Climate-adaptive Community Water Management for Food Security: Experiences from the UNDP Community Water Initiative

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Abstract
Facing the double menace of climate change and water crisis, poor communities are now encountering ever more severe challenges in ensuring agricultural productivity and food security. Hence, communities have to manage these challenges by adopting a comprehensive approach that not only enhances water resource management, but also adapts agricultural activities to climate variability. Implemented by the Global Environment Facility's Small Grants Programme, the Community Water Initiative (CWI) has adopted a distinctive approach to support demand-driven, innovative, low cost and community-based water resource management for food security. Experiences from CWI show that a comprehensive, locally adapted approach that integrates water resources management, poverty reduction, climate adaptation and community empowerment provides a good model for sustainable development in poor rural areas.

Keywords: *Climate adaptation; Water resource management; Community empowerment; Food security*

Introduction - Water Crisis, Climate Change and Food security

Water is a source of life for the planet. Access to water for life is a basic human need, a fact that is complicated by 1.6 billion people living in areas of physical water scarcity (UNEP, 2011). Yet in our increasingly prosperous world, 783 million people have no access to clean water and if the current trend continues there will be 2.4 billion people who lack adequate sanitation (WHO and UNICEF, 2014). 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. The world's poor, who primarily live in the rural areas of Sub-Saharan Africa and South Asia, are particularly affected. They are the ones with the most

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inadequate access to safe water, yet they are also the population groups whose livelihoods and immediate dietary needs are most dependent on these resources.

Water is not only a basic human right in itself, but it is also critical in farming and other livelihood activities. Irrigated agriculture accounts for 69 percent of all water withdrawals in the world, and the proportion exceeds 90 percent in some situations such as in arid countries where irrigation is vital or where other sectors such as water supply and sanitation or industry are less developed (FAO, 2008). Water is the basic production element for agriculture: it takes 1,000-3,000 litres of water to produce one kilogram of rice and about 13,000 to 15,000 litres of water to produce one kilogram of grain-fed beef (IFAD, 2014). Hence, water resource management is critical to ensure sustainable agriculture development and food security. Globally, more than one billion people suffer from under-nutrition and the vast majority (98%) live in developing countries. Communities in South Asia and Sub-Saharan Africa, who also suffer most from water scarcity, face the biggest challenge of meeting their daily dietary needs. More than two thirds live in rural areas, where their livelihoods and well-being critically depend on subsistence farming and other ecosystem services in their area.

On top of the water crisis and its possible severe impact on farming and food production, climate change poses additional challenges for sustainable agriculture and food security. Climate change-induced variability in the hydrological cycle can not only deteriorate water sources and supply, but also increase unpredictability in water resource management. Rainfall and flood events are expected to intensify with more frequent and prolonged droughts in between. Changes in precipitation, increased evaporation rates, salt water 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, each degree of warming is projected to decrease renewable water resources by at least 20 percent for an additional 7% of the global population (IPCC, 2014). By mid-century, annual average river run off and water availability are projected to increase by 10-40% at high latitudes and in some wet tropical areas, while decreasing by 10-30% over some dry regions at mid-latitudes and in the dry tropics, some of which are already water-stressed (IPCC, 2007). These developments have critical effects on the rain-fed agriculture on which most poor communities in rural areas depend.

This paper draws on the experiences and lessons learned from the United Nations Development Programme (UNDP) Community Water Initiative (CWI) in addressing the complex interconnections between water, climate and agriculture. It presents a view from the grassroots level and discusses how the interlinking challenges of climate change, water crisis and food security issues can be addressed by rural communities. These issues are manifested differently under specific local conditions; hence this paper argues that community-based projects that

