Listen to Villagers on Climate Change

Vulnerability Reduction Assessment (VRA)
November 2010

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1. EXECUTIVE SUMMARY

Farmers find climate change complicated; however, they have significantly experienced its impacts.

Climate change can no longer be ignored. Even farmers in Teuk Krahom commune in Preah Vihear province and Bos Leav commune in Kratie province have seen notable changes in terms of the climate over the years. In Teuk Krahom commune farmers see themselves as very vulnerable to droughts; while in Bos Leav, the vulnerability stems from droughts, floods and storms. In Teuk Krahom commune, all the villages have noticed a definite increase in the frequency and length of droughts. Similarly in Bos Leav commune, despite being known as flood-prone areas, all villages within this commune have noticed an increase in the frequency of droughts. In general, floods seem to have stayed steady over 30 years and some farmers have even noticed declines in floods.

Farmers in both communes feel that CC is already affecting their livelihoods in the following main areas: Firstly, droughts and heat negatively impact on the animal health. Animals die because of the heat and diseases, which seem to increase during drought months. Secondly, farmers also see CC impacting negatively on rice yields. Water stress from the heat and droughts affect grain development resulting in low rice yields. The damage to rice also extends to other crops like vegetables grown in the area. Thirdly, droughts dry up the limited water resources, which in turn limit the ability to irrigate during droughts as well as dry season cultivation. In Bos Leav the impact of CC seems to be compounded by silting up of the lakes and dams from deforestation and subsequent soil erosion. Fourthly, human health is also being negatively affected by CC. Farmers noted that diseases like diarrhoea and stomach problems increase as water quality deteriorates in the dry season. Lastly, farmers in Bos Leav mentioned that storm also destroy dams, homes and roads. Farmers feel that animal health, human health, waters resources and crops yields

will be most impacted if CC increases. They also see an increase in food insecurity and a decrease in income if CC increases.

However, all is not doom and gloom. Farmers in both areas see institutional support from NGOs and government as playing a key role in reducing CC vulnerability. This was very strong in Bos Leav which has a large number of NGOs working in the area. NGOs provide humanitarian aid during flood disasters in forms of mosquito nets, food, tents, and evacuation shelters among others. Village animal health workers, who assist in livestock management, were also seen as important. Existence of lakes and dams in Bos Leav and to some extent in Teuk Krahom, also plays an important role in reducing the impact of CC. Some villages in Teuk Krahom see protected forests as providing food and non-timber products which they can sell in lean months.

When asked about the main barriers to CC adaptation, farmers in Teuk Krahom mentioned lack of water resources as the main hurdle followed by lack of money, lack of access to agricultural techniques, lack of CC information and lack of institutional support. In Bos Leav, lack of access to improved rice varieties, lack of access to agricultural techniques, water resource and lack of money are seen as the main hurdles. Accordingly, farmers in both areas felt that their vulnerability indices would improve if the project focused on the following areas: Providing access to improved rice varieties. These are rice varieties that are early maturing, resistant to droughts and floods, high yielding and also high value; providing extension services on how to grow rice and other crops, manage livestock and aquaculture; rehabilitating and constructing irrigation systems, digging perennial community ponds in Teuk Krahom, while Bos Leav asked for deepening and rehabilitation of dams, canals, water gates and natural lakes.

ACRONYMS

AMK	Angkor Microfinance Kampuchea
CALM	Conservation Area through Landscape Management
CARDI	Cambodia Agriculture Research and Development Institution
CC	Climate Change
CGA	Cambodian Global Action
CHE	Community Health Education
CRC	Cambodian Red Cross
CWS	Church World Service
IFAD	International Fund for Agricultural Development
KAP	Knowledge, Attitudes and Practices
KIPD	Khmer Institute for Peace and Development
LDCF	Least Developed Country Fund
MAFF	Ministry of Agriculture, Forestry and Fisheries
MAFF PSU	Ministry of Agriculture, Forestry and Fisheries; Project Support Unit
NAPA	National Adaptation Programme of Action to climate change
NGO	Non-governmental Organisation
NTFPs	Non-Timber Forest Products
Oxfam	Oxford Committee for Famine Relief
PDA	Provincial Department of Agriculture
PADEK	Partnership for Development in Kampuchea
PDOE	Provincial Department of Environment
PDORD	Provincial Department of Rural Development
PDOP	Provincial Department of Planning
PDOWA	Provincial Department of Women Affairs
PDOWRAM	Provincial Department of Water Resources and Meteorology

PFD	Partner For Development
RULIP	Rural Livelihood Improvement Project
SCUK	Save Children of United Kingdom
SGP	Small Grant Programme
UNDP	United Nations Development Programme
VAHW	Village Animal Health Worker
VRA	Vulnerability Reduction Assessment
WCS	Wildlife Conservation Society

2. INTRODUCTION

Around 300 farmers from Kratie and Preah Vihear provinces shared their experiences in this study.

The agricultural sector contributes to around 30% of the Cambodian GDP and engages around 80% of the populations. However, the dependence on a single rice cropping and on rain-fed agriculture makes this important sector extremely vulnerable to any changes in rainfall patterns. And variability in rainfall patterns is expected to increase due to climate change (CC). At present there is already emerging evidence that agricultural-based livelihoods and the overall food security in Cambodia are being affected by increased frequency and severity of floods, dry spells and droughts due to climate change. It is projected that the poor, whose livelihoods are intricately linked with agriculture, will suffer the most from the impacts of CC.

