, placing their lives and livelihoods at risk.

Water shortage problems are expected to continue since growing populations, increasing demands, water pollution, and governance problems continue to strain water supply systems in several regions of the world. Without considering the effects of climate change, projections show that 2.9 – 3.3 billion people could be living in water stressed watersheds by 2025[2]. Most of these people will be from developing countries, especially in Africa and Asia.

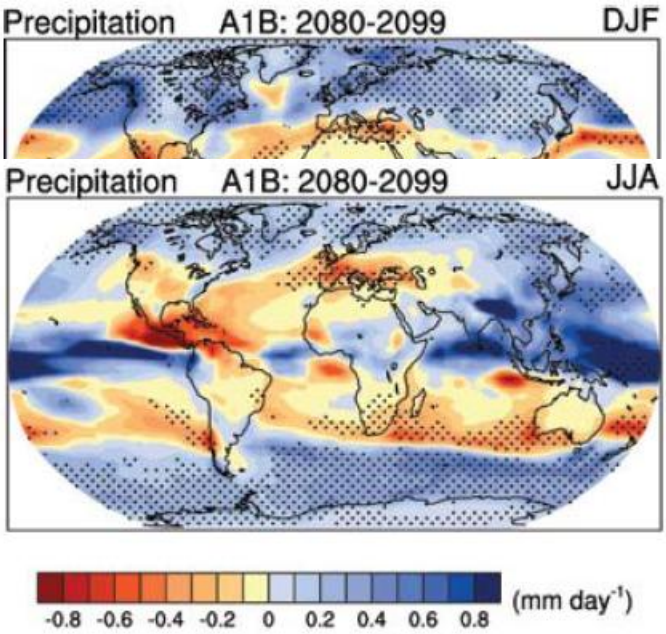
The result would be a greater number of people who find it increasingly difficult to meet their basic water needs. This has the potential for increasing water stress on people and the environment, as well as conflicts between water users that share aquifers, streams, and other water sources. As demands increase, people are increasingly struggling to secure their fair share of water.

Climate Change Effects on Water Resources

> *Globally, the negative impacts of future climate change on freshwater systems are expected to outweigh the benefits. By the 2050s, the area of land subject to increasing water stress due to climate change is projected to be more than double that with decreasing water stress… Increased annual runoff in some areas is projected to lead to increased total water supply. However, in many regions this benefit is likely to be counterbalanced by the negative effects of increased precipitation variability and seasonal runoff shifts on water supply, water quality, and flood risks[3].*

In many cases, climate change is expected to increase current water stress. In 2007, the International Panel on Climate Change released its Fourth Assessment on Climate Change, as well as a supplemental overview of climate change and water in 2008[4]. The inclusion of many new studies in these documents resulted in the use of stronger cautionary language that humans are affecting our global climate. In fact, global temperature has already increased 0.74^{o}C from 1906-2005 causing significant alterations of the water cycle, including: changing

precipitation patterns, intensity, and extremes; reduced snow cover and widespread melting of ice; and changes in soil moisture and runoff.



High latitude regions have generally received more precipitation during the course of the last century, but decreases have been seen in places like the Sahel, Mediterranean Basin, southern Africa, and parts of southern Asia. In most places, when it does rain, more of it has also come in the form of heavier events with drier periods in between – more floods and droughts. Therefore, the global land area classified as dry has more than doubled in the last three decades.

These trends are expected to continue in the future. In general, precipitation is expected to increase in the high latitudes and parts of the tropics, and decrease in some sub-tropical and lower mid-latitude regions. This would mean less rainfall for places like Central America, West Africa, the Mediterranean Basin, southern Africa, and western Australia. It may also mean less seasonal rainfall for other regions, even though the overall trend calls for more precipitation.

Similar to current trends, rainfall and flood events are expected to be greater with more droughts in between. Changes in rainfall, increased evaporation rates, saltwater intrusion into water systems along coastal areas, and reduced mountain glaciers and snow cover will all affect the availability of quality water supplies. For example, by mid-century, annual average river runoff and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, and decrease by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are already water-stressed[5]. In total, the negative impacts of future climate change are expected to outweigh the benefits.

The result of these climatic changes could include the increased exposure of hundreds of millions of people to water stress[6] and heat waves, an increase in endemic morbidity and mortality because of water-related diseases, and greater risk of malnutrition and famine. Additional impacts are also expected to include changes in vegetation and animal species survival and distribution, increased wildfire occurrences, reduced tourism and recreation opportunities, and significant hydropower losses.

In particular, Africa is one of the most vulnerable continents to climate variability and change because of multiple stresses and low adaptive capacity. By 2025, projections show that 75-250 million Africans may be at risk of increased water stress due to climate change, and corresponding crop yields in some countries may fall by as much as 50 percent[7]. Sea level rise may also increase the risk of flooding, seawater intrusion, and local habitat losses in coastal cities, with additional consequences for fisheries and tourism.

In general, climate change will likely cause additional uncertainty for people trying to maintain their livelihoods, and for water planners and institutions responsible for providing reliable amounts of quality water to meet the needs of citizens, industries, and the environment.

Climate Change Mitigation and Adaptation in the Water Sector

> **Mitigation** refers to human intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks[8].
>
> **Adaptation** refers to adjustments in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities[9].

There are many ways to help mitigate and adapt to climate change. Mitigation actions revolve around measures to reduce green-house gas (GHG) emissions and enhance carbon sinks. For example, ***harnessing renewable energy from solar panels, hydropower, and wind turbines*** can create less GHG emissions than traditional coal plants or local wood burning. ***Enhancing crop and land management and planting forests*** can increase carbon storage. These types of actions have the potential for reducing GHG emissions and concentrations in the atmosphere.

However, the damage has already been done to some degree and the problem is expected to grow. Climate change is already occurring and causing impacts in many places around the world. Even if GHG emissions were halted today, the build up of gases in the atmosphere will continue the warming process into the future (although, to a smaller extent)[10]. Therefore, people and institutions should also focus their attention on adaptation. That is, implementing actions to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

Adaptation actions in the water sector are often labeled as "hard" or "soft" options[11]. "Hard" options may include measures such as ***building new dams and reservoirs or rainwater harvesting structures*** to increase water storage, or ***constructing canals and pipelines*** to move water where and when it's needed. "Soft" options would include programs for increasing supplies while reducing demand. These would include ***programs for improving water use efficiency, conservation, allocation, and land management.*** Installing water-efficient technologies, recycling water, and planting less water-intensive crops are all examples of "soft" actions that can be taken to adapt to climate change.

Fostering the capacity of local people to carry out these activities is also essential for mitigating and adapting to climate change. ***Improving social conditions*** (e.g., health, education, income generation, empowerment, etc.) will create societies that are better able to prepare for and respond a wide range of changing conditions. Identifying and implementing the right mix of actions is essential for reducing climate change potential, as well as creating resilient systems and societies that are able to thrive under conditions of climate variability and change.

UNDP Community Water Initiative: Ensuring water security while adapting to climate change

To assist in achieving the Millennium Development goals, the Community Water Initiative (CWI) was launched by the United Nations Development Programme (UNDP) in 2004 in seven countries (Ghana, Guatemala, Kenya, Mauritania, Sri Lanka, Tanzania, and Uganda), and was recently expanded to three new countries (Mali, Niger, and Senegal). It receives financial support from SIDA, Government of Luxembourg, Government of Norway and other donors. The program is implemented through the GEF Small Grants Programme (SGP) implemented by UNDP.

