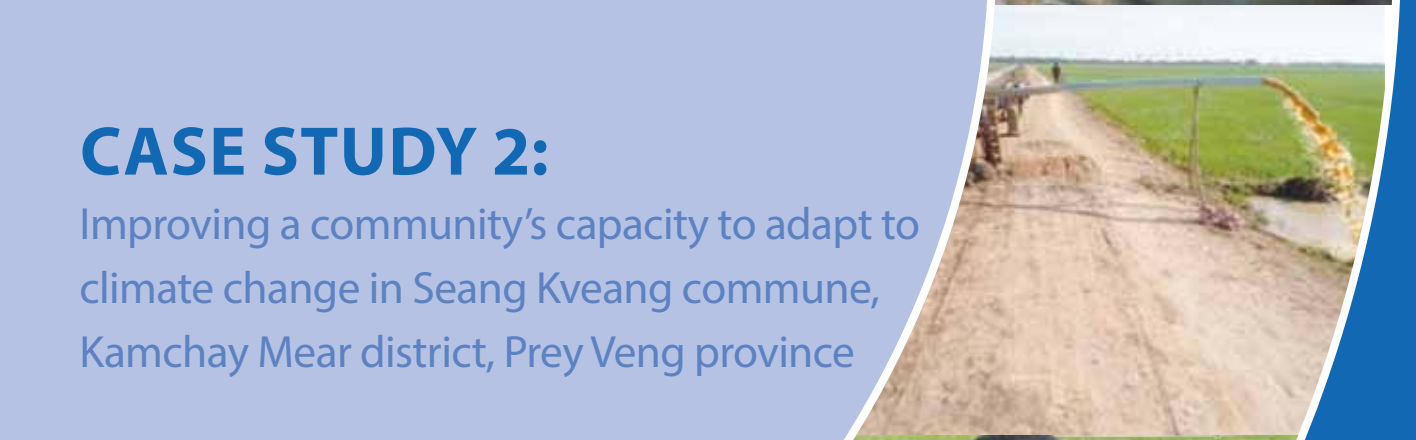
CASE STUDY 1:

Development of water supply for promotion of local livelihood of Kraing Serei Community Forestry in Kampong Speu Province, Cambodia



CASE STUDY 2:

Improving a community's capacity to adapt to climate change in Seang Kveang commune, Kamchay Mear district, Prey Veng province

CAMBODIA COMMUNITY-BASED ADAPTATION PROGRAMME (CCBAP)

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Acknowledgments

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Development of water supply for promotion of local livelihood of Kraing Serei Community Forestry in Kampong Speu Province, Cambodia

CONTENTS

1. BACKGROUND AND OBJECTIVES

Kampong Speu province is an area of Cambodia frequently affected by drought. Specific characteristics of climate change have been observed in the province, including unpredictable delays in the arrival of rainfall in the early wet season; erratic variations in the arrival of wet-season rainfall; the amount of rainfall or duration of the season; and the early end of the wet season. Mini droughts have occurred almost twice every year for the last 20 years between July and August and between October and November[1], causing stress on the water supply for domestic use and agricultural crop production. Among the 420 communes affected by the 2002 drought, Kampong Speu province was most severely affected[2]. Farmers recognize that droughts have had a significant negative impact on their livelihood (including poor health, family violence, irregular school attendance by their children, few opportunities to generate income, lack of community solidarity and lack of food security). Farmers face challenges in finding other livelihood options, as the surrounding environment is not abundant in natural resources.

Surrounded by mountains, Krang Serei village is located in Kiriwoan commune, Phnom Srouch district, Kampong Speu province. There are 67 families and a population of 335 people (179 females). The villagers' occupations are farming, collecting wood, hunting and collecting non-timber forest products (NTFP). However, hunting and forest clearing stopped after the Kraing Serei Community Forestry (KCF) for natural resource management was established in 2004. The community members say their livelihood problems have been exacerbated by water shortages for both humans and animals, particularly during the dry season. According to a Vulnerability Reduction Assessment (VRA) conducted in September 2011, Krang Serei village has been affected by increasing droughts and irregular rainfall since the 1980s. Consequently, the whole community has faced difficulties due to water scarcity, including for farming, cooking, bathing, home gardening and livestock raising[3].

Due to the geographical area of the village, being bordered mainly by Kiriwoan Mountains, drilling wells for domestic water supply in the dry season is expensive and is not successful. Some villagers spent an average of four hours per day fetching water from a public pond some four to five kilometres away for cooking and drinking. As their children were also responsible for fetching water from the ponds so far away, they could not attend school regularly. Community members without labour or transport had to buy water from another. They paid US$2 for 400 litres of water, which was only one day's consumption for each family. This was a significant financial burden for the villagers, considering the Cambodian poverty line is 3,871 riels (less than US$1)[4]. The major challenges for the Kraing Serei community included insufficient water for their crops, livestock and farming, and particularly for domestic consumption and sanitation. Hence, the community has faced food shortages, disease and low levels of hygiene. These problems negatively affect the community's welfare and particularly make small children, housewives and the elderly susceptible to hygiene-related diseases. Some women and children have poor health due to lack of water for sanitation (Vong, 2014).

1 NGO Forum. 2012. "Impact of climate change on rice production in Cambodia". NGO Forum on Cambodia: Phnom Penh.
2 National Committee for Disaster Management (NCDM). 2008.
3 VRA Report. 2011. Vulnerability Reduction Assessment in Kraing Serei Community Forestry, Kampong Speu, p.25
4 Vong, M. 2014. Project "Water Supply System Development and Livelihood Improvement- (WSSDLI) for Krang Serei Community Forestry members". Paper nominated for Equator Prize 2014, p.6

In response to these challenges, KCF, assisted by the Mlub Baitong organization, proposed a project called, "Development of water supply and promotion of local livelihood of Kraing Serei Community Forestry". The main goal of the project was to promote the livelihood of local community members of KCF and enable them to adapt to climate change. The project had three main intervention activities:

2. Construct a 90m x 60m water reservoir with a depth of 4m and a levee at the downstream part of the reservoir;
3. Install a piped water network (1,600m) connecting the reservoir to 67 households and establish a water management committee with a clear bylaw officially recognized by local authorities to manage and maintain the water supply system;
4. Build the capacity of the community to improve income-generating activities by providing training on appropriate agricultural techniques and find markets for the local products.

The project received financial support from Sweden through the Cambodia Community Based Adaptation Programme (CCBAP) managed by UNDP's Small Grant Programme. The project was implemented from December 2011 to November 2012, with total funding of US$60,257 (UNDP/GEF SGP US$49,832, World Vision US$5,700 and in-kind contributions from the community of US$4,225, including land for the reservoir, labour costs and US$500 from H.E Mr. Roath Sovannara, Provincial Chief of Forestry Administration).

2. METHODOLOGY AND APPROACH

2.1. Identifying priority needs of the community

KCF members were informed about climate change and its impacts on the community. KCF conducted the VRA in collaboration with the commune authorities to identify climate change impacts and priority needs. Working within the constraints they faced in their community, members said the priority activities needed to include: the construction of a water reservoir; building the capacity of a water management committee to manage the reservoir and water pipelines; strengthening local knowledge on climate change; increased support to saving groups; and improved tree planting and training on agricultural resilience techniques and animal raising for diversifying livelihood options.