In response to the issues mentioned above, the 'Promoting Climate Resilient Water Resource Management and Agricultural Practices in Rural Cambodia' (A NAPA Follow-up Project) is the first project to be implemented from the Cambodian National Adaptation Programme of Actions to climate change (NAPA) list of priority projects. The project is being implemented by the Ministry of Agriculture, Forestry and Fisheries Project Support Unit (MAFF PSU) with funding support from the Least Developed Countries Fund (LDCF) and the United Nations Development Programme (UNDP).

The project seeks to improve the adaptive capacity of rural Cambodians in agriculture and water resources through capacity development of local institutions in planning for climate change; demonstration of appropriate climate change adaptation mechanisms; and capturing lessons learned for scaling up and for policy debate. The project is being implemented in two contrasting geographical provinces of Preah

Vihear where farmers experience frequent droughts and dry spells; and Kratie where floods, droughts and storms are more recurrent.

In order to gain an in-depth understanding of the impact of climate change on the rural livelihoods in the two target provinces, the project conducted a Vulnerability Reduction Assessment (VRA) between the months of August and September 2010. VRA is a participatory tool developed by UNDP and Small Grants Programme (SGP). It enables farmers to articulate the climatic hazards that impact most negatively on their livelihoods, and to identify prioritized needs in reducing these vulnerabilities. VRA is also an important tool in monitoring and evaluation; it allows practitioners to assess the impact of their activities in reducing the climate change vulnerabilities by engaging the community and to get feedback on how the project activities are reducing the climate change risks and how this can be improved. Engagement with the project beneficiaries through VRA also empowers farmers to take ownership and control of the project activities at the grassroot level.

Although project formulation should be informed and shaped by key issues raised in the VRA process, in this case the VRA exercise was done after project design. However the intention is to use the findings to influence project activities to respond directly to farmers' needs. The exercise provided a VRA index or baseline against which the project and the project beneficiaries will be able to measure progress done against reducing climate change vulnerabilities in the target areas.

3. VRA OBJECTIVES & METHODOLOGY

The study aimed to know current impacts of climate change on farmers' livelihoods. The results became inputs for the project's priorities .

3.1 VRA Objective

VRA is a participatory method that gives community members a direct influence in project design and activities. It can generate qualitative and quantitative data which allow the project to respond to the farmers' priorities while being able to measure quantitatively the progress made in reducing CC vulnerabilities. It is results-based, so the project team can observe which activities have been successful and which haven't and whether outputs have contributed to wider project outcomes/objectives. The VRA is a tool which measures vulnerability and adaptive capacity of a community to CC. It measures these before project activities start to establish a baseline; again in the middle of the project to measure the progress that has been made in reducing climate change vulnerability; and at the end to measure change in vulnerability/adaptive capacity and to capture lessons learned from the intervention.

3.2 Method

The VRA exercise was done in the following stages:

A. Preparing the Farmers:

In order to prepare the project beneficiaries to fully participate in the VRA exercise, a climate change awareness forum was held in Teuk Krahom in Preah Vihear province on the 5th of August 2010 and in Bos Leav Kratie province on the 3rd of August 2010. This was done to ensure that farmers had a clear understanding of climate change concepts and how climate change impacts their lives.

B. VRA Training for VRA Facilitators:

Firstly, the project staff and government counterparts from the collaborating ministries in Preah Vihear, Kratie and at the national level underwent training on the VRA concepts and a refresher course on climate change, and climate change vulnerabilities. As the GEF Small Grant Programme (SGP) was also conducting VRAs around the same time as the NAPA Follow-up project, staff from the NAPA Follow-up project, Provincial Department of Agriculture (PDA) and some Rural Livelihood Improvement Project (RULIP) participated in the SGP VRA trainings in Kratie, which included the practical facilitation of VRA exercise in the same province.

Secondly, a full day training workshop took place on the 18th of August 2010 in Preah Vihear for 34 (7 women) where facilitators received training on VRA concepts and methodology. Furthermore, the facilitators also received VRA facilitation skills to ensure that they are able to engage and receive relevant information from the project beneficiaries, including women whose voice is often excluded in such participatory meetings. The facilitators composed of project staff from the Project Support Unit of Ministry of Agriculture, Forestry and Fisheries (MAFF/PSU) at the national level; staff from the Provincial Departments of Agriculture (PDA); Water Resources and Meteorology (PDoWRAM); Women Affairs (PDoWA); Environment (PDoE); Planning (PDoP) from Preah Vihear province; and PDA and PDoWRAM from Kratie province.

In the afternoon session, trained facilitators made preparations for the real VRA exercise in the field. The trainees were divided into groups of three members, with the intention that each group would facilitate a VRA process with the farmers. They worked out the questions to be asked for field VRA exercises in the vernacular language- Khmer. Since the time was a constraint, the facilitators were not able to practice the questions in role plays and therefore to anticipate potential problems with the questions.

C. The VRA Exercise:

The VRA trained facilitators travelled to Teuk Krahom commune in Choam Khsan district of Preah Vihear a day following the VRA facilitators training to conduct the VRA exercise. The VRA exercise in Bos Leav commune in Kratie took place in September 2010 and was facilitated by the Kratie project teams from the Provincial Departments of Agriculture and Water Resources.