Since 2004, CWI has provided more than US$2 million in funding through 89 projects (up to $25,0000 per project), bringing water supply and sanitation services to more than 260,000 people directly. The types of activities supported by CWI projects include:

- Community-based water supply and sanitation services using low-cost systems manageable by communities
- Water resource conservation and sustainable land management to create resilient systems to combat drought and floods
- Providing clean energy for water pumping
- Capacity building for community-level governance through community water management committees, women's empowerment, and the establishment of water user fee schemes.

A goal of the program is to foster water security for local populations and environment, but to do so in as carbon-neutral a manner as possible. That is, having a net zero carbon footprint; achieving net zero carbon emissions by balancing the amount of carbon released with an equivalent amount sequestered or offset in the projects implemented through the program.

The following case studies represent the types of projects funded through CWI that have helped foster water security in local communities while simultaneously helping them mitigate and adapt to climate change. Case studies 1-2 highlight project that integrate water and renewable energy development to reduce green house gas emissions. Case studies 3-8 describe projects that utilize a range of appropriate technologies (i.e., wells, dams, spring improvements, pipelines, and rainwater harvesting systems) and capacity building techniques to foster water security and climate change adaptation, and case studies 9-11 demonstrate how focusing on water quality can result in similar benefits. In total, the projects form a vision of the direction CWI has taken in tackling the challenge of water security and climate change.

Case Study 1: Rehabilitation of a micro-central hydroelectric installation, Nueva Alianza, Guatemala

2008 Wisions Award Winner (Wuppertal Institute for Climate, Environment and Energy; www.wisions.net)

Project Data

Name of grantee: Syndicate of Independent Workers of Nueva Alianza, El Palmar (STIAP)
Start date: June 2005
Completion date: August 2006
SGP/CWI grant amount: US$21,074

Background

The community of Nueva Alianza is an organic coffee and macadamia plantation owned and operated by a cooperative of forty Guatemalan families in the western Quetzaltenango District. These families formed the Sindicato de Trabajadores Independientes (STIAP, syndicate of independent workers) and purchased the estate in 2004 after the previous landlord abandoned it because of debt.

There are many challenges in operating a plantation in this region of Guatemala. Poverty rates are high and many areas are isolated from the main electricity grid, creating a heavy reliance on diesel fuel for power generation[12]. There are also two main seasons in the region: the rainy season (May - mid-November) and the dry season (December - May). The region may experience very little rainfall for months on end during the dry season, and periodic droughts result in significant agricultural, energy, and social impacts. Guatemala's location between the Caribbean Sea and Pacific Ocean also makes it a target for hurricanes. Hurricane Stan, in 2005, was especially damaging for the local area as rains washed out bridges and roads, cutting the region off from the rest of the country and caused water and diesel shortages[13,14].

Climate change is expected to increase these challenges with projections calling for increased temperatures (1.5-4.5°C by 2050) and reduced precipitation, especially during the rainy season, which could result in increased evaporation and water stress[15]. More frequent extremes are also projected for Central America, which could lead to an increase in both drought and flooding[16].

Project Activities

To promote water development and help mitigate and adapt to climate change, CWI provided funds to assist STIAP to rehabilitate some idle structures that had been abandoned during the landlord's days. This incorporated the rehabilitation of the old micro hydropower structures, a coffee plant with operative machines, empty houses, electrical generators and a diesel engine. The project also comprised the construction of new civil works, the installation of transmission and distribution lines, the building of 40 domestic electrical and water connections and an additional one for industrial use.

The rehabilitated hydropower plant has an installed capacity of 10kW. It's designed to run two electrical generators, each with a capacity of 8kW, which increases the total power to 16kW. In the winter, when heavy rain swells the river, both generators are used. In the dryer summer season, Nueva Alianza produces biodiesel by recycling oils from nearby restaurants to run the electrical generators. A climate contingency plan, that halts energy production and diverts river flows, was also put in place to protect the plant whenever a hurricane threatens.

The project also included capacity building activities to foster women's involvement and community self-management. Women took the lead in organizing workshops on construction and maintenance of the facilities, as well as implementing conservation projects to protect the river's riparian zone.

Results and Lessons Learned

The project has allowed Nueva Alianza to generate non-polluting, renewable, and cheap hydropower, which supplies agro-industrial activities for the production of macadamia nuts and is also used for household consumption. It has also created dependable supplies of water to local families, and fostered the production of purified water that is bottled and sold in surrounding towns.

The benefits of the project were made especially clear during Hurricane Stan, in 2005. The community was not as affected as other local areas because they implemented their climate contingency plan to save the hydropower facilities and macadamia crops[17], and they were able to provide purified water to devastated communities around Retalhuleu[18]. In 2005, the community won the productivity award "a la Productivadad" from the government of Guatemala.

Another positive impact of the project was the establishment of community self-management. Because of their forest and water management efforts, the area has been designated as a Private Natural Reserve[19], and an ecotourist center has been developed. Other neighbor farms are now investigating how to replicate their success.

Climate Change Mitigation and Adaptation

Using hydropower as an energy source can reduce the amount of green-house gases that are generated in comparison to other traditional sources, which serves to mitigate climate change. This project utilizes water for hydropower when it's abundantly available (and protects local production when it's excessive), and utilizes local waste products for biofuel to run generators during the dry season. These efforts which will help stabilize local energy, water, and agricultural production under variable climate conditions.

Implementing water and land management conservation activities also helps protect the local environmental resources, foster carbon sequestration, and creates more robust ecosystems that are more resilient to the effects of climate change. Similarly, stabilized agricultural production and diversification into other businesses increases local capacities of the local population to better deal with the uncertainties associated with climate change.

Case Study 2: Solar-powered water supply and irrigation system, Chanyauru, Tanzania

2008 Wisions Award Winner (Wuppertal Institute for Climate, Environment and Energy; www.wisions.net)

Project Data:
Name of grantee: Kikundi cha Kilimo, Chanyauru (KKC)
Start Date: October 2001
Completion Date: December 2006
SGP/CWI grant amount: US$48,270 and US$4,541 (in two grants)

Background

Many communities along the shores of Lake Victoria suffer from food shortages. The rain-fed agriculture that is practiced in this region does not produce sufficient crops to address food and income poverty. The Chanyauru region, on the southeastern shore of Lake Victoria, is no exception. Rainfall is scarce and variable from season to season, which is a limiting factor. Even though the adjacent Lake Victoria offers enough irrigation water to compensate for the insufficient rainfall, this option is rarely used because of limited financial resources and lack of adequate techniques to access the lake water.

Climate change brings additional uncertainty for water and agricultural development in the future. Climate projections show temperature increasing during the next decades, but also an increase in rainfall over East Africa[20]. This could lead to an increase in hot days and nights and increased evaporation on the one hand, with an increase in extremely wet seasons and associated runoff on the other. This is expected to lead to short-term declines in Lake Victoria water levels, followed by water level increase in the long-term. In regards to farming, rainfall variability and drought will still be a factor, especially if the rains come in more intense events with drier spells in between. In addition, higher temperatures and evaporation rates could exacerbate drought conditions when they do occur.