Community meeting during VRA

2.2. Construction of water reservoir and pipe network installation

There was a potential location for the reservoir approximately one kilometre upstream from the village, at an elevation of 94m above the mean sea level. Water drained from approximately 15 hectares of forest catchment area, flowing into the reservoir and filling it during the rainy season. During the first phase of construction, the reservoir was built at a length of 90 metres, width of 60 metres and depth of 4 metres. It was then expanded, with an additional area of 50m x 30m x 3m of good quality construction. The reservoir can store 25,000 cubic metres of water.

The dike surrounding the reservoir was built at a length of 250 metres, a bottom width of 10 metres, a top width of 4 metres and a height of 4 metres. A box culvert was annexed to hold water in the reservoir. Technical staff from the Provincial Department of Water Resources and Meteorology (PDOWRAM), Kampong Speu province, supported the construction.

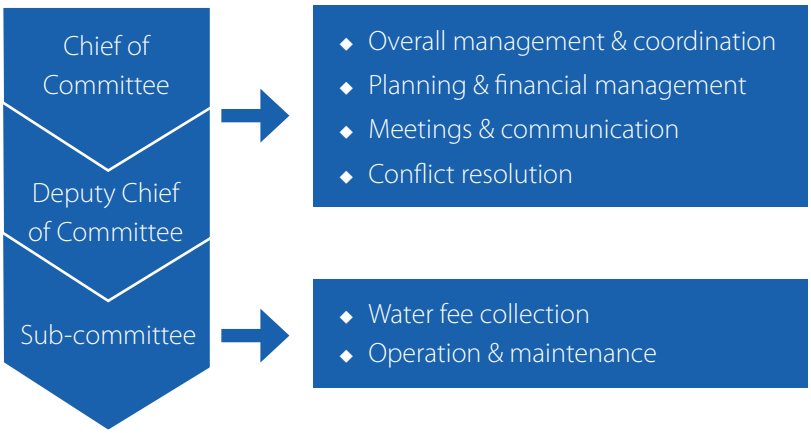
A main pipeline of 2,892 metres was installed to transport water from the reservoir to the village. The connection was set up with four main lines (Line 1 was 440 metres with a pipe diameter of 150 mm; Line 2 was 440 metres with a pipe diameter of 100 mm; Line 3 was 288 metres with a pipe diameter of 80 mm; and Line 4 was 1,724 metres with a pipe diameter of 49 mm). The pipe installation was set up using a topographical survey and was assisted by a technical officer from PDOWRAM.

Constructing the reservoir to support a community water supply system

Labourers installing the pipe network from the water reservoir to residential areas in Kraing Serei village

2.3. Establishment of water management committee and management of water fees

A water management committee and sub-committee were set up after an election by the community forestry and its community members in 2012. The water management committee consisted of seven members (one woman), while the sub-committee had five members (two women). The tasks and responsibilities of the management committee can be seen below.



The committee played an important role ensuring the management and maintenance of the reservoir and piped water system, including water meters, during and at the end of the project. They also had to ensure fair water distribution to community members and sustainable water use for one year in the village. They created water-use regulations with eight chapters and 20 articles. Their tasks include operating the reservoir, monitoring the piped water network and collecting water fees from the community beneficiaries. Water usage fees (US$0.12 per cubic metre) went directly to the committee and were used to finance the maintenance of the pipe network and other community development activities.

Meeting for election of water management committee

2.4. Capacity building

The project provided capacity building to the water management committee and community members by training them on finance and reporting so they could perform their duties transparently. During the project implementation, villagers were trained on using water from the piped system, agricultural techniques and raising livestock.

Community participating in training on water supply management

3. INTERIM ACHIEVEMENT AND RESULTS

3.1. Improved water security to adapt to climate change

During the wet season, water for household consumption, crops and animals is not a major problem, as people generally use rainwater. However, water shortages for both domestic use and crop cultivation during the dry season have caused problems for the Kraing Serei community. The construction of the reservoir, which has a storage capacity of 25,000 cubic metres, has given new hope to the community for coping with the impacts of climate change.

During the rainy season, water flows from a catchment area of 15 hectares into the reservoir, which is generally full during September. This means the community could have water security during the dry season, especially when there is erratic rainfall, prolonged drought and little water from nearby natural ponds. The newly constructed reservoir has supported 67 KCF households.

Water in the newly constructed reservoir for community water supply

Water flows through the pipeline to the residential area approximately 900 metres away, at an elevation of between 74 metres and 82 metres (12 metres to 20 metres below the reservoir level). From here, the villagers can connect to their households; all households within the community have connected. They contributed their own money to connect from the main pipe system (for pipes and water meter). The villagers are very pleased with the new water system. They no longer need to transport water for up to four hours per day or buy water from surrounding villages. During the first year, each family had a quota of up to 15 cubic metres per month. The community consumes only about 1,000 cubic metres per month, more than enough for domestic consumption during the six-month dry season, given the reservoir's capacity of 25,000 cubic metres. The remaining water in the reservoir can be used for other purposes, including an expansion of the piped network to nearby villages. The reservoir had the capacity to extend the system to two neighbouring villages and 20 households in Kantout Chhrum village in 2013, as well as 35 households in Chhrak Chhar in early 2015.

Access for community households to piped water supply

3.2. Training and capacity building

After providing training on managing the water supply system, as well as basic financial management and reporting, a sub-committee to manage the water supply system was created and functioning well. The sub-committee had its own regulations and was created using a participatory approach involving representatives of each household in the village. Several training sessions were held on vegetable gardening techniques, animal raising methods and skills for micro-businesses. Twenty-eight members were trained for two days to help them improve their alternative business activities.

The community reported that after the project ended in late 2012, more families were adopting home gardening and animal raising for their own family consumption, while selling any surplus at the market. It was observed that knowledge provided to the community helped them manage and improve their living conditions and cope with the difficulties resulting from climate change.

Training provided to community members in Kraing Serei Community Forestry

3.3. Improvement of livelihoods and other alternative options

KCF members found it difficult to find water for both human and animal consumption before the project. Community members would have to stay overnight at remote water springs far from the village to collect as much water as possible. Sometimes, this led to conflict and violence among others in search of water, as well as within families. These difficulties meant people wasted valuable time looking for water, rather that creating income-generating opportunities. The water supply from the reservoir has not only supported KCF for domestic use but also for home gardens and livestock.

Before the project, villagers did not have enough water for personal consumption, making it very hard to pursue alternative livelihood options. If they bought enough water for one month, they would spend too much money and create a financial burden. Since the project, villagers have not needed to spend money buying and transporting water from other places. Before, they paid US$2 for 400 litres of water (0.4 m^3), which would last only one day. Based on the regulations established by the water management committee, the KCF villagers now spend only 500 riels (US$0.12) for one cubic metre (1 m^3) of water and each family can consume a maximum of 15 cubic metres per month. Therefore, they need to spend only US$1.87 per month for 15 cubic metres.

Before the project, 10 households bought water from the neighbouring village for a three-month period when there was no rainfall or any water source. They spent US$5 per cubic metre, while 50 to 60 households transported water themselves and spent at least US$10 per month on motorbike transport. Most households now spend less than US$2.50 per month on water fees, even during the dry season. This could save some households up to US$58 per month (Table 1).