In both communes, introductions were made and the objective of the VRA exercise was explained, which is to learn from the villagers the effects of climate change on their livelihood, their capacity to cope with the changes in the climate and priority needs/solutions to reduce these vulnerabilities. To enable the farmers to better participate in the exercises, CC community forum had been organised in the previous month. However, a brief description on climate change causes and effects was done and so were explana-

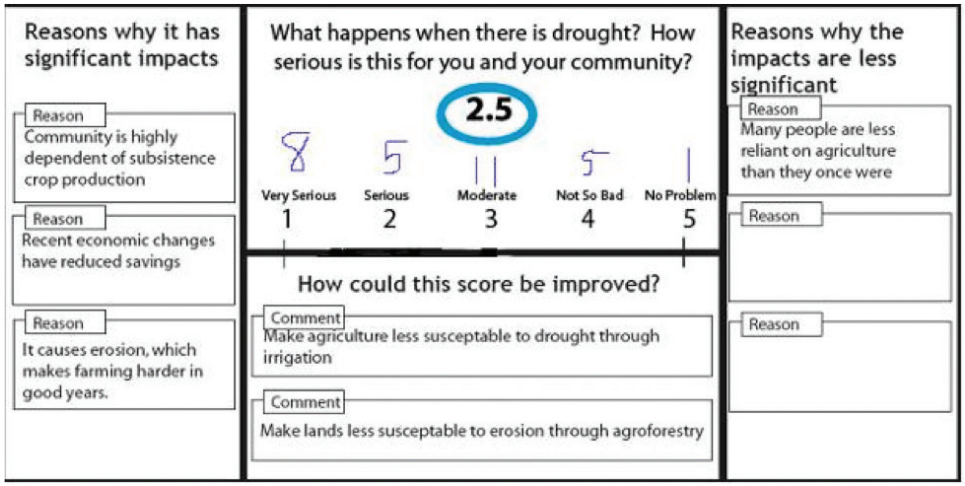
tions of a few terms used in the exercises such as climate change vulnerability and adaptive capacity and adaptation. Each village was divided into a women and men group to ensure that women's voices were fully captured.

3.3 VRA Tools

Two main tools were introduced and used for the VRA exercises:

a). Trend analysis measures people's perceptions of climate change. It complements the H form, which only measures the present and future climate risks, by enabling the project to understand whether people have noticed climate change and by helping facilitators to frame the H form discussion. For example through the trends analysis, the project was able to identify droughts as the main threat to Teuk Krahom, while storms, floods and droughts are more prevalent in Kratie.

Figure 3.1: H-Form



b). The H-form – A tool used for VRA facilitation and data collection, see the sample above.

The left hand side of the H-Form captures the views of the farmers on how CC is negatively affecting their lives and livelihoods, while the left hand side looks at factors and reasons that help reduce or relieve the impact of CC. After discussing this, farmers are asked to rate their own vulnerability on a scale of 1 to 5, 1 being least vulnerable and 5 most vulnerable. After scoring, the participants are asked to suggest solutions on how to improve the score. In addition, four separate H-Forms are done to capture information on different aspects of CC as listed below.

Q1. What current experience do you face because of climate change and what is the effect on your lives?

Q2. What would happen if droughts / floods were twice as frequent? How would this affect you and your community?

Q3. What stands in the way of adapting to increasing droughts / floods? What means do you and your community have to manage events occuring more frequently?

Q4. Rate your confidence that the project activities will continue after the project period?

3.4 VRA Scoring

Qualitative Data

To generate the score for each question, the scale from 1 to 5 was used where 1 stands for low vulnerability; and 5 for high vulnerability. After discussing the negative and the positive impacts of CC, farmers were asked to rate their vulnerability based on the scale above for each of the four questions. The average for each question was done by multiplying the each score with the number of votes and by dividing the total with the total number of participants in each group. The average for each women and men group in each village was combined and divided by 2 to provide an average for each question for each village. The VRA score for the four questions (in this case three, as Q4 was ignored) were combined and divided by number of question to arrive at the VRA index for each village. The VRA indices for each village were further combined and divided by the total number of villages participating in the VRA exercise to determine the VRA index for each commune. The VRA index for each commune becomes the VRA baselines against which will be measured in the subsequent mid term VRAs to determine progress made in reducing the vulnerability.

Quantitative Data

Quantitative data comprises of all the information captured during the session and classified in different parts of the H-Form (Figure 3.1 above). These include:

- Negative Impacts of CC
- Positive impacts of CC
- Barriers to CC adaptation
- Suggestions on how to improve the VRA score

3.5 Reflection on the VRA Exercise

The day after the VRA exercise in Preah Vihear, facilitators discussed the challenges that they met during the VRA exercise and how these could be improved especially for Kratie which had not yet done the VRA exercise at the time of the VRA reflections. The issues and challenges are captured in the lessons learned section at the end of this report.