Project Activities

To address the lack of reliable irrigation and domestic water, this project focused on the construction of a dual-purpose system, consisting of a solar-driven pump, a reservoir tank, distribution canals for irrigation, and standpipes for domestic water use. Solar panels were installed to power the pumping required to fill a water tank. The water used for irrigation is then diverted into the main and lateral canals that supply the fields directly. The water for domestic purposes can be withdrawn from central standpipes. In addition to the SGP/CWI funding, the local government provided engineering oversight and technical assistance equivalent of US$7,500 to ensure quality in the construction of the reservoir, installation of

solar panels, pump and accessories and laying of main and lateral pipelines. Local communities provided unskilled labor equivalent of US$12,500.

The water users are required to pay an affordable monthly fee for the right to draw water from the system. This fee contributes to the 'Water Fund', from which maintenance costs and payment for water operators and a watchman are covered. Even though the solar system is easy to run, villagers were trained in the operation and maintenance of the system. These local technicians in turn trained other villagers, thereby increasing the local pool of knowledge.

Results and Lessons Learned

The project benefited at least 1,000 villagers in many ways. On one hand, the available irrigation water has improved food security as well as increasing income generation through the sale of high value crops. Furthermore, irrigated farming has offered unemployed youths the opportunity to develop entrepreneurial skills (e.g., by earning income through horticulture). Immediate access to water for domestic purposes has also lessened the women's burden, as it is the women who are responsible for fetching water. In addition, the project has eliminated previous crocodile attacks on women while drawing water from the open lake.

Waterborne diseases have also decreased because low quality water is no longer fetched from local ponds. Nevertheless, consumption of the lake water is not harmless and therefore it was necessary to make villagers aware of the need to boil water before use. Furthermore, the villagers were trained to refrain from malpractices that would lower the water quality. Statistics from the local dispensary show that there is a fall in water borne diseases by 60-75%, which is attributed to the availability of the increased amount of water and water treatment. Awareness raising and training in the use of organic fertilizers, as well as proper tillage methods to avoid soil erosion and siltation, have preserved the balanced ecosystem of the lake and, in return, ensured that the water is of a suitable quality for drinking purposes. Because of its success, the project has already been replicated in other adjacent communities facing similar problems, with the support of central Government and church organizations.

Climate Change Mitigation and Adaptation

Solar power is a clean, renewable energy source that emits no greenhouse gases or other pollutants when in operation. The provision of reliable quantities of quality irrigation and domestic water for crop production and human health is also a key adaptation to uncertain future climate variability. In addition, agricultural best management training is essential for protecting soils and water quality, especially under the likelihood of heavier rainfall events in the future that could increase the transport of soils and contaminants.

Case Study 3: New wells and community development in the Zukpuri Traditional Area, Ghana

2009 Kyoto World Water Grand Prize Top 30 Finalist

Project Data

Name of grantee: Zintang Healers Association
Start date: May 2006
Completion date: December 2006
SGP/CWI grant amount: US$9,800

Background

Zukpuri Traditional Area is made up of ten rural communities in the Nadowli District of the Upper West Region of Ghana. The settlement is comprised of over 500 compounds scattered over one square kilometer (km) and home to about 4,500 people. Villagers had poor access to potable water supply and very low sanitation conditions. The only source of drinking water was a pond about 2.5 km from the last compound in the settlement. This water source was both for animals, and humans. Unfortunately, the water regularly dries up during the dry season (December-March) and when recurrent drought afflicts the region. As a result, women and children often spend over three hours daily looking for water from the Black Volta, which is about 4 km away.

The poor water and sanitation directly threatened people's health by generating common diseases including diarrhea, dysentery, stomach disorders, and guinea worm. The area was identified as one of the highest guinea worm infested areas in the Upper West region.

Traditionally, the incidences of these diseases were linked to spiritual and cultural beliefs that they were punishment from the gods for disobedient children. Past attempts to improve water supply by advising people to boil and sieve water before drinking were unsuccessful because of the indigenous beliefs that their forefathers had used these same water sources and had been healthy. Thus, anyone who boils water before drinking was being disobedient to the gods and the consequences could be severe.

Project Activities

Ten young men and women formed the Community Water Initiatives of Zukpuri. With funding through the SGP Community Water Initiative, five of these people (three females and two males) were trained in well drilling, casing and screening, pump testing, water quality testing, hand pump installation, and community water management.

Using traditional knowledge for locating potential ground water sources, the group identified five well sites. Curious people followed them and helped them dig the wells, and. soon they were able to mobilize 100 people to dig the 50 meter deep wells. The wells were fitted with hand pumps made from local materials. A care taker was appointed for each water point and the community agreed on the number of times each family can take water from the well to ensure adequate recharge. A committee is responsible for the maintenance of the well, and funds are collected through the sale of farm produce from local households.

Results and Lessons Learned

The project has introduced the construction of low-cost and affordable technologies in the provision of potable water supplies, and facilitated the effective management and delivery of water year round in the area. It has also demonstrated the beneficial incorporation of traditional knowledge with rural water engineering to implement a culturally and technically appropriate project. When it was discovered that people who drank water from the wells and boiling water were not getting sick, traditional leaders thanked the gods for their visitation. In less than a year, 65% of the villagers were drinking from the wells.

Because of reduced illness rates and more time to devote to other activities, school attendance rates increased from 25% to 95%. Women were also able to produce higher quality shea butter oil because they could use good drinking water to process the oil (poor odor from the water had previously limited exports).

In following years, other communities requested help from the Zukpuri-CWI to help them dig wells. In response, the local government now gives contracts to the group to construct hand pump wells, creating employment for 30 young people. The group has now constructed more than 30 wells for the 16 communities in the Upper West Region, providing more than 26,000 people with access to safe supplies of water.

Climate Change Adaptation

Mean annual temperature has been increasing (1°C) in the region since 1960, and is expected to increase[21]. Climate change projections are highly variable, but tend toward increasing rainfall during the wet season and decreases in the dry season. However, even during the wet season, rains may fall in heavier amounts with longer times in between. This, along with increased evaporation from higher temperatures, could result in increasing drought.

Increasing the reliability, diversification, and sustainability of water sources while, at the same time, increasing the quality of life and economic capacities of local people, are essential for adapting to the uncertainties associated with climate variability and change.

Case Study 4: A community well and land reclamation, Hadiya village, Niger

Project Data
Name of grantee: HASKE (community-based organization)
Start date: January 2008
End date: June 2009
SGP/CWI grant amounts: US$18,509 and US$17,690 (In two grants)

Background

Hadiya village is located 25 kilometers (km) from the national main road in the Dogondoutchi District, with a population of 560 people. The people are very poor and farming and livestock production are their main activities. Grass and food shortage are very common due to variable rainfall. In fact, the Sahel has been identified as one of the regions most vulnerable to increased drought in a warming climate. While rains have been relatively good in recent years (except for periods of drought), the long-term projections are for longer and more frequent floods and droughts across the region as global temperatures rise[22]. Even if places receive an increase in rainfall, dry conditions may be exacerbated because of higher temperatures and increased evapotranspiration[23].

Despite its 560 inhabitants, which is beyond the national standards for access to safe water (one well for every 250 people), the village was not able to get a well from the local government. As fetching water is related to women and children's activities, and the cost of digging a deep was high, local men didn't have a great deal of incentive to push and mobilize the government to meet their needs.