Table 1: Budget spent by a household on water fees before and after project implementation

water use in dry season	Before		After		Remarks
	Unit (m^3)	Price (USD)	Unit (m^3)	Price (USD)	People could save about $58/month
Per unit	1	5.00	1	0.125	
Per day	0.4	2.00	0.5	0.0625	
Per month	12	60.00	15	1.875	

This project has significantly improved livelihoods within KCF communities, particularly the 67 households which stand to save between US$1,000 and US$1,500 per month (US$6,000 to US$9,000 in total for six months in the dry season). In the second year of implementation, the project also helped two neighbouring villages of 57 households to access the piped water supply. Currently, 124 families have benefited from this project.

Since the project began, KCF people no longer need to search for water. This saves them a lot of time and allows them to focus on livelihood-improving activities. Some families have started to grow vegetables and crops near their houses and some raise animals. More than 50 percent of total households use piped water to grow vegetables during the dry season from November to June and some 30 percent use piped water for raising animals. These income-generating activities help them improve their adaptive capacities in response to frequent droughts, in both the rainy and dry seasons, in their community.

The project provided three ponds to KCF to improve alternative livelihoods, through fish raising and storing rainwater for crop cultivation in the early part of the dry season in November.

The positive impacts of fish raising increase adaptive capacities of some farmers and ensure food security. After harvesting the fish, they can use the water to grow vegetables from November onwards.

Improving crop cultivation and animal raising using community water supply system

Community pond for fish raising and irrigating vegetables

The project supported community members to improve four existing saving groups. Each saving group received start-up capital of US$500. Each member contributed between US$2.50 and US$7.50 per month to the saving groups. Members could pool the money in case of emergency and get low-interest loans to start a small business, buy agricultural materials and pay for health care. Community members agree that the saving groups are easy sources of loans at affordable interest, which can give them additional support during natural disasters, particularly prolonged droughts. By early 2015, the savings in the four groups increased (see Table 2). Without the saving group, community members would have to take loans from private moneylenders or local banks, where interest was much higher. There was an increase in borrowing from saving group members to finance livelihood-improving activities (19 percent used loans for business capital, 13 percent for animal-raising capital, 43 percent to buy agricultural inputs and materials, 28 percent for health care and 14 percent to send children to school)[5].

Table 2: Funds from four saving groups in Kraing Serei Community

Saving group	Establishment date	Start-up fund	Total saving fund (at February 2015)	
		Supported by project (USD)	Saving fund by community (USD)	Project fund and saving fund by community
Group 1	January 2012	500	875	1,750
Group 2	January 2012	500	1,125	3,500
Group 3	January 2012	500	750	1,625
Group 4	January 2012	500	750	1,625

5 Evaluation Report. 2012. Water Supply System Development and Livelihood Improvement (WSSDLI) for Krang Serei Community Forestry Members, p.24.

3.4. Social and environmental impacts

Children in the community attending school

https://lyrathana.files.wordpress.com/2013/06/phaao_schoolkids-e1278578741873.jpg

Since the project was implemented, there have been remarkable changes in social and environmental issues. Before the project, the community faced family violence, poor health, irregular school attendance and time lost in fetching water.

Access to clean toilets using the community water supply system

Having access to pipe water from the community water supply system has led to significant improvements in sanitation in the village, and children are going to school regularly. The majority of community members did not have toilets before the project was implemented, and practiced open defecation. Now, of 65 households, 40 have toilets with a piped water connection, compared to only two before the project. The local people can now take a bath more often than before. They can also consume healthier food as they now grow vegetables during the dry season for their own consumption and for sale. It was observed that the number of people visiting the local health centre for water-related diseases such as diarrhoea and strep throat has decreased by nearly 70 percent (Vong, 2014). School teachers reported that children now attend class full-time and more regularly as they no longer need to spend time fetching water for their family. Deforestation has reduced as community members have turned their attention to income-generating activities.

Women in the community were encouraged to be involved in implementing the project. Starting from the design stage, women were consulted and their concerns and views were included in the VRA report that formed the basis of the project design. They were also inspired to take part in meetings and training, and to make decisions. For instance, the four saving groups, which aim to enrol women in family income-generation, are made up of women from all families in the community. With the US$500 that the project contributed as capital for each group, the women can pool money for savings and collect interest later. They can also borrow money from the saving group at lower interest rates than commercial microfinance services in case of emergency or for starting up a small business.

The number of villagers entering the forest to collect non-timber forest products has declined. As they no longer need to spend several hours per day fetching water, they can pursue other work such as in construction, tending their home vegetable gardens, and raising livestock and fish to earn money for their families. The community members have a better understanding of the relationship between the forest and water, which has encouraged them to protect the forest around their community. They know that deforestation leads to water scarcity. This kind of awareness had increased the community's participation in protecting their forest from illegal logging. They also understand that protecting the community forest will help absorb more water to be stored in the reservoir. The amount of wildlife such as wild pigs and deer has increased due to forest conservation and water availability. The availability of water will also enable people to save the forest in case there is a fire, especially during the dry season. The community now understands the relationship between catchment management, natural resources and livelihood improvement.

Preserving forests to improve natural resources and water in the reservoir

3.5. Sustainable management of community water supply

The water management committee is the principle mechanism to ensure project sustainability. The committee has played an important role in ensuring good management and maintenance of the reservoir and piped water systems, including water meters, both during and after the project. The training they received will enable them to manage this system in the long term. For example, the water management committee was able to extend the water pipeline to other villages using money collected from water fees, as well as borrowing money from its network. The committee used water fees for various purposes. In 2013, spending/saving for operation and maintenance (O&M) of the water supply system was estimated at US$100. The remaining money from O&M was used to top up the saving group. Another portion of the water fees was allocated to supporting volunteers to patrol the forest for illegal loggers and prevent forest fires.

4. MAIN CHALLENGES

Even though this project was successful, there were challenges. There should be more technical support and time allocated to the water management committee to practice their role and work professionally. The construction of the reservoir helped community members improve their livelihoods. If these members use water for irrigation and animal raising, the water management committee could encounter new challenges, such as management of water use and water pollution from these activities. Some community members did not comply with the water use regulations and used too much water to irrigate their plantations and rice fields. The rising number of beneficiaries each year (67 families in 2012; 20 families in 2013; and 35 families in early 2015) could pose challenges for the committee in managing distribution and income.

The quality of the water in the reservoir will need to be monitored if community members begin to cultivate crops upstream using chemical fertilizers and pesticides. Poor-quality water from the reservoir could cause diseases if the water is untreated. Regarding fee collection for the water system (500 riels or US$0.12 per cubic metre), the management committee will need to develop a budget if it wants to expand to other villages, as the current fees are low. These fees would not cover severe damage, should it occur. The water management committee receives a very low incentive to manage the system (5,000 riels or US$1.25 per month). Therefore, it is doubtful that members would want to volunteer long-term to manage the water supply.

5. GOOD PRACTICES AND LESSONS LEARNT

Even though the project has only been implemented for one year, there have been some visible good practices and lessons learned.