3.6 Analysis of Data

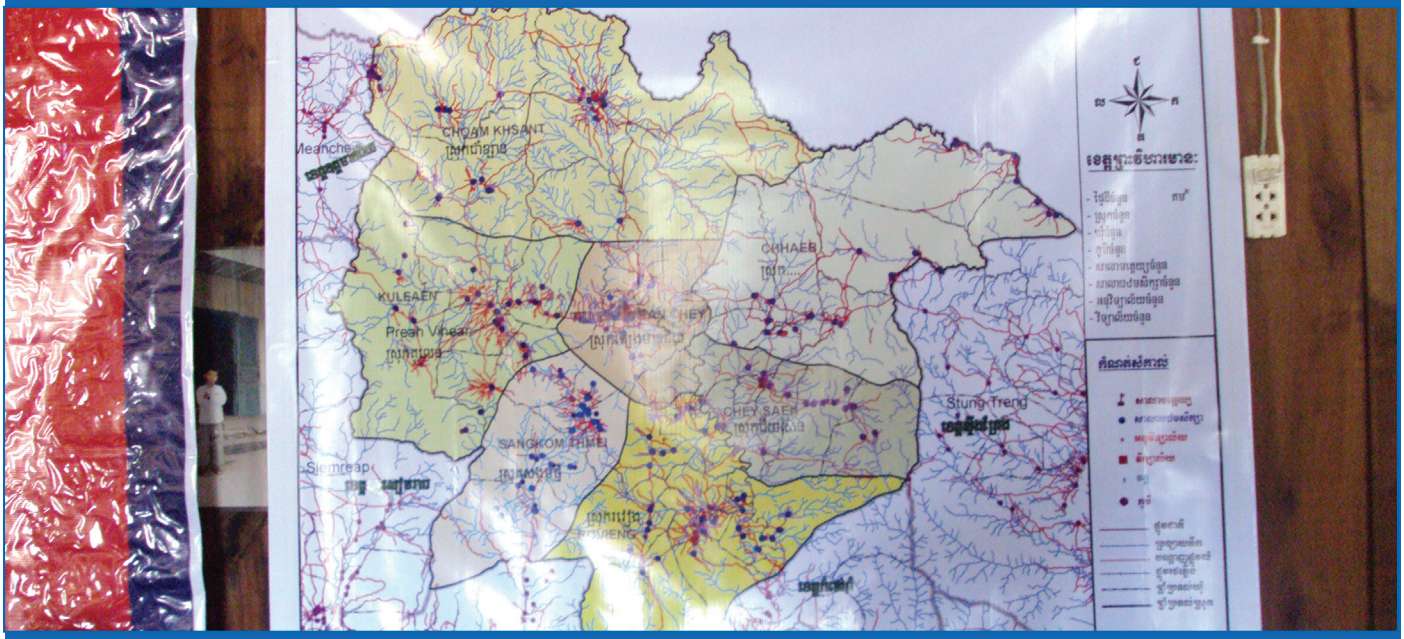
Rather than analyzing each village on its own, an aggregate of answers from each question was collected by isolating the most frequent answers as representing the views of the majority. In this regard, answers provided by less than two of the villages in Teuk Krahom and less than three villages in Bos Leav were disregarded as not representing the general views of the commune. However the answers that are not recorded discussed in this report can still be used by the project when addressing specific village needs.

3.7 Credibility of the findings

Each village group had a different set of facilitators and the VRA was conducted simultaneously and so the results were reached independently. In addition, the project sought clarifications from farmers on answers that were unclear or ambiguous on a later date. Similarities in the answers from the women and men groups in each commune is seen as reflecting the climate change issue being faced by the villagers in the same communes. While differences in answers between Bos Leav and Teuk Krahom commune reflect geographical differences. However, it should be noted that NAPA Follow-up project is being implemented in partnership with the IFAD/UNDP funded Rural Livelihood Improvement Project (RULIP) which focuses on improving the livelihoods through agriculture. RULIP project is already operational in some of the NAPA Follow-up target areas, especially in Preah Vihear. As a result, there is a high possibility that the answers provided by farmers were skewed by activities already being done by RULIP. It was noted that farmers mentioned RULIP and RULIP-related activities in Preah Vihear, but this was not the case in Bos Leav where RULIP is not present.

In September 2009, a typhoon Ketsana, a severe storm, hit many parts of Cambodia, including Preah Vihear and Kratie and caused a significant loss and damage to crops and properties. In addition, the unusual late rains in 2010 had an impact on farmers in terms of the timing of rice sowing and also repeated sowing as crops dried up. There is a high chance therefore that some of the answers could be influenced by these two recent events. For example, it is possible the impact on droughts and heat on livestock features highly in the report due to a high number of animals that died due to heat and diseases at the beginning of the year (KAP Study 2010).

4. VRA FINDINGS IN TEUK KRAHOM COMMUNE



Preah Vihear frequently experiences droughts that affect agriculture, water resource, human and animal health.

4.1 Background

Teuk Krahom commune is located in Choam Khsan district and has a total of about 854 people. The commune has a total of six villages, namely Teuk Krahom, O Khsan, Sangkum Thmei, Chat Taing, Trapang Thom and Robugn. Eighty-eight villagers (41 men) from five villages attended the VRA exercise representing just over 1% of the Teuk Krahom commune population.

4.2 Trend Analysis and Types of Climatic Hazards

Before conducting the VRA a trend analysis was done in order to assess if people had noticed changes in the climate over a period of time and also identify which climate change hazards affected people the most in Teuk Krahom. Two climatic hazards that impact on their lives and livelihoods include droughts and floods. The trend analysis identified drought as a major threat to livelihoods and as result, the VRA focused on droughts in this commune.