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Country	Number of Projects	Number of Beneficiaries	Grant Amount	Co-Financing Cash	Co-Financing In-Kind	Total Budget
Mauritania	34	36,925	$585,1	$130,8	$255,4	$971,3
Mali	23	164,185	$500.0	$128,2	$108,6	$686,9
Niger	22	313,042	$465,7	$35,0	$117,4	$618,1
Senegal	21	71,443	$449,9	$96,2	$351,7	$897,87
Guatemala	14	17,268	$240,2	$349,8	$235,7	$825,7
Kenya	14	34,443	$207,5	$292,3	$57,4	$557,2
Sri Lanka	13	18,664	$220,5	$49,4	$100,1	$370,0
Tanzania	11	28,880	$171,6	$261,3	$107,3	$540,2
Uganda	8	13,865	$105,0	$29,7	$36,5	$171,2
Ghana	7	16,840	$94,9	$69,4	$70,0	$234,3
Total	**167**	**715,555**	**$2,990,2**	**$1,442,2**	**$1,440,0**	**$5,872,5**

Table 1 Summary Table of CWI Portfolio (Financial Numbers in'000)

integrate water resource management, climate change, livelihoods and community empowerment can provide an effective development model for poor communities which are unreachable for larger development initiatives. The design of specific water management solutions for food security needs to take into account the specific context in which the community operates, including the multiple uses of water by men and women and other factors that shape access. Four cases of community-based water management for agriculture are presented and analysed for future learning and replication.

Community Water Initiative: Community Empowerment for Adaptation and Food Security

UNDP CWI is an initiative to address water and food issues at the community level. Launched in 2003, CWI has managed to build a strong portfolio comprising 167 projects in 10 countries. With a primary focus on Africa, projects were launched in Ghana, Kenya, Mali, Mauritania, Niger, Senegal, Tanzania, and Uganda. Pilot countries in South Asia (Sri Lanka) and Latin America (Guatemala) were added as well. More than 70% of the CWI projects and 74% of CWI grants go to the Least Developed Countries (LDCs). Table 1 includes the summary of the CWI portfolio.

CWI supports a decentralized, demand-driven, innovative, low-cost, and community-based approach to water resource management and sanitation projects in rural areas. It is rooted in the strong belief that local management and community initiatives play a key role in ensuring the direct relevance and sustain-ability of these initiatives. Relying on a holistic approach to water resource management, poverty reduction and community empower-ment, CWI has chartered a valid course towards sustainable food security for poor communities.

CWI has been implemented through the Global Environment Facility's Small Grants Programme (SGP), which has since its launch in 1992 gained extensive experience focusing on supporting community-based

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actions to protect the global environment. CWI finds its synergies and linkages with SGP activities to ensure that the water supply and sanitation activities are green and environmentally sustainable. For example, through collaboration with SGP activities, CWI has introduced the use of solar energy in water pumping and integrated water supply activities with reforestation and organic farming.

A large share of CWI projects integrates the promotion of food security and sustainable agricultural practices as a core element in their project design. Increasing the availability of water has not only eased pressure on precious freshwater resources and land, but also provided water for farming and livestock activities. The provision of sanitation facilities, on the other hand, has facilitated the rehabilitation of terrestrial and aquatic ecosystems. CWI has thereby employed a range of innovative strategies to promote climate-adapted food security such as small-scale irrigation, dry-season gardening, soil-less agricultural techniques, and climate-adaptable crop varieties. For improved water supply, communities rely on a combination of traditional and innovative technologies such as rain and rock water harvesting, groundwater and watershed rehabilitation, and solar-powered pumps. All CWI communities integrating agricultural activities into the projects have been able to record substantial health improvements, particularly in child nutrition.

It should be noted that the community-based approach of CWI follows the principles of demand-drivenness in that communities themselves identify their needs and ensure community consensus in developing and implementing projects. Building upon the twenty years of community experiences from SGP, CWI has adopted an inclusive and participatory management approach that not only respects the traditions, values and cultures of local communities, but introduces elements of change to ensure transparent and democratic governance of the project (UNDP 2012). Part of this process includes a vulnerability reduction assessment at the beginning of each project, which pays particular attention to the social inclusion of vulnerable groups including women, youth, and the disabled. Particularly, CWI promotes gender mainstreaming by making women's participation a criterion for project proposal selection. Every project requires the community to form a gender-balanced committee to manage the new water scheme.