Good practices:

- Cooperating with partners who supported the project. For instance, the Mlub Baitong organization facilitated the VRA process and assisted in developing the proposal and writing the report during the project implementation. World Vision Cambodia contributed to the installation of the pipeline. The commune council played a role in the project implementation and worked closely with the community forest committee to collect contributions from villagers to connect from the main pipeline to their houses.
- Selection of project site: water flowed by gravity, alleviating the need for a pump.
- Regular meetings with project beneficiaries to reflect on the status of the water management system and budget management. This avoided internal conflict and conflicts of interest.
- Promoting ownership and providing capacity building to improve decision-making during project implementation.
- Strong support from local authorities for the project implementation and working closely with the water management committee to collect funds from each villager to connect from the main pipeline to their houses. Strong support from elders in the village increased solidarity.
- Provision of technical skills to the chief of KCF to become a technical expert in water pipeline connection and management. He was then able to share his expertise with one World Vision project and two Rain Water Cambodia (RWC) projects.

Lesson learned:

- Development of a piped water supply from a gravity reservoir turned a water-scarce community into a community with surplus water for domestic use and alternative livelihood options, such as home gardening and raising animals.
- Highlighting the real challenges of the community (shortage of water for household use) attracted donors who supported the project and encouraged the community to own it.
- Good management of the water committee led to an increase in the number of project beneficiaries, from 67 households to 124 households. The experience can be replicated in other project sites.
- The availability of piped water improved the sanitation standards of families. Many families built toilets and bathrooms and ceased practicing open defecation.
- Good cooperation with local authorities made the project sustainable.

The project enabled villagers and other donors to support community development, such as constructing toilets, without funds from outside. It taught agricultural techniques that the community could put into practice, using the water for irrigation. The project demonstrated a good model for managing water and adapting to drought in higher areas, and provided a good example to replicate to other projects, such as those under Word Vision and RWC. In addition, KCF had an opportunity to build capacity in managing small businesses and community-based water supply.

Since the end of the project, the commune authority has observed improvements in people's livelihoods and is willing to support them in the long-term. The commune chief requested that the project donor consider implementing a similar project in a nearby community forestry that had been suffering from water scarcity and livelihood difficulties. The achievements and socio-economic benefits of the project inspired commune authorities to integrate climate change adaptation into commune development programmes.

6. CONCLUSIONS AND RECOMMENDATIONS

The project had positive impacts, accomplished the general objective and ensured its sustainability. The outcomes respond well to the needs of the community and beneficiaries. KCF has the capacity to manage the community water supply and is supported by the local authority. The project can be considered a good model for other communities with similar geographical conditions.

Water security was identified as a main challenge in the community and this project is recognized as a long-term solution to reducing poverty among KCF members. The construction of the water reservoir and installation of the piped water system have reduced the stress of drought and water scarcity for all the community members. Managing water from upstream can help the community adapt to irregular rainfall, changing rain patterns and prolonged drought. There is now sufficient water supply for household use for the whole year. The project has turned the community around, from suffering water shortages to having a surplus that could supply other villages. Several training sessions, including management of the water supply system, basic financial management, report writing, home gardening and livestock raising, were provided to the committee and community members to enhance their capacity for alternative livelihood options. They have reduced the time they spend collecting water, enabling them to pursue alternative livelihood options. As a result, the livelihood of the community has been improved and they have increased their adaptive capacity to cope with prolonged droughts resulting from climate change.

From the beginning, the community members identified this project as their top priority. They formulated the project by integrating their priority needs into the project implementation. This promoted ownership and active participation after the VRA consultation. The VRA process involved all villagers in making decisions on what they needed and what they would do next. The community took ownership in deciding on the appropriate water fee from each household to support the maintenance of the reservoir and the piped system. The initiative enjoys the recognition, support and participation of the villagers and commune authorities. KCF worked closely with the commune council when managing the saving group and helped guard against financial conflict within the community. This displayed cooperation in solving communal problems and other issues, and the commune authority has now considered including this type of project in its commune development plan.

Recommendations for improving similar projects or continuing existing projects:

- Produce a map of the piped water network to improve maintenance work.
- Develop a budget management plan for efficient use of fees.
- Monitor the reservoir's capacity and take immediate action to regulate water consumption when the water supply falls to a level where only consumption for basic needs is allowed.
- Improve water use regulations for other purposes, such as irrigation and animal raising in order to reduce conflicts due to benefit sharing among community members.
- Promote catchment management to maintain health and water quality by improving forest cover and reducing external pollutants that can eventually reach household taps. Likely pollutants are from fertilizers and pesticides used in farmlands around and upstream of the reservoir. It is highly recommended that KCF create a mechanism to control this possible pollution.
- Replicate the project to other nearby communities where there is a potential location for construction of a reservoir and gravity water supply distribution.

7. REFERENCES

[1] NGO Forum. 2012. "Impact of climate change on rice production in Cambodia". NGO Forum on Cambodia: Phnom Penh.

[2] National Committee for Disaster Management (NCDM) report, 2008.

[3] VRA. 2011. Vulnerability Reduction Assessment in Kraing Serei Community Forestry, Kampong Speu, p.25.

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CASE STUDY 2:

Improving a community's capacity to adapt to climate change in Seang Kveang commune, Kamchay Mear district, Prey Veng province

CONTENTS

1. BACKGROUND AND OBJECTIVES

Prey Veng province is 90km from Phnom Penh, in southeast Cambodia. It has a total land area of 4,883km^2, of which some 63 percent is agricultural land and 4 percent is forest[1]. The most severe impacts of climate change witnessed here are floods and droughts, low crop yields, water shortages and water-borne diseases[2]. Prey Veng was identified as the province most vulnerable to floods and second-most vulnerable to droughts. Prey Veng was highlighted among 17 provinces in Cambodia as most vulnerable to climate change in the Climate Change Vulnerability Mapping for Southeast Asia[3].

"The average mean temperature for 25 years from 1987 to 2011 was 28.2°C, the maximum mean temperature was about 33°C and the minimum mean temperature was 23.3°C. The average annual rainfall for the 27 years from 1985 to 2011 has fluctuated between 949mm and 1,867mm, based on peak years of 1996, 2000, 2010 and 2011, which were above 1,700mm annually" (NGOF, June 2014)[4].

There were 13 villages in Seang Kveang commune, Kamchay Mear district, Prey Veng province selected as the project target area. They include the villages of Lvea, Sangkae, Opakma, Leak Nuem, Tnaot, Bos, Ruessei Chuk Ty Mouy, Ruessei Chuk Ty Pir, Chong Boeng, Toul Sophi, Bayab, Krous and Chuk. There are 2,757 families with a population of 10,635 people (5,483 women)[5]. The main occupation is rice cultivation with 97 percent of total families doing this, while the other 3 percent are involved in small enterprises or middle-man activities[6]. They also grow vegetables, raise animals, work as labourers in the local area (spraying pesticide and cropping) or migrate to other provinces and cities for factory work. Some, particularly the young, migrate to Thailand or Malaysia.

1 http://en.wikipedia.org/wiki/Prey_Veng_Province retrieved on 20 November 2014.
2 CCCA Project Factsheet August 2012: Together addressing climate change initiative - Prey Veng (TACCI-PV).
3 Yusuf & Francisco, January 2009. Climate Change Vulnerability Mapping for Southeast Asia. Economy and Environment Program for Southeast Asia (EEPSEA): Singapore.
4 NGOF, 2014. Farm conservation and sustainable use of cereal diversity through participatory plant breeding and securing local seed systems in climate vulnerable provinces of Cambodia, by Mr. Kim Soben.
5 Seang Kveang commune population data in 2011.
6 Seang Kveang commune situation Data Book 2011.