As a result, the village's women and children were forced to walk 14km a day during the dry season to fetch potable water at other villages where there is sufficient well water. During the rainy season that lasts only three months, they still had to walk 7km to fetch water in temporary water ponds at the Farin Guémé communal grazing area, where land is seriously degraded. This not only resulted in water stress for the village, but was a great burden for women and children and reduced the amount of time they could devote to other domestic, income-generating, and educational activities.

Project Activities:

The CWI grant was used to construct a 75 meter deep, cemented well in the village of Hadiya, as well as to plant 3,000 seedlings near the well to sell for non-timber forest products. A well management committee, led by women, was also established to coordinate access to the well and ensure its long-term maintenance.

Results and Lessons Learned

The well provided quality water for the local village. However, it also reduced the burden and time commitment that women spent hauling water, allowing them to participate in other leadership and income-generating activities. For example, women are leading the well management committee, which will generate resources for maintenance of the well thru contracts with nomadic people for livestock water and the selling of seedlings.

Women were also freed to participate in other local land rehabilitation projects and income-generating activities. For example, the Global Environment Facility's Small Grants Program (GEF-SGP) and the World Food Programme recently funded efforts to rehabilitate 150ha of the nearby, degraded Farin Guemé grazing area through the planting of grasses and trees. However, the women of Hadiya were not able to fully participate because of the time they devoted to hauling water. However, by demonstrating success in local resource management, the Hadiya Community Water Initiative project helped catalyze additional funding from the GEF-SGP and Lutheran World Relief to continue land reclamation efforts and develop income-generating activities for women related to ground-nut production, oil extraction, and trading. Without the burden of water hauling, local women are able to devote more time to fully engage in these activities.

Link to Climate Change Adaptation

Under climate change scenarios and in the absence of effective natural resource management approaches in Niger, the threat of future water shortage and famine is increased. It also promises the further desertification of fragile lands in the Sahel[24].

This project is addressing these climate change issues by organizing the women from Hadiya to assist in securing access to safe water in their village, participate in land reclamation and income-generating activities, and lessen competition for scarce resources. In this particular case, the water barrier has been removed and the community is able to focus on building ecosystem resilience, including long term income generating activities through an investment in non-timber forest products. The community has, through the project, been shown the value of addressing local needs by addressing environmental concerns. Increased environmental awareness and willingness to support long-term natural resources management has enhanced their adaptive capacity to better deal with climate variability and change.

Case Study 5: Wells and land dikes for safe water and agricultural production, Magta-Lahjar, Mauritania

2009 Kyoto World Water Grand Prize Top 30 Finalist

Project Data
Name of Grantee: Club UNESCO for Culture and the Environment
Start date: April 2005
Completion Date: February 2006
SGP/CWI Grant Amount: US$10,040

Background

Magta-Lahjar is a community in the Brakna Region of southern Mauritania. It lies in the semi-arid Sahel region and has one wet season between July and September, which is highly variable. Like in many rural areas of Mauritania, the areas surrounding Magta Lahjar faced limited access to drinking water. People used surface water during the wet season, but water was generally collected without any precautionary hygiene processing. Wells constructed to supply water for local populations regularly dried up between March and July each year. Water supply problems were exacerbated by severe droughts in the region during the last three decades. These water issues have been a factor in the displacement of local people to scattered camps and major urban centers, which has added to rural decline and strain on urban resources.

Climate change is resulting in additional uncertainty in precipitation. Average annual temperature has been increasing in the region (0.9°C since 1960), and is expected to continue this trend[25]. Although forecasted precipitation trends are variable, amounts are expected to decrease with more rain falling in heavy events during the wet season and less during other times of the year. The combination of higher temperatures, less rainfall, and more of it falling in heavier events (with drier times in between), could result in more drought and floods. With this increased climate variability, local communities will be more vulnerable to water shortage, threatening people's basic water needs and agricultural productivity.

Project Activities

To help resolve water scarcity and sanitation problems in the region, several activities were undertaken as part of this CWI project:

- constructed a series of land dikes in order to retain surface water and promote infiltration to recharge ground water
- improved water infrastructure and management for agriculture and livestock watering
- dug wells to provide potable water to local people
- organized sessions to raise public awareness on hygiene and sanitation
- distributed filters to households to reduce waterborne diseases

Results and Lessons Learned

Today, thanks to the community water project, local people are settled in their camps with safe access to drinking water for themselves and their animals. This has resulted in a side benefit of allowing children more direct access to educational opportunities. Public dams and wells are being maintained by the entire community, and most families have been able to build dikes to benefit agricultural management.

These projects not only provide stable access to potable drinking water throughout the year, but locals have typically doubled their agricultural production. In some cases, it has also fostered agricultural diversification through the introduction of corn crops. In addition, the project has also resulted in a reduction in waterborne disease in the project areas, as well as conflicts between local water users. In terms of capacity building, the project fostered leadership development in the construction of wells and improved awareness and training on hygiene practices.

Climate Change Adaptation

Under the pressures of limited water supplies and increasing climate variability, associated with climate change, this project has assisted in providing safe supplies of reliable water by focusing on: 1) the construction of land dikes to store water and recharge aquifers when it does rain, 2) the construction of wells and a hygiene program to provide secure drinking water supplies and reduce disease throughout the year, and 3) enhanced agricultural production to reduce poverty and increase economic viability, and 4) built the collaborative and management capacity of local people to better manage local resources. These factors have the combined effect of fostering water security while adapting to climate variability and change.

Case Study 6: An improved dam and habitat restoration in Tinkélé, Mali

Project Data:
Name of grantee: Survie au Sahel
Start Date: July 2009
Completion Date: December 2010
SGP/CWI grant amount: US$23,961

Background

The village of Tinkélé is 120 kilometers from the capitol, Bamako, with a population of 7000 in southwestern Mali. Though rainfall is sometimes abundant in southern Mali, the land quickly dries up afterwards. Droughts are also common placing additional stress on the water resources. The resulting water shortages have made conditions difficult for living on traditional lands, often forcing local people to resort to income generation that has devastating consequences for the local environment - the sale of timber and charcoal. This has resulted in the degradation of local lands and reduced biodiversity, and contributes to climate change.

Given the widespread shortage of water and land degradation, local villagers sought the assistance of the NGO "Survie au Sahel" to assist them in building a dam to store water for year-round access to water, promote land rehabilitation, and foster economic development. Funding was provided by the GEF Small Grants Programme and a small dam was built. However, it was soon realized that it was too small and water was being lost through leakage.

Project Activities

The Community Water Initiative provided funds to better consolidate and heighten the dam, as well as create a filter system to better manage seepage flows. This has tripled the storage capacity of the initial dam. A local committee has been established to manage the dam and water resources.

Results and Lessons Learned

The dam provides year-round access to water for livestock and provides recharge to ground water, raising the levels of local wells used for domestic and agricultural purposes. The availability of water, and the reintroduction of trees and plants like the Jujube that yields fruits in demand in local markets, have increased agricultural production and commodity production. The water and plants also attracted bees to the area, resulting in new business opportunities for the production and sale of honey. Local women have organized themselves into a cooperative to improve production and gain an even better price for their products.