Methodology

In 2013, the authors conducted a global study of the CWI portfolio to review the progress made, identify good case studies, and collect good practices and lessons learned. The study team was composed of the Programme Manager and a consultant (the authors of this paper) who worked with the support of the CWI/SGP National Coordinators based in each of the ten participating countries. The study involved a global desk review and database analysis, survey, interviews and site visits. The ten SGP National Coordinators (based in UNDP country offices) played a critical role in obtaining and providing data and information from local communities, who actively participated in the

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global survey. Based on the findings from the global survey as well as recommendations from the National Coordinators, case studies were identified and developed to facilitate global learning.

The desk review involved the review and categorization of CWI projects based on specific themes and focus areas. 167 projects were reviewed, categorized and analysed by the types of activities and impacts achieved. The raw project information data are included on SGP online database (www.undp.org/sgp). Categorized projects were then sent to National Coordinators in the field to verify and validate.

Results and feedback from the projects were collected through a global survey which was completed by all 167 community organizations in the programme. Data and information were further analysed by the study team, and sent back to the field for verification and validation. Site visits were conducted by National Coordinators (some were through regular monitoring visits) to evaluate the project progress and to collect information on results. Interviews with project grantees, which were conducted as a joint effort between the study team and the National Coordinators, provided another source of information for the development of the case studies.

Cases of Community-based Water Management for Food Security

Revitalizing Ancient Irrigation Technologies near the Sigiriya World Heritage Site, Sri Lanka

Background

Located near the ancient city of Sigirya, Pollattawa village hosts the Pollattawa reservoir and an ancient canal called *Kapu Ela.* Over the course of time, the traditional lifestyle of the indigenous farming community in Pollattawa village had been lost, which led to the degradation of the local watershed area and made it difficult to meet the water needs for agricultural and domestic purposes. Pollattawa's 108 families used primarily groundwater for their daily water needs, which they accessed through three tube wells that were shared by two villages. Two of those tube wells served drinking water purposes while the third well was reserved for other domestic purposes. A few families were able to construct their own wells.

Farmers, who cultivated Big Onions as the primary crop, relied on water from the communal water storage tank or the *Kapu Ela canal* for irrigation purposes. However, harvests, which typically amounted to 3,000 kilos per acre, fell well below the projected amount of 5,000 kilos of onions per acre. In addition, the limited water resources forced farmers to spend more time on watering their crops, leaving little remaining time for other work on the farmland.

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Project activities

With active engagement of the local community throughout the project, the CWI grantee Centre for Eco-Cultural Studies (CES) implemented a series of activities to help the community create a sustainable supply of water and rehabilitate the watershed area. The primary objective of the project was to revitalize the community's traditional rainwater harvesting techniques by renovating the ancient cascade system, including its tank ecosystems and ancient canal *Kapu Ela*. The canal harvests rainwater from the Yan-Oya catchment area and feeds into the Polattawa reservoir before it runs another seven kilometres to Pidurangala where the onion paddy fields are located.

The second objective was to rehabilitate the watershed area, by steering the community towards enhanced organic farming and non-timber products as source of alternative livelihood activities. Specifically, the project sought to upgrade the organic agricultural area with solar energy for improved access to irrigation water. The community selected ten farmers to pilot drip irrigation powered by solar energy water pumps. The water pumped from the well is supplied to the farmland through soil-based PVC pipelines, which run along the crop beds. Each pipeline has several tiny holes that drip water on the soil and, as the water is supplied near the roots of the plant, wastage from evaporation is minimal. Through this micro-drip irrigation system, the plants receive water all day long from morning to evening. This has freed farmers' time to increase weeding and fertilization activities to optimize effective agricultural practices in the area. Farmers have also been able to realize significant savings in fuel cost (around 60%) to run the water pumps, since the installation and operation cost of those solar pumps is minimal.