According to a Vulnerability Reduction Assessment (VRA) conducted on 27 April 2011, most villagers in the target area have experienced several negative impacts of climate change in the last five years, including long periods of drought and unpredictable delays in rainfall, resulting in water shortages for irrigation and livestock. Faced with frequent droughts, villagers decided to dig a well for underground water for their farming. However, this did not yield enough water, and it was expensive to use a pump. It negatively affected the daily consumption of the villagers.

One existing old canal named "Bra Lay Rorng Klab Kour" or "Bra Lay Tra-Loung Trom" could not be used as it could not store enough water for agricultural purposes in the rainy season (see photo above). Farmers could only harvest one crop as they depended heavily on rainfall. They sometimes faced mini-droughts during the rainy season, from late July to the middle of August, resulting in a low rice yield. People in this area have limited access to farmland, due to the lack of a proper road to access the rice fields and to transport agricultural products to market. Traditional farming practices, as well as the inappropriate application and overuse of chemical fertilizers for cultivation, result in degraded soil, reducing the rice yield to below 2.3 tons per hectare. Farmers use around 100-150kg/ha of chemical fertilizer and pesticide, which increases their daily expenses. This also affects people's livelihoods, particularly the vulnerable and poor people, women-headed households and farmers themselves. Environmental degradation occurs in both surface and underground layers[7]. These impacts could affect food security and the health of people in this area.

The canal before the project was implemented

To combat this, Community Resource Improvement for Development (CRID) initiated an adaptation project with financial support from Sweden. It was channelled through the Cambodia Community Based Adaptation Programme (CCBAP) and managed by UNDP's Small Grant Programme. Grants included US$52,354.55 for the first project, made up of US$42,528.84 from UNDP/GEF SGP and other in-kind contributions from collaborating partners (CRID and beneficiary farmers) totalling US$9,825.71. UNDP/GEF SGP financed the second project with US$46,142.00. The first project ran from December 2011 to November 2012 and the second project from December 2012 to November 2013. The main goal of the project was to reduce communities' vulnerability to droughts and enhance their capacity, particularly poor farmers and women-headed households, to adapt to changes in rainfall patterns. This was done via rehabilitating canals, establishing a rice bank and building capacity on improving technical knowledge and skills on agricultural productivity. The two main objectives were:

- Increase effective management and use of irrigated water among 2,246 local villagers (1,141 women) in the three villages of Seang Kveang commune for agricultural productivity from a canal rehabilitation of 2,100m.
- Increase the rice yield of 260 households (at least 100 women) in 13 villages of Seang Kveang commune from 2.3 tons to 4 tons per hectare by applying new varieties and knowledge gained from agricultural training provided by the project.

7 CRID proposal on "Community's capacity improvement for adaptation to CC in Seang Kveang, Kamchay Mear district, Prey Veng province", December 2011.

2. METHODOLOGY AND APPROACH

2.1. Identifying priority needs of the community

Based on the VRA, common climate change-related problems faced by the target communities were: water shortages for agricultural practices, such as improving the number of rice crops and raising livestock, limited access to farmland and traditional farming methods. To respond to these issues, the target communities agreed that the priority activities would include canal rehabilitation, a canal management committee, capacity building on improved agriculture technologies (particularly System of Rice Intensification (SRI)), a rice bank and a saving group to support each other's livelihood improvement.

2.2. Promoting stakeholder participation and collaboration

The involvement of all relevant stakeholders, especially community members, commune authorities, technical line departments at sub-national level and NGOs was a key factor in the project's success. The project engaged beneficiaries to implement interventions in all stages including project development, planning, implementing, monitoring and evaluation. Farmer beneficiaries, including men and women-headed households, worked collaboratively to identify the problems caused by climate change and set the priority needs to improve their living conditions. They contributed their own money and labour for canal rehabilitation, road construction and maintenance, they planted saplings on the dike and contributed rice seed for rice bank sustainability. The local authorities, including the commune council, village chief and technical line departments (PDA and PDOWRAM) worked closely with each other to ensure the project benefited the right people at the right time. The commune council promised to contribute commune funds for canal and road operation and maintenance (O&M), PDA provided technical support to ensure communities could apply knowledge learnt in training sessions to their agricultural activities, and PDOWRAM cooperated with the organization to provide technical support for canal construction and to establish the canal management committee. This ensured the functioning and distribution of irrigated water, as well as conflict resolution. The Development Khmer Community (DKC) organization provided saplings to plant along the dike to prevent soil erosion and improve the environment in the canal area. There was close collaboration between CRID staff, local authorities (including the village chiefs of the target areas) and the Seang Kveang commune council to form a procurement committee to select a contractor. This was done with transparency and accountability.

2.3. Constructing irrigation canal and new road

Without enough rainwater and/or streams, ponds and rivers to support agricultural activities, some 97 percent of households (240 households) in Lvea, Sangker and Oub-ma villages of Seang Kveang commune had experienced food insecurity and food shortages[8]. The shallow existing canal could not store enough water for agricultural cultivation during periods of drought in the rainy season. To adapt to prolonged drought in the rainy season, the first priority for immediate intervention in the project target area was water management, while canal rehabilitation was the main priority for farmers. The 2,400m canal (bottom width 2m, depth 2m, top width 5m), which exceeded the project plan of 2,100m in Lvea village, was completely restored by the end of March 2012. This was the first phase, with support from the Seang Kveang commune procurement committee, organization staff, commune council members, the canal management committee and technical support staff of Prey Veng PDOWRAM. The second phase saw a 1,400m canal extension, with the same dimensions, supported by UNDP's Small Grant Programme (CCBAP), bringing the total canal length to 3,800m (Lvea and Chiklang villages). The irrigated water from the canal could potentially support 321 hectares of rainy season rice for 313 households in five villages (Lvea, Sangker, Oub-ma, Chiklang and Chhker Korn) of Seang Kveang and Chiklang communes.

Canal construction in March 2012

The excavated soil was turned into a dam along the both sides of the canal to manage the water in the canal. The dam became an important road (see picture) for villagers to access their rice fields and other villages in the area. The dam along the canal will be used to collect run-off water from upland areas. This road connects Seang Kveang to Chi Klang commune, making it easy for farmers to access their land and transport their agriculture products.

Road construction along the canal

8 Data from Kveang commune in 2011.

2.4. Formulating farmer water user committee (FWUC) and rice bank

Establishing a farmer water user committee (FWUC) was the key factor to ensuring the sustainability of the canal's O&M. This was done through collecting water fees and donations, and managing water distribution and conflict resolution among the FWUC in the project area. The FWUC members were elected from the three villages of Lvea, Oub-ma and Sangker, with facilitation and technical support from the Prey Veng PDOWRAM (see picture). Recognized by the local authority, the FWUC was responsible for managing and monitoring the canal rehabilitation, water distribution and conflict resolution, planting saplings, and rice bank processing.

The FWUC played an important role in collecting money to repair the canal and dam and to communicate with the commune council. This was done with support from CRID, who communicated with the district governor and PDOWRAM to form a transparency and accountability procurement committee. The committee hired a qualified canal dredger and contractor to install a sluice gate at a reasonable price. The committee was the key group tasked with dealing with conflict resolution and making sure irrigated water was distributed equally among each farmer in the target area.