The increased agricultural and economic development and higher awareness of environmental management, has decreased the need for timber harvesting and charcoal

production. Conversely, the presence of water has allowed an increased in biomass of herbaceous and woody plants in the area.

Climate Change Mitigation and Adaptation

Mali already experiences recurrent dry periods and drought that causes widespread impacts and strains the capacities of local people and the government. Increasing this problem, the annual average temperature has increased by 0.7°C since 1960 and is expected to increase with more hot days and nights in climate change scenarios, especially in southern Mali. Although there is uncertainty, projections also tend to highlight the potential for reduced rainfall. In southern Mali, this trends towards decreasing rainfall during the wet season, and more of it falling in heavier events. Projects to capture rainfall when it's available will help adapt to this increased climate variability.

The widespread cutting of trees and creation of charcoal as an energy source also has climate change implications. The removal of trees reduces carbon storage, and the burning of wood into charcoal releases green house gases into the atmosphere. Limiting these activities and restoring local habitat will not only benefit the local ecosystem but also serves to mitigate climate change.

Case Study 7: Integrated rainwater harvesting and management in pastoral communities, Rift Valley Province, Kenya

Project Data

Name of grantees: Kailer Village Development Committee; Cheptolil Self Help Group
Start date: August 2006 in Kailer; November 2006 in Cheltolil
Completion Date: July 2008
SGP/CWI grant amounts: US$19,115 (for Kailer); US$17,081 (for Cheltolil)

Background

The communities of Kailer and Cheptolil are within the Baringo and Koibatek Districts, respectively, within the Rift Valley Province of western Kenya. Kenya has two distinct wet periods – the "short" rains in October to December and the "long" rains from March to May. However, the year-to-year and month-to-month rainfall variability is large in the region resulting in frequent floods and droughts.

Climate change projections show that current climate trends may be amplified in the future with higher overall rainfall received but much of it coming in the form of heavier rainfall events[26]. With increasing temperatures predicted, along with more hot days and nights, efforts that focus on capturing water when it's available will assist rural communities in getting through the inevitable dry periods.

Project Activities

With funding from the CWI, the Kenya Rainwater Association assisted the communities in implementing two community water projects - one with the Kailer Village Development Committee (KVDC) in Baringo district, and one with the Cheptolil Self Help Group in Koibatek district. The overall objective was to promote integrated rainwater harvesting and management (RHM) systems and complementary technologies to enhance improved livelihood systems, socio-economic development, and sustainable natural resources management for these marginalized communities.

The projects' implementation process adopted an integrated, participatory and multi-sectoral approach that promoted effective community involvement and contribution. Specific project activities, included:

- Construction of two water pans and auxiliary structures (i.e., draw-off system, livestock trough and community water point) to supply water for livestock, domestic use, and micro-irrigation.
- Construction of six ventilated improved pit latrines and bathrooms.

- Establishment of two tree/vegetable nurseries for agro forestry, afforestation and reforestation, and vegetable production.
- Installation of 44 low-head drip irrigation kits for vegetable micro-irrigation.
- Introduction of draught animal technology (DAT) – animal drawn plough, sub-soiler, tined harrow and dam scoop for rangeland rehabilitation and dam de-silting.
- Institutional strengthening through exposure visits and training in leadership and organizational skills, financial management and record keeping, alternative livelihoods, health, sanitation and hygiene, environmental conservation, integrated water resources management, and formulation of water user's by-laws.

Results and Lessons Learned

Several results were achieved through these CWI projects. First, an adequate supply of quality water was realized for domestic, livestock, and micro-irrigation purposes. The adoption of toilets (30-50 households and 2-12 households in Kailer and Cheptolil communities, respectively) also assisted in proper sanitation. These activities have improved human and livestock health, as well as added to improved food and income security. The communities were able to use the water and micro-irrigation to diversify crops and increase reliable food production.

Enhanced community capacity in leadership, project implementation, and management was another benefit of the project. Capacity building enhanced the realization of the communities' potential in managing their own resources sustainably. Similarly, collaborations were strengthened between the communities and the District Water Offices (DWOs) in Baringo and Koibatek districts, which helps to form a stronger network of development resources.

Climate Change Mitigation and Adaptation

Because of the high degree of current climate variability and the uncertainties associated with future climate change in the region, efforts to foster water security and adaptive capacity are vital. This project capitalizes on the potential to capture future rains, enhance sanitation to protect water and promote personal well being, promote micro-irrigation to use available water conservatively to promote food security, and created a tree nursery to facilitate land rehabilitation and carbon sequestration. These activities, along with enhanced environmental management abilities and collaboration between communities, have increased local capacities to mitigate climate change and adapt to the effects of climate variability.

Case Study 8: Rainwater harvesting and spring development for quality water, Senyi Landing Site, Uganda

Project Data

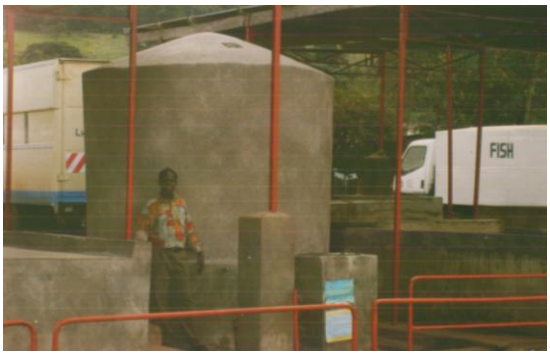
Name of grantee: Uganda Association for Socio-Economic Progress (USEP)
Start date: June 2006
Completion date: December 2007
SGP/CWI grant amount: US$ 40,000 (US$15,000 in Phase and US$25,000 in Phase II)

Background

Senyi Landing Site is located on the northern shore of Lake Victoria in Mukona District. The community is the largest fishing village in the District with 2,200 residents (increasing to 5,000 people on market day). Even though the village is located on the shores of a lake, access to adequate supplies of quality water is a struggle and the population is prone to diseases such as diarrhea, cholera, and dysentery. The Lake Victoria water is highly contaminated and requires a thorough treatment process. There are two springs in the area, however one is low-yielding and the other is 1.1 km from the village. Moreover the rainfall in the area is highly variable and trends suggest the region has experienced higher temperatures and more frequent droughts in recent decades[27,28].

In addition, international regulations require fish landing sites to have a reliable supply of (piped) potable safe water, toilet facilities, and hand washing facilities. Being a major fish landing site, Senyi's contribution to the economy of Uganda is significant given that the fisheries sub-sector is in the forefront of Uganda's economy as the fastest growing non-traditional export, and the second most important foreign exchange earner after coffee[29]. Continued access to markets in Europe, Australia, and East Asia depend on fulfillment of these hygiene-related regulations.

Project Activities



The project was implemented by a non-profit organisation, Uganda Association for Socio-Economic Progress. The first phase of the project provided rainwater harvesting and toilet facilities (with flushing water closet), The Executive of the Beach Management Unit has contributed the sanitary ware within the toilet on behalf of the community.