Floods: Most of the women noted that the frequency of floods in the targeted villages has stayed steady since the 1980s or have even decreased. Men in Trapang Thom, O Khsan and Teuk Krahom felt that floods have increased while the men in the rest of the villages felt that floods have stayed the same or decreased. In general farmers have not noted major increases in floods over the past 30 years. Nevertheless, floods negatively impact on their livelihoods by destroying their crops. In this area, farmers noted that like with floods, the impact on crops is high but also steady over the past years. In addition to destroying

crops, floods also destroy roads and irrigation systems as was the case with the Ketsana Typhoon, which destroyed one of the irrigation systems in Teuk Krahom commune.

Droughts: The frequency and the length of droughts were noted as increasing over the past 30 years by all women and men groups in all the target villages. The impact of droughts on crops also mirrors the increase reflected in the frequency and length. It should be noted that all the villages rated the impact of droughts on crops extremely high in the last five years and this could have been influenced by the droughts that was experienced in 2010 at the beginning of the rainy season.

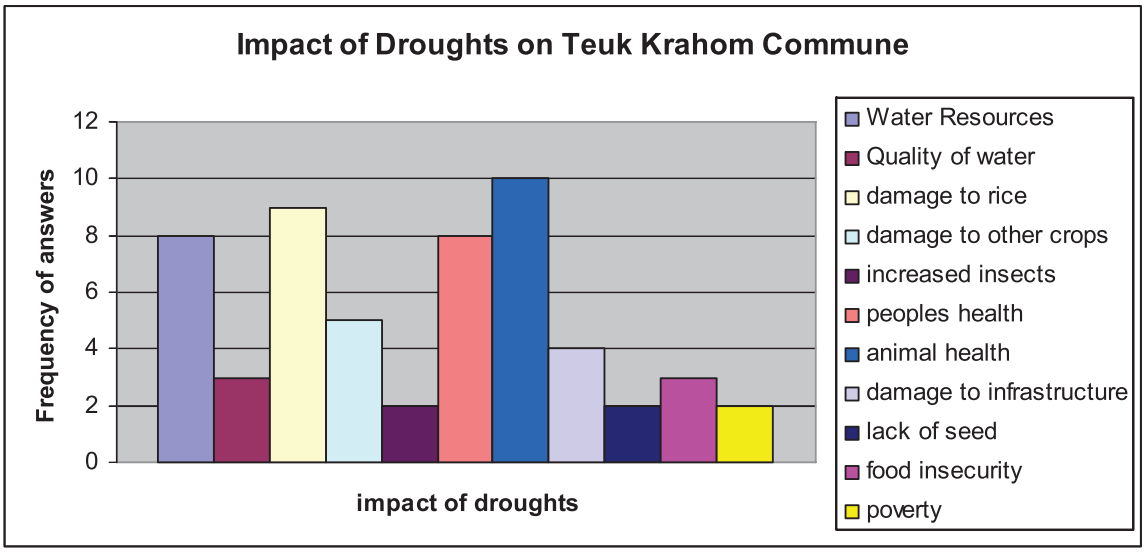
4.3 Climate Change Risks in Teuk Krahom

Question 1: What current experiences do you face because of climate change? And what is the effect on your lives?

Based on the results there were no major differences between the answers provided by women and men. Six main (in order of importance) areas were identified as being most impacted by climate change, specifically by droughts and dry spells:

1. Negative impact on animal health;
2. Damage to rice, resulting in low yields;
3. Negative impact on water resources;
4. Negative impact on people's health;
5. Damage to other crops;
6. Damage to infrastructure.

Figure 4.1: Current Impact of CC on Teuk Krahom Commune



As indicated in the figure, all the five villages, men and women, see climate change as posing the biggest threat to their livestock. How climate change impacts on livestock was not clearly articulated in the actual VRA exercise. However follow-up discussions indicated that when it gets too hot, animals get sick and die from Newcastle disease in chickens; foot and mouth, haemorrhagic septicaemia in cattle and buffalos. The second area most affected by droughts is damage to rice. This damage is in forms of scorching to rice seedlings, and immature grains due to water stress during droughts or dry spells, both if which result in low yields. Damage to other crops was also mentioned as one area impacted by droughts, ranked fifth.

The third and fourth areas are the negative impacts on human health and water resources. The later refers to dams, irrigation systems, community ponds and wells which seem to dry up in a drought year. Wells and community ponds play a key role in water for household while the rest of the water resources are used for crop irrigation and watering animals. The impact on human health refers to stomach problems and diarrhoea which seem to stem from deteriorating water quality as clean water sources dry up during droughts and in the dry season. The sixth area refers to damage to infrastructure, which relates to floods rather than droughts. The farmers indicated that floods damage roads and irrigation dams, as evidenced by O Khsan medium scale irrigation dam in Teuk Krahom Village, which was destroyed by Ketsana in 2009.

The H-Form below shows an aggregate of all common answers provided by the men and women groups from all the five villages. The left hand side shows the negative responses with regard to how climate change is affecting people, while the right hand side show positive responses. The positive responses capture farmers' perceptions of what factors exist in their villages which enable them to better cope with climate change.