The committee was also responsible for ensuring the canal operated well and was protected from soil erosion and ecological system damage. They encouraged local communities such as teachers, students and local authorities to contribute labour. A total of 300 people planted 1,350 saplings on the dike.

Canal maintenance, sufficient stocks of rice and food security were the main reasons for sustaining the irrigated water use in the community. The FWUC was given the additional role of Rice Bank Management Committee, responsible for the rice bank management approach, formulating the rice bank terms of reference, including borrowing and returning, and structure of borrowing and returning process sheets. Farmers who used the water from the canal for one hectare of land provided 5kg of rice seed to plant after harvesting. The seed was kept for the next borrower. In the beginning, the project provided 1,093kg of seed for the rice bank. To encourage the community to use the rice bank, farmers could borrow pure rice seed without

FWUC members were elected by their communities

Planting saplings along the new canal

interest the first time they borrowed (Sen Pidor, Roum Dourl and IR 66). This method was applied both inside and outside the target area to ensure sufficient use of rice seed in the commune as a whole. The rice seed was not 100 percent pure, as borrowers had no experience in seed purification. The rice bank was charging 2 percent interest. Because of this, the rice seed provided to the bank was used for many functions. Some was sold to raise money for canal O&M, water fees and road maintenance, while some villagers sold it and used the money to buy pure seed for cultivation. The rice in the bank increased by 1,414kg.

Rice seed was stored in the rice bank for the next borrower

2.5. Formulating saving groups

Forming a saving group was another mechanism to maintain livelihood stability and climate change adaption in the targeted communities. There were four groups of 20 people each. The saving group committee was elected by the villagers and was recognized by the commune council. Four training sessions on borrowing, saving and returning processes were provided to the saving group committee and the 80 members (64 women). In January 2013, each saving group (in Lvea, Oub-ma, Doun Yu and Prey Rusey villages) was given US$500 by the project, with an additional budget of US$568. This totalled US$2,568 in the fund and US$356 in interest from the project and the saving fund contribution. This approach led to a significant livelihood improvement for villagers involved in the groups, as they could repay the money they had borrowed at high interest rates from micro finance institutions in their area. Five households borrowed money from the saving group to raise hens (8 hens), while another 11 households borrowed money to raise pigs (11 pigs).

Forming the saving groups

2.6. Capacity building and community empowerment

A three-day training course on canal and rice bank management was provided to the FWUC. The course focused on methods and mechanisms, including O&M, FWUC fee collection, in-kind fund raising contributions, suitable storage places for stocking and dividing rice seed varieties, returning the proceeds of rice seed processing to the bank, and reporting sheets for loans. Ten training sessions (three days each) on SRI were provided to 266 participants (183 women) from 13 villages in Seang Kveang commune. They covered new techniques and selecting resilient seeds that would provide high yield while needing only a small amount of water. The project provided training of trainers (ToT) on SRI protocols and selected 40 key farmers for knowledge application. SRI can provide more yield than traditional methods. These agricultural methods are appropriate to apply in this target area, as it faces climate change challenges, particularly long droughts. With this application, farmers only use 15-20kg of rice seed per hectare and can increase rice cropping to two times per year. Only farmers in Lvea village could apply the SRI method as they have small farms. The other farmers could not use the method, due to large farms (2-3 ha). This method can also only be applied where farmers have enough labour for SRI cultivation.

SRI training and field demonstration

3. INTERIM ACHIEVEMENT AND RESULTS

3.1. Improving rice cultivation through canal rehabilitation

The new 3,800m canal was successfully renovated. It harvests enough water to irrigate the rice fields during prolonged periods of drought in the rainy season, and has a storage capacity of 25,000m^3. At the upper part of the canal, about 2,050m, there is a lake approximately 250m wide, 1,000m long and 1m deep. This lake is the main source of water to flow down/fill the canal for irrigating rice fields, especially late in the rainy season. The canal is located in a lowland area and receives good water flow from upstream. Two dams in the canal hold water upstream to cultivate the rice fields in the early part of the rainy season, as well as during prolonged droughts. The canal and dams are important for managing water in the rice fields located upstream and provide resilience to droughts during the rainy season. The canal is also connected to the district canal, which is the main source of water from the main canal constructed by the Ministry of Water Resource and Meteorology. But to get water from the district canal, communities would have to pay for a machine to pump it, as the district canal is lower than the new canal and does not have the right structures at the connecting point.

A box culvert was constructed to keep the water level and distribute the flow from the canal to the farmlands. This canal has provided new hope for the farmers. They will have enough water to cultivate rice and possibly to double their crop harvests in the early part of the season (33 ha) and the late part of the season (26 ha). Before, they could not cultivate in the early and late parts of the wet season.

Newly renovated canal to irrigate rice fields along both sides of the canal during prolonged droughts in the rainy season

New canal providing irrigated water for increased rice cropping

Before the project implementation, farmers in the target area (320 ha) only cropped rice once, in July, the middle of the rainy season. They had to wait until there was sufficient water in their fields, but they often faced long periods of drought. Since the project, 60 households with rice fields of some 53 hectares next to the canal in Lvea village can access water during the prolonged drought periods occurring in late July to early August. With the access to irrigated water provided by the project, they can start their rice farming in May for the first crop, continue in August for the second crop, and do a third round in early November (see Table 1) by pumping water from the canal. Around 20 to 30 households who were previously not confident of achieving even one crop per year can now look forward to cultivating three times per year.

Table 1: Change in farming activities before and after the project implementation

Agricultural practice	May	June	July	August	September	October	November	December	January	February
Before the project			Long term rice							
After the project	Early cropping			Middle cropping			Late cropping			

3.2. Capacity building on canal and rice bank management, and agricultural techniques

Capacity building on agricultural methods to the target beneficiaries, including the canal and rice bank management committee and selected farmers, improved their initiative and ownership over the project. The FWUC managed their time effectively and ensured the functioning of the canal O&M and the rice bank. They received strong support from Seang Kveang commune councillors. The communities built solidarity through working together. They can identify climate change risks in their area and can set up financial and technical support, through this project as well as their in-kind contributions. Farmers can now generate more income from the project as they can apply agricultural techniques, particularly on selecting resilient rice seeds that provide greater yield (more than 3 tons/ha), and they have access to adequate water supply from the canal.

3.3. Successful approach in canal operation and maintenance (O&M) and rice bank management

The FWUC, with technical and administrative support from PDOWRAM, PDA, local authorities, and project staff in the target area achieved many things. An accountability and transparency procurement committee, which included the local authorities and FWUC, was selected to recruit a contractor to rehabilitate the canal at a reasonable cost. The cost of rehabilitating the canal was less than estimated, so the renovation was able to go beyond the target, from 2,100m to 2,400m during the first phase, and a further 1,400m in the second phase (total 3,800m). The rest of the budget supplemented road construction, which was not targeted under the project. The project was even more successful because of in-kind support from the farmers, under the intervention of the canal committee. Water was distributed equitably and a conflict involving three households around a 300-metre rice field next to the canal was solved by an intervention by the commune council and PDOWRAM. By seeing the livelihood improvements of not only the farmers but also the FWUC members themselves, the FWUC regularly monitored and evaluated the use of the canal and the road. If there were any problems, they took action as soon as possible, for example by not allowing cattle or buffalo across the dike in the rainy season but allowing bicycles to use the road. Another time, when water almost overflowed from the dam, FWUC called an emergency meeting with commune authorities to raise money from the commune and members of FWUC to do maintenance. The members of FWUC contributed their in-kind support and water fees to re-construct the dam along the canal when it was damaged, or to ensure canal O&M and rice bank processing. They were willing to contribute, as infrastructure development is one of the main sectors of commune development and farmers benefit from the canal and from the road being in good condition. They can travel safely to their rice fields and they can reduce the cost of transporting agricultural products and materials. Moreover, the road is a shortcut connecting the villages in Svay Antor district.