Organic farming production has been further strengthened through a few other steps. For one, the project sought to capture traditional knowledge on wild crops and local water governance through a series of documentation activities. This knowledge has then been integrated into farming activities, which have also promoted the cultivation and rotation of traditional crop species. In addition, the project has advanced organic fertilization to reduce water pollution by chemical fertilizers. On the ten selected farms, organic waste matter is now recycled into compost. A chopper is used to cut the large organic litter into little pieces, before cow dung and other materials are added to create the compost mixtures. The farmers can either use the compost on their farms or sell the compost on the market to generate additional income.

Promoting alternative, non-timber-product-based livelihoods also formed an important element of the project. Firstly, farmers opened a sales outlet for vegetables, fruits and other food items to cut the transportation cost for their produce to a market in Dambulla. Twenty families have also taken up beekeeping after they were trained in apiculture and honey production, and twenty women created micro-enterprises based on rush and reed products. Additional activities of the project included community

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awareness and education programmes, which sensitized the community to the issues of water conservation and management and built women's capacity to share these benefits and responsibilities on an equal basis. The community also established a water management committee to ensure equitable sharing and sustainability of the water scheme.

Results

The rehabilitation of the watershed area itself has promoted the recharging of the groundwater table. With the rehabilitation of the ancient cascade water supply scheme, increased availability and sustainability of the water resources have allowed the community to further develop traditional farming and domestic activities. The rehabilitation of the watershed area has promoted the recharging of the groundwater table. This has enabled the community to expand into alternative livelihood activities comprising the sale of organic produce, rush and reed products, honey products and compost. The project has also enhanced equitable water use and management among community members, especially for women. An important element of this process was the documentation of traditional knowledge, which informed the formulation of the new community-based water governance policies. These new policies are designed to ensure equitable sharing of benefits and responsibilities in the use of water resources and protection of traditional customary rights among all community members. The project serves as an exemplary model for revitalizing traditional practices and integrating them with modern, cutting-edge technologies.

Creating Safe and Sustainable Drinking Water Sources for People and Livestock in a Pastoral Community, Mauritania

Background

The project, which was initiated by the UNESCO Club for Culture and Environment, targeted a pastoral community in the Brakna region in southern Mauritania. Being located in the semi-arid Sahel region, it has one wet season between July and September, which is highly variable. Like many rural areas of Mauritania, the areas surrounding the village of Magta Lahjar have been facing limited access to safe drinking water. Wells constructed to supply water for local populations regularly dry up between March and July each year. During the wet season, people traditionally rely on surface water as drinking water for both people and their cattle. Since the water is usually shared among people and livestock and has generally been collected without any precautionary hygiene measures, the community frequently suffered from the effects of water-borne diseases. Over the course of the last three decades, severe droughts in the region have rendered access to adequate water resources increasingly difficult. These water issues have regularly forced the pastoral community to abandon their camps during dry season and seek refuge in the town of Magta Lahjar. Especially, the limited watering opportunities for their cattle posed a significant burden for the pastoralist community.

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

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expected to continue this trend (McSweeney et al., 2009). 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, lower but more intensified rainfall (with drier times in between), could result in more droughts 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.

The goal of the project was to develop the area's conservation and sustainable management of the surface waters to improve access to safe drinking water for both humans and animals.