Table 4.1: A summary of most frequent answers provided for Q1

Reasons for negative answers	Question 1	Reasons for positive answers
1. Impacts on water resources for agriculture and household use. 2. Damage to rice seedlings, rice and other crops due to floods, droughts and insect attack 3. People's health is affected negatively 4. Animal health is affected negatively 5. Damage to infrastructure (dams & roads) 6. No seed to replant after drought or floods 7. There is limited skills in agriculture in coping with the CC impacts	**What current experiences do you face because of climate change? And what is the effect on your lives?** **Score** **4** **How can the score be improved?** 1. by rehabilitating/building dams and ponds for irrigation during droughts 2. by providing training in crop extension and vegetable gardening 3. by improving access to early maturing, high yield and drought resistant varieties 4. by restoring wells for drinking water 5. by improving access to animal health services	1. There is a health centre for people to go to 2. Some of the villages have wells 3. Old dams exist 4. There are some VHAW 5. Some of the villages have irrigation systems and ponds 6. Some receive help from RULIP project, CWS and provincial departments in home gardening, animal health, VAHWs, & digging wells

The middle section shows that VRA score for question 1, which is 4, on the scale of 1 to 5. Below the score, the H-Form shows farmers' views on how the score of 4 above can be improved. The section gives farmers a voice on how the project activities can be shaped to respond to the negative impacts of climate change highlighted on the left hand side.

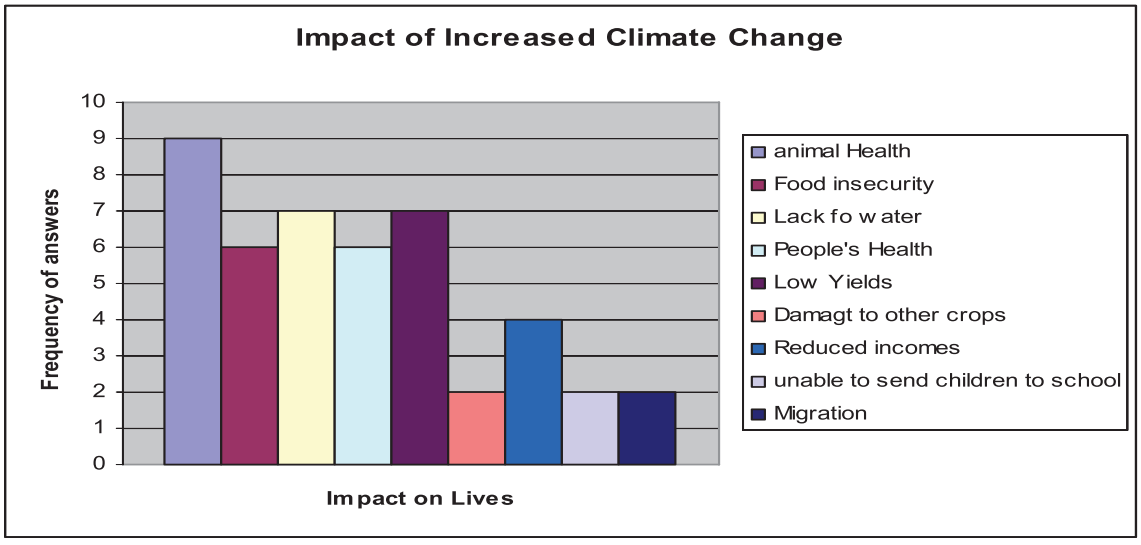
Question 2: What would happen if droughts were twice as frequent? How would this affect you and your community?

Question 2 tries to identify how people's lives and livelihoods would be impacted upon if there is an increase in incidences and frequency of climatic hazards. Based on the trends Q 2 focused on the potential impact of increased incidences of droughts. Based on the chart below, the responds are very similar to those provided in Q1. In order of importance, farmers felt that increase in drought would negatively affect the following areas:

1. Animal health would be negatively affected even more;
2. Rice yields would reduce;
3. Water would become more scarce;
4. People would become more food insecure;
5. People health would be negatively affected
6. Reduced income

Farmers in Teuk Krahom think that increased incidences of droughts would impact the most on animals. After livestock, farmers were most concerned with the impact of droughts on rice yields and water resources. With the later, farmers indicated that more droughts would result in low yields and their ability to produce enough rice. The emphasis on rice stems from the fact that rice is a staple for all the villagers interviewed and for Cambodia in general. The emphasis on rice can be contrasted by damage to other crops which was mentioned by only one village.

Figure 4.2: Impact of Increased Climate Change



With regards to the impact on water resources, farmers see more water sources drying up resulting in scarcity of water available for animals and irrigation. Some farmers also indicated that access to clean

water would become a problem as the water quality deteriorates with increased droughts. In Sangkum Thmei village, farmers also felt that increased incidences of droughts could result in water-related conflicts.

The potential impact of increased droughts on people's health and food insecurity resulting from reduced yields can be rated the same. Food insecurity and reduced income are a result of cumulative impact of increased droughts. Farmers indicated that reduced income and food insecurity would affect their ability to feed themselves, send children to school among other things. Women from Chat Tiang and Teuk Krahom mentioned that if droughts increased, people could migrate away from the villages although there was no mention of where they would migrate to.