While water management is an important component of resilience agriculture during prolonged droughts in the rainy season, rice seed is another key resilient adaptation. Using a rice bank mechanism in areas vulnerable to climate change ensures there is enough seed, even during drought or flood. Before the project, farmers had to spend a lot of money buying rice seed for their crop. However, after the rice bank was established, farmers did not need to buy seed from outside as they could borrow from the bank in advance, then return the seed to the bank for the next borrower after harvesting. The rice bank functions well due to two main mechanisms: the management committee's knowledge of administration and management, and the legal acknowledgment of the bank by the commune council. There are 231 households from Seang Kveang and Chiklang communes involved in this rice bank. By the end of the project period in November 2013, the amount of rice seed increased from 3,293kg to 4,058kg. This approach is not only useful for the project target area but also in the other villages of the commune.

3.4. Livelihood improvement after the project implementation

The project improved the livelihood of farmers in the target area by changing agricultural practices (one cropping per year). Farmers in this area usually practiced traditional rice cropping, which could not be adapted to the current climate change patterns (drought). As a result, they had a low standard of living[9].

Rehabilitating the canal had a positive impact in this area, with improved access to water for rice fields, particularly the fields along the renovated canal, and changes in farming activities (early rainy season, middle and late cropping). Managing the water in the canal has increased soil moisture around the canal and changed soil structure. The community now has an opportunity to cultivate other crops such as watermelon or cucumber in the early dry season, after harvesting rice in December. With seed loans from the rice bank, the saving group and the application of SRI method, farmers can improve rice production at affordable prices and they understand that SRI is a good method for rice seed purification. They only need to use around 15-20kg of rice seed per hectare of cropping. On average, three tons of dry season rice has been produced from 15 hectares of land belonging to 17 households in Lvea village (each household has around one hectare of land). Seven households out of 20 that apply the SRI method reached yields of up to four tons per hectare, compared with the previous year of only 2.6 tons per hectare. However, SRI is only suitable for small plots, as this method requires a lot of labour.

In the early rainy season, about 15 hectares could be cultivated using the supplementary water from this irrigation canal. Farmers could cultivate about 10-15 hectares by the end of the rainy season. Generally, about four tons have been harvested per hectare, with average production costs of around US$500 per hectare (Table 2). Thus, farmers could earn between US$250-350 per hectare (if 1kg of rice = $0.2 or 800 riels).

The newly constructed canal can generate rice profits in both early and late wet season of between US$7,000 and US$10,000 per year (newly cultivated land in early and late wet season of 20-30 hectares). If the canal can produce between 200 and 300 hectares of wet season rice in the target area during periods of mini drought, the canal rehabilitation can be considered extremely cost effective for community-based adaption.

Dry reason rice cropping using irrigated water from the canal (10-15 ha)

9 CRID, 2011. Full proposal on "Community's capacity improvement for adaptation to climate change in Seang Kveang, Kamchay Mear district, Prey Veng province".

Table 2: Average cost of rice production (3-4 month growing period) based on focus group discussion with more than 10 farmers in the target area

Item	Cost of rice production per hectare (US$)	Remarks
Land preparation	75	Ploughing machine and personnel fee (only one time/cropping)
Seed (Rumdol, Senpidor variety)	50	200kg/ha (traditional broadcasting method)
Fertilizer	150	30 US$/package (5 packages/ha)
Herbicide	10	4 packages/ha
Petroleum for pumping	65	1.5 containers/ha (1 container = 30 litres)
Harvesting	75	Harvesting machine and personnel fees
Personnel costs	50	Broadcasting, fertilizer and herbicide work, pumping
Miscellaneous	25	Local transportation, water fees and others
Total	500	Total rice production cost/ha

A new 4km road (width 3m) was constructed after the canal rehabilitation. This can connect to another road at the end of the canal, making it easier for farmers to access their rice fields (not set as a project indicator). Before the project, it took farmers around 30 minutes to commute from home to their fields. They also had to use the rice field dike as the main road for transporting seeds (for broadcasting and after harvesting) and fertilizers. Some farmers had to drive 15-18km to reach the district market. But with the new road along the canal, they now spend only 5-10 minutes commuting from home and it is now only nine kilometres from the village to Svay Antor market. Two years after the project, new houses have been built along this road, saving farmers even more time. They can use this time to explore alternative livelihood options such as home gardening, other cropping activities, and/or animal raising to improve their living conditions.

Farmers use the new road to access their land and district markets

With more and deeper water in the canal, farmers have observed environmental and ecological improvements, including more fish. About 10-20 households can now catch an average of two kilograms of fish per day, earning them some US$5 per day each. The fishing season runs for four to six months per year (June to November), so this alternative livelihood option has the potential to generate around US$600 to US$900 per household per year. The total income from fishing could reach US$10,000 per year for the 10-20 households. This is an indirect benefit of the project, where the canal has turned threats into opportunities, allowing farmers to build their adaptive capacity to cope with climate change impacts and to improve their livelihoods through fishing.

Fishing in the canal in December 2014

3.5. Improving the integrated participatory approach for project sustainability

This project not only had socio-economic benefits for the target beneficiaries, but built cooperation and commitment among villagers, local authorities, technical departments and other local organizations based in the area. The role of women on the management committee was a catalyst for the integrated participatory approach. Women were involved in the design and intervention of the project which benefited both men and women. The project also involved women in leadership positions from its early stages, with two women being elected to the six-member canal and rice bank management committee. Their involvement, commitment and knowledge from the project demonstrated the benefits of the integrated participatory approach to community-based adaptation. Management committees supported their communities on a voluntary basis, using their own time, mobilizing funds in the community for O&M and ensuring the rice bank was meeting farmers' needs.

The most successful approach was seeking in-kind cooperation with relevant stakeholders. Communities themselves contributed their own farm land and labour for canal rehabilitation, road construction and sapling planting, as they believed their contribution would improve their livelihoods. The integrated participatory approach for project sustainability saw:

Both women and men were involved in all stages of the project

- 266 households (200 of Lvea, 33 of Sang Ker and 33 of Oub-ma villages) contribute US$228 of their own money for canal rehabilitation.
- Two roads totalling 295m in length (width 3m) and costing US$960 were built with funding from 170 households. Each household contributed between US$2.50 and US$7.50. Three households whose land was located in the project area (about 300m) allocated their land for canal construction.
- DKC provided 1,350 saplings for the community to plant on the dike to protect the soil from erosion. Some 300 people, including youth, communities, teachers, local authorities and management committee members participated in planting the saplings.
- Farmers contributed in-kind support to repair 35m of damaged road along the canal, using 26 trucks full of soil.
- The commune council used the commune budget for the canal and road rehabilitation and considered this project a commune development project.