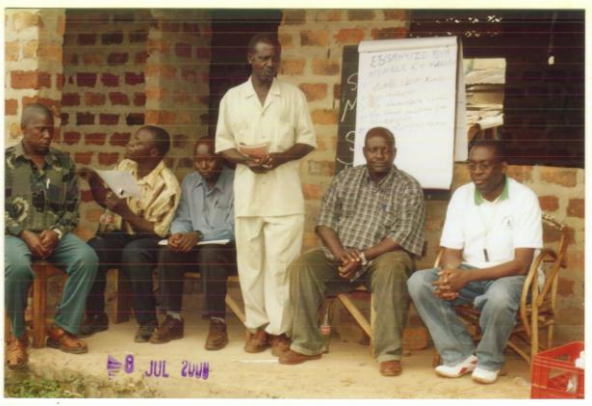
The project to provide safe water and improved sanitation facilities, coupled with hygiene education The district government provided the training manuals and CASDEV Consultants have guided the community to produce a play on Hygiene and Sanitation.

However it was felt that the site still lacked a reliable water supply. Therefore, a second phase was dedicated to building a gravity water flow system from the 1 km far protected spring. The water flow system includes a water reservoir that is sized to collect a safe limited

yield of 24m^3/day. Limiting the harvested yield resulted that some water is left for attendant ecological systems downstream, which could be otherwise adversely affected. The pipe works are comprised of a transmission line, which is also a distribution line.

Results and Lessons Learned

Two ferrous cement water tanks of 10 litter-capacity and two latrines with septic tanks were constructed. The facilities put in place are contributing to improvement in health and living conditions through the reduction in occurrence of water-borne diseases, and reduction in substantial time and energy savings for water collection (especially for women and children).



The project also supported maintaining the Senyi's fishing landing site as a leading source of Uganda's fish exports.

Climate Change Adaptation

Although there have been recent trends for declining rainfall, particularly during the "long" rains from March to May, long-term climate change projections point toward a reversal of the trend in favor of wetter conditions[30]. However, much of that rainfall may fall during heavier events during the rainy seasons and be difficult to capture for use in times of shortage. In addition, higher expected temperatures and evaporation rates could exacerbate drought conditions when they do occur.

Investing in rainwater harvesting systems provides an opportunity for local people to capture rain when it's available for use during times of shortage. In addition, the creation of the piped water distribution system provides an additional buffer against water scarcity, as well as helps to ensure the long-term viability of the local, fishing-based economy. It does so without drawing on the limited resources of Lake Victoria. To the contrary, the increased sanitation efforts will help to maintain the quality of the local water resources, especially under the threat of heavy precipitation events that can transport wastes into local water bodies. Overall, increasing the diversity and security of local water resources will help protect the lives and livelihoods of local people by improving water access and quality, especially under the threat of increased climate variability.

Case Study 9: Well disinfection and sanitation facilities on the island village of Dionouar, Senegal

Project Data
Name of grantee: FELOGIE de Dionewar
Start date: 2007
Completion date: 2008
SGP/CWI grant amount: US$16,467

Background

Dionouar village, located on the periphery of the Saloum Delta National Park (a Biosphere Reserve and a Ramsar Convention site), is a small island of nearly 5,000 people. Its lack of infrastructure for water supply and sanitation caused water shortages and adverse health affect among the local population. In particular, local people rely on traditional, shallow wells (7 to 8 meters deep) for their drinking water. This poses enormous difficulties, especially in the dry season, as the quantities of water produced by these wells is inadequate. Rainfall is also highly variable from year to year, resulting in recurring drought. This situation forces women to stay for hours in wells waiting to fill their buckets. During the rainy season, rising ground water provides enough water but poses a problem of quality.

Much of the local water quality issues are a result of latrines built on piles immersed in the sea, which contributes faecal material into the surrounding ocean and beaches, where children play and women wash grain. Parasitic diseases and dysentery were also linked to the consumption of certain fish from inland waters. These factors, combined with poor hygiene practices, resulted in a high prevalence of cholera and other diarrheal and parasitic diseases, which represented over 40% of the reasons for consultation at the local health post.

Project Activities

To overcome these difficulties, the federation of women of the village received a CWI grant, which funded:

- participatory exchange meetings for selecting the locations of wells
- the improvement of eight local wells
- disinfection of traditional wells for drinking water
- construction 55 latrines in concessions, and
- the organization of a day of advocacy for the active involvement of local authorities, resource persons, the vulnerable (children and women) and traditional leaders in the fight against the use of pile latrines.

Because of the local capacity that had been developed, local women were also able to self-finance and participate in reforesting 20 hectares of mangroves on the periphery of the adjacent Saloum Delta National Park.

Results and Lessons Learned

Because of this project, access to drinking water and sanitation has been secured for the village, and part of the periphery of the Saloum Delta National Park has been preserved from faecal pollution. Five thousand people have been educated on the threat of faecal pollution and now have access to adequate amounts of quality water, and more than 1,000 people use the new latrines built in houses. As a result, use of immersed latrines have fallen, the cleanliness of the village and beach has improved, and diarrheal diseases have declined.

Because women are able to spend less time hauling water, they now have more time to undertake other livelihood and habitat protection activities. The project also created employment in the village and increased the income of local villagers. In addition, local capacities were developed among women and other local stakeholders, and social cohesion was strengthened through solidarity and mutual assistance required for implementation of the project.

Climate Change Mitigation and Adaptation

Senegal has one wet season between July and September, but rainfall is highly variable from year to year, resulting in recurring drought. Average temperature has also been increasing since the 1960s (0.9°C), along with wet season rainfall in the southern region[31]. Climate projections predict the increasing temperature trend to continue with an increase in the number of hot days and nights. Compounding the problem, rainfall is projected to decrease, particularly in the wet season, and more of the rain will come in heavier events. Sea levels are also anticipated to rise and violent storms may increase, which threatens local coastlines and adjacent surface and ground water with seawater intrusion.

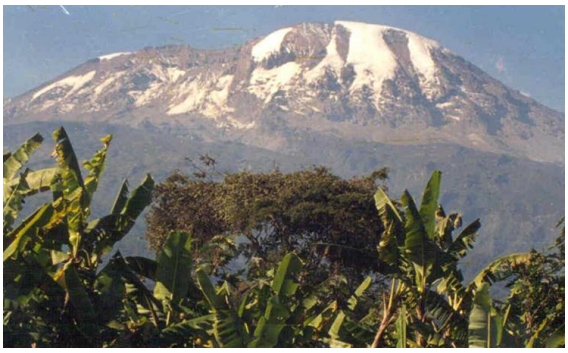
Creating a more secure water supply reduces the threat of rainfall and water quality effects anticipated under climate change scenarios. In addition, this CWI project helped build the capacity of local villagers to self-finance the improvement of vulnerable mangroves that will be increasingly threatened by rising sea levels. Improving the mangroves helps protect the coastline from storms and tidal surges, ensures important fisheries habitat, and serves as an important carbon sink for green house gases.

Case Study 10: Recycling of waste water for paddy irrigation farming, Moshi, Tanzania

2009 Kyoto World Water Grand Prize Top 10 Finalist

Project Data
Name of Grantee: Mazingira Group
Start Date: October 2006
Completion Date: December 2008
SGP/CWI Grant Amount: $31,021

Background



Moshi is a Tanzanian town situated on the lower slopes of Mt Kilimanjaro, the highest mountain in Africa. The local area receives most of its rainfall from October to May, with most occurring from March to May. However, there is a high degree of variability with the onset, duration, and intensity of rainfall from year to year, often resulting in droughts and floods. In addition, since 1960, average annual temperature has increased by 1.0° C, and rainfall has decreased during the wet and dry seasons, leading to local water shortages[32].