Table 4.2: A summary of the most frequent answers provided for Q2

<table>
<tr><th>Reasons for negative answers</th><th>Question 2</th><th>Reasons for positive answers</th></tr>
<tr><td rowspan="2">1. More animals would get sick
2. More negative impact on human health
3. They would become more food insecure
4. There would be no water for people, cattle & for irrigation
5. Increased damage to rice and low yields
6. People would migrate to other areas
7. There would be no clean water</td><td>What would happen if droughts were twice as frequent? How would this affect you and your community?

Score
4.48</td><td rowspan="2">1. Villagers can collect NTFP (mushrooms, rattan shoots, snails and fruits)
2. There is support from government and other NGOs and Red Cross
3. There are some wells being dug
4. There are possibilities to grow other crops</td></tr>
<tr><td>How can the score be improved?
1. By building & rehabilitating dams
2. By improving access to early maturing, high yield and drought resistant rice varieties
3. Providing training and skills in animal raising
4. Training in crop diversification and vegetable gardening
5. By planting more trees</td></tr>
</table>

From the H-Form above, farmers in Teuk Krahom Commune feel that their current vulnerability of 4 (VRA

score for Q 1) would increase to 4.48, if droughts incidences increased because of CC.

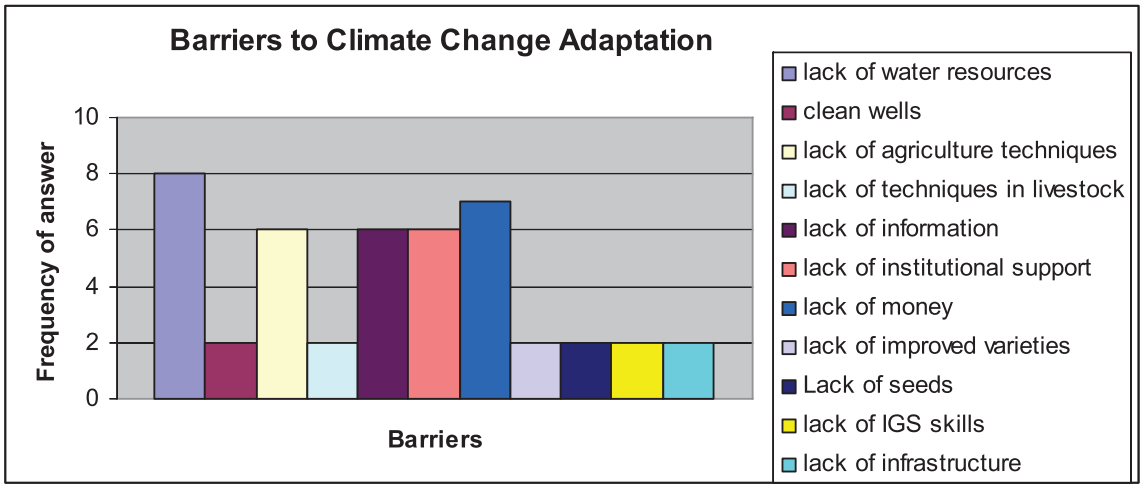
Question 3: What stands in the way of adapting to increasing droughts? What means do you and your community have to manage events occurring more frequently?

Main barriers include:

1. Lack of water resources
2. Lack of money
3. Lack of agriculture techniques;
4. Lack of information;
5. Lack of institutional support

Unlike the Q1, & Q2, answers to the question on barriers to CC adaptation were less homogeneous. Nevertheless, the lack of water is seen by most villagers as the highest barrier to adaptation. Lack of water resources for irrigation systems, dams and family ponds are seen as a major hurdle that stop farmers from coping with climate change in agriculture. Water would enable farmers to irrigate when there is a drought or dry spell. It would also allow them to grow vegetables in the dry season and water their livestock.

Figure 4.3: Barriers to CC Adaptation



Lack of money emerged as the second impediment to coping with CC. Farmers indicated that they lack money to buy seeds when their crops are destroyed; to build water tanks for rain water harvesting; to support their daily livelihoods; to send their children to school. Unfortunately most of the responses on money as a barrier to CC adaptation were not expanded to give an insight in terms of how the money could be used in coping with CC.

Six groups out of 10 felt that lack of skills and knowledge in agricultural techniques, lack of information, and lack of institutional support are also barriers to adaptation. Lack of agricultural practices include techniques on how to grow rice better, how to grow other crops like vegetables and fruit trees, techniques in animal raising and aquaculture. With regard to CC information, the answers did not give specific details on the type of information that would be useful in coping with climate change. Most farmers; however, explained information in forms of techniques and skills in agriculture. Concerning lack of institutional support, farmers felt that their villages were not well supported by NGO and government institutions. This area needs further analysis as many farmers also indicated NGOs like Church World Service (CWS) and government institutions working in the targeted villages assist in ameliorating the problems related to droughts as outlined in the section under positive responses below.

The responses to Question 3 had some subtle differences based on gender. All the women groups (women from all five villages) felt that lack of water resources was the main barrier to adaptation while only three men groups felt the same way. The project could try to explore why all women groups gave this answer. Similarly four women groups out of five indicated that there is very little institutional support and also that they lack agricultural techniques. The probable reason for this could lay in the statistics that very few women ever receive extension services (MAFF 2006[1]). It is also possible that local institutions prefer to work with men; therefore women may not be exposed to the NGOs working in the area.