The above results were achieved through the efforts of the FWUC, which cooperated with the commune council to deploy money from the commune fund for infrastructure development. PDOWRAM cooperated with the management committee to help the community form FWUCs. This community was registered and recognized formally by the commune council.

All relevant agencies cooperated with each other, extracting the right skills from each sector to boost socio-economic improvements in their areas.

4. MAIN CHALLENGES

The rehabilitated canal can only be used for a few years, and can only supply water to farms nearby. Irrigated water from the canal rehabilitation could only be distributed to the rice fields in Lvea village, which is nearest the canal; others could not access the water. Only 10 percent of the target beneficiaries could access the water. While this strategy can help communities adapt to climate change during prolonged droughts in the rainy season, a cement canal would be the best method of adaptation in the long term. However, it would be expensive.

If farmers need more water from the district canal to increase the number of crop cultivation cycles, they will need to use a pump. This would make rice production more expensive. The rehabilitation of the canal did not help farmers whose land was further than 500m from the canal. It is important to build a sub-canal that could bring more water to support the downstream rice fields that are far away from the main canal. This canal primarily depends on rainfall, and mainly drains run-off water from upland rice fields, thus, if there is no rainfall, it is likely to be dry. It will be a challenge for the FWUC to manage any expansion of rice fields in the late rainy season if the irrigated area is increased to more than 20 hectares. Conflicts could arise with regard to sharing water.

The duration of the project (only one year) was too short for target beneficiaries. The canal and rice bank management committee struggled to adapt and be independent in choosing which method of agricultural cultivation and O&M was best for sustainability. The ability of the FWUC and rice bank management committee to manage their roles and responsibilities is still limited. This is particularly true with regard to collecting water fees for O&M and providing clear guidelines to farmers on how to select the best rice seed to return to rice bank. This can affect the quality of seed used in the next cropping season by the next borrower. The training provided on SRI did not fit the needs of the people, as they had less labour available to them and large farms; 50 percent of trained farmers could not apply SRI.

5. GOOD PRACTICES AND LESSONS LEARNT

Even though the project only operated for one year, there were several major achievements and good practices in the target areas. Communities received strong support from PDOWRAM, as well as commune and village authorities. There were good opportunities to bring technical staff and local authorities together to discuss issues with communities. They were able to address problems related to the canal rehabilitation, climate change and other needs. The participatory approach worked well and gave relevant stakeholders, particularly villagers, the opportunity to set up project activities while collaborating with the project 'owner' and commune council members. As a result, communities were empowered to take ownership on O&M and agriculture. The FWUC functioned after the project finished, even with limited capacity to manage the canal, as the commune council still recognized it and it had the formal support of PDOWRAM. Farmers understand the importance of agricultural techniques; some apply SRI and some are changing from SRI to drum seeders, depending on the condition of the land. They intend to apply this method, which could help them adapt to the changing climate in their area and reduce the use of pesticides. Most farmers contributed in-kind support for canal rehabilitation, road construction and tree planting, etc.

The significant lesson learnt from this project is that farming communities could turn threats into opportunities, by constructing the canal to store and harvest water from upland areas of the dam. This works not just for rice production but also fisheries, generating alternative livelihood activities.

It was also important to learn that accountability and transparency in the bidding process for canal rehabilitation would save the project money in management and procurement. The project's budget met demands beyond its targets. There was good cooperation between associations, farmers, contractors and local authorities, including the commune council, PDOWRAM, DKC organization and other partners. The contribution of the Climate Change Fund allowed local authorities and project beneficiaries to manage and sustain the project outputs. This project was the best starting point for communities and local authorities to build their ownership, as well as to build a culture of collaboration with each other towards improving their standards of living.

Another good lesson learnt which should be applied to the next project is the practice of gaining rice yields after harvesting instead of collecting cash through water fees. This method could make farmers feel more secure, as they would not need to pay to use water. However, this could be risky for FWUC on O&M if farmers could not generate adequate rice yield compared to their total expenditure on rice cultivation.

By using the VRA, not only the communities themselves but also local authorities, particularly the commune council, could identify people's main challenges and set priority needs to be implemented in their area. This boosted the socio-economic benefits for villagers' livelihoods. This tool could encourage all relevant stakeholders to consider the participatory approach, discussing ways to deal with problems together – it is different from the culture of silence of Cambodian people. The implementation of CRID, in cooperation with target communities and relevant stakeholders, inspired the commune authority in Seang Kveang commune to integrate climate change adaptation into its commune development plan.

6. CONCLUSIONS AND RECOMMENDATIONS

Choosing to rehabilitate two canals/dams along the canal proved successful in harvesting and managing water in the canal. The areas up and downstream can keep soil moist longer during prolonged droughts in the rainy season. The dam has become the main road in the target area to access rice fields and neighbouring communes and districts. This reduces the time and cost of transporting material inputs to the rice fields and transportation to outside. There were unexpected outputs, such as increased numbers of fish in the canal, additional crop cultivation (watermelons or cucumbers) and new residential areas for the villagers. The community increased their income and freed themselves from debt. Some families can now send their children to study at university in Phnom Penh.

The intervention responded to adaptation measures, with the community ensuring food security through harvesting and managing water, and having enough water to cultivate rice in the rainy season. Farmers closest to the canal could increase their crop cultivation from one to three times per year, fisheries improved, and there was enough rice seed stored in the rice bank. The saving group mechanism proved successful, with more money in the village fund, and the new road improved accessibility to the rice fields and the market.

Through capacity building provided by the project, including raising awareness on climate change, management methods on canal O&M and rice bank processing, the communities and commune council have been strengthened and have greater ownership to push for socio-economic development in their area. This adaptive approach has supported farmers to feel confident and change the way the cultivate crops, increasing cultivation and diversifying the way they farm. The fishery is increasing, with the good environment and ecosystem in the canal draining more water from upland rice fields. This has the potential to become a way for communities to generate income.

A significant success of the project was the collaboration and participation among the communities, local authorities and relevant technical departments. They will consider using the commune fund and in-kind support of the villagers for future development activities.

Some recommendations for future improvement of similar projects or the continuation of existing projects are:

The SMART (Specific, Measurable, Achievable, Realistic and Time-bound) approach is the key factor in achieving success within a short time period.

Consider extending the project period from one to two years, as either the project staff or beneficiaries (canal and rice bank management committee, local authority and farmers) could strengthen their capacity and be able to adapt to climate change vulnerabilities in their area.

It is crucial to understand water sources, requirements, potential irrigated land for proposed irrigation projects, identify canal dimensions and prepare sound water resources. It is important to strengthen the capacity of the FWUC to push for more responsibility and for commune authorities to be functioning well on canal O&M. Irrigated water sharing must be well planned to avoid conflicts of interest.

It would be more successful if the possibility existed to build a sub-canal to bring more water from the upstream lake, and build another sub-canal to help farmers whose rice fields are located downstream far from the main canal.

Many people, particularly young people, leave this area in search of work in urban areas or other countries. This decreases the amount of labour available for agricultural work. Keeping the young generation nearby and providing them with more opportunities is an important consideration. If they can earn enough, they will stay in their own country with their family.

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