The reduced rainfall has directly affected crop production in the area, as well as flows needed for irrigation. Farmers are experiencing reduced flows of freshwater to their farms, which is affecting agricultural production and food security. The results of water scarcity in the Kilimanjaro region have included decreases in agricultural production and food intake, reduced agricultural incomes, and loss of employment opportunities. Agriculture is an important resource of revenue for Tanzania as it provides income and employment to over 80% of the population[33]. On several occasions, conflicts have occurred as farmers competed for meager water resources for irrigation.

Climate change projections show a trend for less rainfall in the future and much of it in irregular heavy rainfall events. Higher temperatures may result to drier and harder conditions for local communities.

Project Activities

A project on recycling waste water for irrigation farming was established in response to these problems. Project implementation involved the following

key components: (1) treating of waste water through waste water stabilization ponds, (2) releasing treated waste water from maturation ponds through trapezoidal channels to farmlands, (3) clearing and demarcating farm plots adjoining the oxidation ponds for new farms, (4) changing the mindset of farmers on the suitability of odorless waste water for agricultural production, and (5) establishing a farmers association, complete with leadership structures for aggressive market access.

Results and Lessons Learned

To date, the project stands as a best practice for sustainable development in Tanzania showcasing the following results:

- It demonstrates that waste water can be recycled for productive use.
- Irrigation has allowed two harvests per year, which has led to food security and reduced income poverty at the household level for a total of 80 farmers.
- Fertilizer use has been eliminated because nitrates and phosphates embedded in waste water provide nutrients for agricultural production, which has decreased the cost of production by 50%.

- Conflict for fresh water for irrigation has been eliminated.
- Cooperation between scientists, the local government, and farmers has improved.
- Study visits have been conducted by various stakeholders with a view to replicating the project in other areas.

Link to Climate Change Adaptation

Recycling water for irrigation serves several purposes. It is an adaptation measure that provides a new source of water to buffer against climate variability and water scarcity. The project has also fostered poverty reduction and food security in the local community, which reduces vulnerability to climatic and other perturbations. It has also reduced conflict over water allocation and enhanced the capacities of and cooperation between local communities, scientists, and the government, which will support future climate change planning. Increased irrigation and water recycling are two of Tanzania's priority National Adaptation Program actions. They feel that these types of activities are the most effective and efficient ways to cope with the affects of climate change. Furthermore, they represent projects with a high probability of affecting poverty reduction and health, and are reliable, replicable, and sustainable techniques[34].

Case Study 11: Ground Water Quality Improvement through Ecosystem Management, Sri Lanka

2009 Kyoto World Water Grand Prize Top 10 Finalist

Project Data
Name of Grantee: Neo Synthesis Research Centre
Start date: November 2003
Completion date: March 2007
SGP/CWI grant amounts: US$21,487 and US$18,170 (in two grants)

Background

The Kalpitiya Peninsula is located on the west coast of Sri Lanka. The people in this region experience a range of serious environmental, social, and water supply issues. The region receives modest rainfall (less than 900 mm), which is becoming increasingly erratic in its occurrence. This has resulted in the widespread use of ground water withdrawals for crop production and domestic use from the underlying aquifer.

However, relatively large-scale, monoculture agriculture (3-25 acres) is practiced in the area, which includes the continuous and liberal application of chemical fertilizers. The heavy use of these fertilizers has led to the contamination of farm and domestic wells with nitrates, and fosters the release of nitrous oxide – a greenhouse gas. The implications of nitrate contamination on human health include the incidence of methaemoglobinemia (blue-baby syndrome). Surveys showed that 64% of local infants had methaemoglobin levels above the recommended range, as well as malnutrition and anemia problems from poor diets.

In addition, increasingly high temperatures are prevalent in the region assisting salt laden winds in desiccating local vegetation. This effect has been exacerbated because local mangroves and other trees have been cleared for shrimp and agricultural production and almost no natural forest remains, affecting the local climate and habitat for biodiversity.

With climate change scenarios expecting even higher temperatures, increased rainfall variability, and increasing storm activity and sea level rise that could cause inundation and

erosion on some parts of the peninsula[35], efforts were needed to protect existing water resources, restore the local ecosystem, and strengthen people's adaptation capacities.

Project Activities

The project built on successful demonstration of bioremediation to improve the quality of ground water contaminated with nitrates, previously carried out by the Neo Synthesis Research Centre. The landscape design of the well area involved three aspects: bioremediation, production, and fence areas.

The immediate area around wells was planted with several deep rooted, mostly native species of trees that had long and short growth cycles. They were planted in a dense manner to form a 'root mat' below the surface and facilitate the uptake of the contaminants by the roots of the trees (**bioremediation**). The process of microbial remediation required that large quantities of organic matter be added to the sandy soil since a carbon rich environment was mandatory for the process of denitrification to occur. Initially coconut peat and straw were added. As the trees and shrubs grew the organic content required was provided through leaf fall and detritus.

The **Fence area** was developed using several species that could withstand the salt laden sea breeze and serve as wind breaks. The surrounding area was developed as a **production area** where both perennial and annual crops were grown using organic cultivation regimes. Nearly eight thousand plants belonging to fifty four species were planted in home gardens, around public wells and aside the lagoon.

The bioremediation technology was extended in 2006 through the Community Water Initiative to 39 public wells located in schools, churches, mosques, hospitals and 13 private wells. Organic crop production was also introduced in 25 home gardens. In 2007, because of the success of the project, the technology was applied to 1001 wells in Kalmunai on the eastern coast of Sri Lanka, an area worst affected by the Asian Tsunami.

Results and Lessons Learned

Water testing in 2004 showed levels of nitrates exceeding 58.5 mg/liter, but the levels had been reduced to 12.1 mg/liter by 2008 (compared to the World Health Organization guideline for nitrate-nitrogen of 10 mg/liter). The project improved water quality in the wells serving more than 10,000 people on the Kalpitiya Peninsula and over 5,000 people in Kalmunai. Furthermore, the three wells at St. Anne's Church in Talawila provide water to 1- 1.5 million pilgrims and visitors who visit the ancient Christian Shrine each year.

Soil fertility also increased, reducing the dependence on chemical fertilizers. Garden owners began to reap harvests for domestic consumption, thus increasing food availability and diversity. The increased diversity also allowed the harvest and sale of produce throughout the year, improving nutrition and reducing the need to purchase food from markets.

Climate Change Mitigation and Adaptation

This project resulted in several climate change mitigation and adaptation benefits. The increase in local trees and vegetation serves as an important carbon sink, and organic farming plays a significant role in mitigating the escape of nitrous oxide as a greenhouse gas.

Adaptation was also fostered by modifying the landscape, improving ground water quality and public health, and increasing income-generating opportunities. By improving ground water quality through bioremediation, the project essentially created a "new" water supply that will provide security now and under changing climate conditions. Healthier people with a wider variety of economic options will be better able to deal with the adverse effects of climate change. For example, increasing crop diversity that allows harvesting throughout the year is an important risk reduction strategy for dealing with changing climate conditions that could affect particular seasons. Finally, the threat of increasing sea levels and storms was reduced by the planting of trees in the littoral area of the lagoon landscape, which will help protect the coastline and enhance habitat for biodiversity.