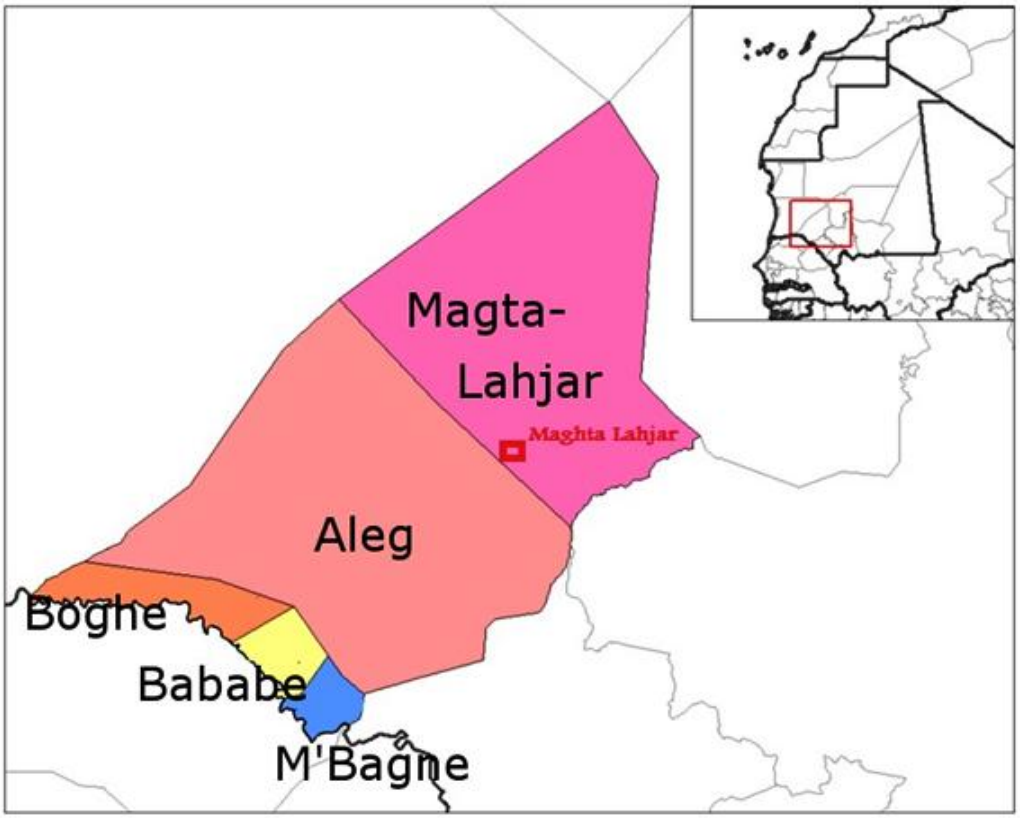

Figure 2 Project Site: Maghta Lahjar in Mauritania - Scale: 1:200; (Source: DATAR/MIDEC Année 2000, Mauritania)

To help resolve water scarcity and sanitation problems, several activities were undertaken as part of this CWI project. Firstly, the community constructed a series of diguettes (micro-dams) or rock lines along the contours of the gently sloping land. Rocklining promotes water and soil conservation by retaining surface water and promoting infiltration of rainwater to recharge the ground water. Rain and run-off water can develop a micro-climate for the cultivation of vegetation and crops

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between the diguettes, and thus promote the rehabilitation of the local environment.

In addition to rock lining, the project rehabilitated two wells and constructed two new wells for potable water. The project also set up small pools for water retention and built troughs to improve access to water for animals. Other important elements of the project constituted those of improving water management for agriculture and livestock watering. For this purpose, the community established a water management committee. To improve hygiene practices in the community, a series of sessions to raise public awareness on hygiene and sanitation were organized and water filters were distributed to households to reduce water-borne diseases.

Results

After completion of the project, the community has been able to permanently settle in their camps, being able to rely on stable access to drinking water for their families and their animals. The diguettes and improved water infrastructure have empowered farmers to rehabilitate their land and double agricultural production. In some cases, the project has also fostered agricultural diversification through the introduction of corn crops.

CWI's water infrastructure, combined with awareness and training sessions on hygiene practices achieved a significant reduction of water-borne diseases among the 1,200 beneficiaries in the project area. Improved water, nutrition and sanitation have had a particularly positive impact on children's health. As children missed less school due to illness or water collection duties, school attendance improved as well. In terms of capacity building, CWI has fostered leadership and institutional development for the construction and management of the water infrastructure, which is maintained by a community committee. These developments have also reduced conflicts between local water users.