However, one of the greatest benefits of the project is its simple design, versatility, and ease of replication in other regions. It relies on natural processes that can easily be applied and reduces the need for poor countries like Sri Lanka to adopt sophisticated water purification measures that are energy consumptive and expensive.

Conclusions and Lessons Learned

The preceding case studies are representative of many places and people in the developing world. They provide a glimpse into the daily lives of people who are affected by water insecurity and climate change, and who are striving to overcome these problems. Each story is different and provides valuable lessons for communities trying to address water insecurity and climate change and for those organizations assisting them. Following are a few of the conclusions and lessons learned through the implementation of projects funded through the Community Water Initiative.

CWI projects have helped foster water security, while reducing the likelihood and effects of climate change

CWI has been able to implement a range of projects that have simultaneously addressed water security and reduced the likelihood and affects of climate change. In terms of **mitigating climate change**, some projects have incorporated renewable energy sources and/or a focus on modifying activities to reduce green house gas emissions. Others have fostered carbon storage through agricultural and land management activities, such as reforestation. For example,

- Rehabilitating a micro hydropower plant at Nueva Alianza, Guatemala, created a reliable water supply and clean energy source for agricultural processing and domestic use (Case Study 1).

- The installation of a non-polluting solar powered pump in the Chanyauru region of Tanzania allows domestic and irrigation water to be withdrawn from Lake Victoria, while new organic farming methods reduce GHG emissions from chemical fertilizers (Case Study 2).

- Increasing the size of a dam in the village of Tinkélé, Mali, increased water storage and raised ground water levels in surrounding wells, fostered local biomass production, and reduced the economic need to harvest trees for charcoal production (Case Study 6).

Other CWI projects focused more heavily on **adaptation to current water stress and climate change** by creating water storage facilities, improving water quality, and fostering water

management capacities. This development strategy utilizes appropriate technology and local resources to develop water management systems that meet local needs and build capacities to cope with climate variability and change. A variety of systems have been designed to increase water storage, create "new" supplies of safe treated water, and foster socio-economic development to combat climate variability and change. For example,

- Digging new wells and the creation of land dikes for rainwater harvesting at Magta-Lahjar, Mauritania, has created healthier and more reliable water supplies, doubled agricultural production, and reduced local conflicts and forced migration because of periodic drought (Case Study 5).

- A new waste water recycling facility for Moshi, Tanzania, has created a new source of irrigation water to buffer against declining water availability and climate change, which has doubled local crop production, reduced poverty, and eliminated conflict over limited water supplies (Case Study 10)

- The use of bioremediation, by planting tree crops around public wells and gardens, on the Kalpitiya Peninsula, Sri Lanka, reduced nitrate contamination in ground water by nearly 80% in four years, thereby, creating safe water supplies and enhancing food and income generation under the threat of increasingly erratic rainfall and tropical storms (Case Study 11).

CWI projects also serve broader development goals that increase communities' capacity to deal with climate variability and change

In addition to providing water security, CWI projects have also fostered the realization of broader development goals, such as improving health, education, economic development, natural resources management, technical skills, and self-governance capacities. The provision of safe and reliable water resources has resulted in healthier people who are able to devote more time to other activities, such as income generation and education, and provided the basis for economic growth (agricultural, trade, industrial, etc.).

The participation of local people in CWI projects has also increased their technical, management, and collaborative skills, as well as fostered their involvement in other natural resources management projects. These benefits are helping to create more robust and empowered societies that are better able to manage resources and address problems that may arise in the future due to climate change or other disturbances. For example,

- The digging of new wells in the Zukpuri Traditional Area, Ghana, provided clean water for domestic use, as well as increased school attendance rates from 25% to 95% and created employment for 30 young people in constructing similar hand pump wells in other communities (Case Study 3).

- At Hadiya, Niger, a new well provided a local water supply that reduced the hauling time required by women and children (7-14km per day), which allowed women to plant and sell seedlings for non-timber forest production, manage water contracts with local nomads, and participate in the rehabilitation of a communal grazing area (Case Study 4).

- At the Senyi Landing Site, Uganda, rainwater harvesting and the development of a spring and water distribution system, along with sanitation facilities, has created a safer and more robust water supply, which has decreased the occurrence of water-borne diseases and ensured that health regulations can be met for local fish processing (Case Study 8).

CWI projects address water security and climate change by fostering appropriate technology, local ownership, collaboration, sustainability, and transferability

The design and implementation of CWI projects is often unique to particular places and people, however, several concepts emerge among particularly successful projects. First, these projects have identified strategies that are **technically and culturally appropriate**. CWI projects have striven to implement carbon-neutral and relatively low-cost strategies, ranging from constructing micro hydropower plants and solar powered pumps to digging wells, building small dikes and dams, and constructing rain water catchments with local labor. Creative and long-term planning is essential for identifying strategies that will address current water needs, meet climate change mitigation and adaptation goals, and increase the communities' development capacities.

Indigenous knowledge is also incorporated whenever possible, such as using traditional techniques for well drilling or acquiring the assistance of local spiritual leaders to site wells. For example, the inclusion of spiritual leaders in locating well sites in the Zukpuri Traditional Area, Ghana, created a collaborative process that was able to overcome local tensions. The involvement of community leaders and members are essential for fostering **local ownership** that will help ensure the implementation and continuation of the project into the future. By taking leading roles in the projects, local participants were able to overcome many potential obstacles that could have threatened the success of the projects.

In fact, successful projects rely on a wide variety of **collaborations** to leverage additional technical and financial resources to expand their development efforts. For example, the Hadiya Village CWI project, in Niger, helped catalyze additional funding from the GEF-SGP and Lutheran World Relief to continue land reclamation efforts and develop income-generating activities for women related to ground-nut production, oil extraction, and trading.

Fostering these types of collaborations and including local investment and income-generating activities in the design of the projects helps ensure the **sustainability** of the project over time. CWI projects generally include provisions for local community members to donate time and pay fees to maintain water works. Additional income generated from related activities help ensure the ability of local communities to continue their investment in water and other development activities.

Finally, the strength of many CWI projects is their **transferability.** They provide specific examples, which other communities can follow in addressing water and climate change issues. In some cases, this is already occurring. Project members from the Zukpuri Traditional Area in Ghana have used their training to constructed more than 30 wells for the 16 communities in the Upper West Region, providing more than 26,000 people with access to safe supplies of water. Similarly, because of the success of the bioremediation projects in Sri Lanka, the technology has already been applied to other regions, such as the tsunami affected Kalmunai on the eastern coast of the country. The continued transfer of the lessons learned from these types of development projects is essential for fostering community water initiatives.

The continuation and expansion of the these activities are essential for enhancing water security and minimizing the threat of climate change in a targeted, efficient, and equitable manner

Tackling the inter-related issues of water stress and climate change will require a combination of local action, national direction, and regional and global coordination. The Community Water Initiative has demonstrated what can be done through the provision of small amounts of money to motivated, local stakeholders. Effectively targeting these resources to some of the poorest and most vulnerable populations, helps ensure equitable access to development resources. The continuation of such efforts is vital for helping the most vulnerable develop and protect their water resources, and better deal with current climate variability and the effects of future climate change.

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