Reconstruction and Rehabilitation of a Dam for Water and Food, Mali

Background

The village of Tinkélé is located 120 kilometres from the capital Bamako in south-western Mali. Though rainfall is sometimes abundant in southern Mali, the land tends to quickly dry up afterwards. Droughts are also commonly placing additional stress on the water resources. The resulting water shortages have made conditions difficult for life on traditional lands, often forcing local people to resort to income generation that has devastating consequences for the local environment, such as the production and sale of timber and charcoal. Deforestation and wood fires have not only resulted in severe degradation of local lands and loss of biodiversity, but also contribute to climate change in the long term. Overall, annual 5 day rainfall maxima have decreased by 4.0mm pe r decade since 1960 while temperatures have increased by 0.7C. Climate change projections are difficult to undertake for the Sahel which faces high hydrological variability. Various projection models estimate, however, that the south-western corner of Mali, the location of

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the project site Tinkélé, will experience the largest decreases in total rainfall in Mali during the wet season (McSweeney et al., 2009).

Project activities

Given the widespread shortage of water and land degradation, local villagers sought the assistance of the NGO Survie au Sahel in building a dam to store water for stable access to water, promoting land rehabilitation, and fostering economic development. After project completion, however, the community soon realized that the small dam was not sufficient in securing sustainable water supply and water was being lost through leakage.

CWI provided funds to enhance the design of the dam and create a filter system to better manage seepage flows. By expanding the initial dam, its storage capacity has been tripled, providing many benefits to the local population. Specifically, the improved water scheme offers year-round access to water for people and livestock, while helping recharge the groundwater and raising water tables for local wells that supply water for domestic and agricultural purposes. A village water committee was established, which has taken on the responsibility of overseeing and managing the dam and related water resources.

Results

Improved availability of water has increased agricultural production and enhanced counter-seasonal gardening, which provides an important source of livelihood for women. In addition, the project reintroduced indigenous trees and plants, like the Jujube, that yield fruits and can be sold at local markets. The increased availability of water and plants also attracted bees to the area, enabling apiculture and new business opportunities for the production and sale of honey products. The local women managed to improve production and pricing for their products by organizing themselves into a cooperative.

The combination of increased agricultural and economic development and a heightened awareness about environmental issues has decreased timber harvesting and charcoal production as a source of income. Conversely, the presence of water has spurred an increase in herbaceous and woody plants in the area, which, besides capturing greenhouse gases, also creates a micro-climate favourable for rehabilitation and conservation activities.

Safe Drinking Water for the Community in Belen, Guatemala

Background

Nestled in the high lands of Guatemala in the Tacaná region of San Marcos, the rural community of Belen faced difficult living. Extreme poverty conditions in the community was perpetuated by poor housing and inadequate access to safe water. Women were responsible for supplying water, which they usually collected from a polluted river in the upland. The water supply for drinking and cooking was collected from the same areas where women washed the laundry. The community relied almost exclusively on rain-fed subsistence farming which was, more often than not, insufficient to feed their families. The local forest and

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watershed also suffered from severe degradation through wood cutting to clear land for agriculture and to collect fuel wood for cooking. The effects of the tropical storm Stan, which had caused extensive damage, further exacerbated forest degradation. Realizing that 60% of the forest had been lost and water supply conditions had further deteriorated, the community decided that rehabilitation measures needed to be urgently taken.

Project activities

The women-led CBO Comite de Desarrollo Integral Comunitario initiated a CWI funded project to implement a gravity-fed drinking water system for the community, which also included one elementary school. By tapping water from four local springs, the gravity-fed water scheme stores the water in two new storage tanks before distributing the water to individual household tabs through a piped network. To finance the water scheme, the community decided to raise the money collectively. In each household, one male member left for Mexico to earn and contribute money towards the new water infrastructure (widow households were exempted). The collective effort, which built on the community's traditional, ancestral village organization, ensured that the entire community would benefit from having water in their homes. The community members, of whom a quarter is indigenous Mam, also received training in the installation and management of the water distribution system. With the goal of improving water efficiency, the community of Belen set water usage rules and formed a committee for the management and maintenance of the water system.

A core element of the project involved reforestation activities to improve water catchment and replenishment of aquifers. Recognizing that future conservation of resources is mainly in the hands of their children, the community made a special effort to include children from elementary school in the reforestation activities. Striving to conserve indigenous varieties, the community created a tree nursery with local seeds from alder, pines and cypress, which they had collected from the local forest. As a result, one hectare of forest has been rehabilitated around the field springs each year for conservation and sustainable wood harvesting purposes. Since 2007 with the rehabilitation of the forest, springs have been replenished and serve as a stable source of water.

Various soil preservation techniques for slopes and mountainous terrain were also introduced to diminish soil erosion, mud slides and landslides during the rainy season. Home gardens were equipped with soil preservation structures like terraces, contour lines and rainwater harvesting pits. In addition, some home gardens implemented agroforestry measures to create windbreaks. With these improvements, the community has been able to expand farming into the dry season, thereby increasing production of local produce varieties which included potatoes, corns, beans, lima beans, carrots, broccoli, cabbage, apples and peaches.

As many children in the community suffered from water-borne diseases, the project also sought to strengthen the community's capacity in managing health. With the participation of teachers from

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elementary school and the women of the community, several trainings were implemented to educate about clean water, food handling and personal hygiene.

Results

The woman-led project implemented a gravity-fed water system that supplied drinking water to all households in the community. In addition, the soil preservation and reforestation activities helped revitalize the watershed area including groundwater, springs and the forest. This has enabled the community to expand agricultural production and consistently meet dietary needs for their families. Furthermore, farmers have been earning additional income from selling produce surplus on the local market. A combination of reforestation and soil preservation techniques have thus not only improved water supply for farming but also reduced the community's vulnerability to climate change related hazards such as tropical storms. The trainings in personal and food hygiene reduced water-borne diseases by 70%. Together, clean water, improved food and hygienic practices improved the health among community members.

Discussion

Successful community-based projects are multi-faceted, and offer a package of comprehensive solutions to all development needs, such as water, food, climate adaptation, education and gender. Water management without considering the needs of communities, their livestock and farming could lead to the further depletion of water resources. Water management should go hand in hand with analysis of agricultural activities and promotion of water-efficient agricultural activities. Similarly, social-economic conditions should be included in development and implementation of projects. For example, in many water deprived rural areas, the burden of water-fetching and harvesting falls on women and girls who also play a critical role in providing food for their families. Given these high stakes, women have a strong commitment to make food and water-related project activities successful. Gender empowerment is therefore a critical component in the design and sustainability of such projects.

It is important to recognize the role of economic benefits in any development programmes for poor communities. In the context of poor rural areas, such economic benefits are highly related to enhancing agricultural productivity for food security. With improved water supply and sustainable, climate-adaptive agricultural techniques, local people can achieve more secure food production. Effective on-the-ground projects have combined a wide variety of activities that integrate water management measures such as irrigation, rainwater harvesting, spring water protection, dam construction and others with agricultural activities such as crop farming, fruit tree planting, and drought-resistant vegetable cultivation.

All cases show the great need to develop local capacities and community-based management arrangements to run community-based activities. CWI projects mobilize local leadership and

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community participation by developing local, gender-balanced water management institutions. Such management committees or groups have been established and continue managing water resources beyond the completion of the projects. Local people have been trained in the maintenance and repairing of water facilities, and the management of water resources. Such an approach recognizes that building the management capacity of the communities ensures the sustainability of impacts and benefits achieved.

Conclusions

Water management and food security are highly complex and context-specific issues that require micro-level analysis and interventions. Water resources, their uses and threats are specific to local conditions, as climate change impacts are manifested differently across local levels, and choices in livestock and crops cultivation are highly related to local environmental and physical conditions. Hence, development efforts should involve detailed analysis of local conditions and local development needs, and activities should be initiated and owned by local stakeholders.

It is important to recognize and promote communities' roles in addressing their specific water, food and climate challenges. While the international development community seems to have reached a consensus on the role of climate variability in complicating the water-food nexus, there has not been an adequate amount of investment and attention to the needs of local communities in dealing with these issues. This paper calls for more action at the local community level and advocates for governments to incorporate community-level experiences and lessons learned into government programmes and policies.

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