Table 4.3: Summary of most frequent answers provided for Q3

<table>
<tr><th>Reasons for negative answers</th><th>Question 3</th><th>Reasons for positive answers</th></tr>
<tr><td rowspan="2">1. Lack of water resources (dams, wells irrigation systems)
2. Lack of agricultural techniques
3. Lack of institutional support
4. Lack of information
5. Lack of money</td><td>What stands in the way of adapting to increasing droughts? What means do you and your community have to manage events occurring more frequently?
Score
3.64</td><td rowspan="2">1. There is support from government and other NGOs
2. There are some saving groups
3. There are protected forests</td></tr>
<tr><td>How can the score be improved?
1. By digging more ponds and irrigation systems
2. By having disease resistant animals
3. By having appropriate (early maturing) seed for rice and other crops
4. By having more institutional support</td></tr>
</table>

1 Ministry of Agriculture, Forestry and Fisheries (MAFF) 2006: Gender Mainstreaming Policy and Strategy in Agriculture

The H-Form above shows that the VRA score for Question 3 is 3.64. The score means that farmers perceive themselves as vulnerable when they consider their abilities in adapting to CC.

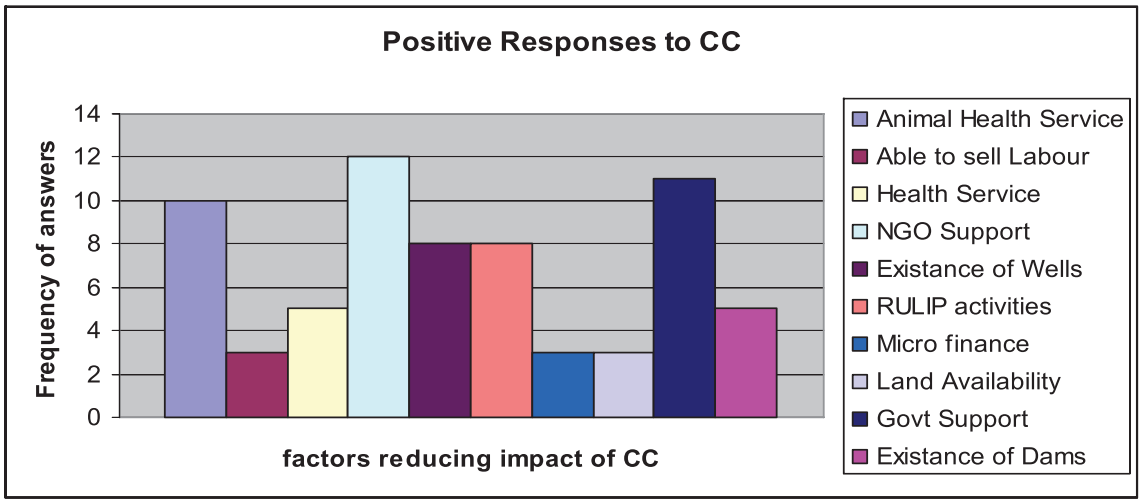
Question 4: Rate your confidence that the project activities will continue after the project period?

Although Question 4 was asked in the VRA exercise, the data collected has been ignored as the answers were unclear. Even though farmers are familiar with climate change concepts and its impacts, however, they are not fully aware of the project activities, and so it was difficult for them to rate the confidence in the project. As a result the VRA indices for both Bos Leav and Teuk Krahom Communes exclude the score given under Question 4.

4.3.1 Reasons for Positive Answers

Although the emphasis of the VRA process is to identify how CC impacts negatively on the communities, in some instances, CC could bring in positive results. In the case of Preah Vihear; however, farmers were not able to identify areas where CC has had a positive impact. Nevertheless, farmers pointed out the following areas, which are perceived as ameliorating the impact of CC. (See Chart below)

Figure 4.4: Factors Reducing the Negative Impact of CC



The chart shows a summation of positive answers from Q1, Q2 and Q3 which were frequently mentioned by the groups and at least from at least 3 villages of the five villages.

1. NGO support
2. Government support

3. Provision of animal health services
4. Existence of drinking wells; RULIP project activities

Despite farmers seeing lack of institutional support as a barrier to CC adaptation (see above), NGO support was mentioned by all the five villages where NGO activities are seen as helping the villagers to cope with CC. Church World Service (CWS) is prevalent in all the five villages that participated in the VRA process and is involved in home gardening training, provision of food for children under-2, health services, water and sanitation (including wells, latrines and water filters). Cambodia Red Cross (CRC) and Khmer Institute for Peace and Development (KIPD) were also mentioned, but they seem not to be prevalent in all the five villagers and it is not clear what activities these NGOs engage in.

Government support was also mentioned by most villages. The support includes provision of seeds and training in agricultural techniques by PDA, although it is likely that this support is through the IFAD funded RULIP project. PDoWRAM and Provincial Department of Rural Development (PDoRD) were also mentioned without the elucidation on the type of support provided. Support in animal health care was pointed out by at least three villages, where they indicated that they receive training in animal-raising and vegetable gardening; they received animals (piglets and chickens), fruit trees, vaccinations etc. Again some of these activities related to the on-going RULIP interventions. Specific mention of RULIP project activities was made with reference to provision of seeds, animal raising, home gardening and trainings in agricultural techniques. Existence of wells, dams and availability of land for dam/community ponds construction were also seen as areas that could counter the negative impacts of CC.

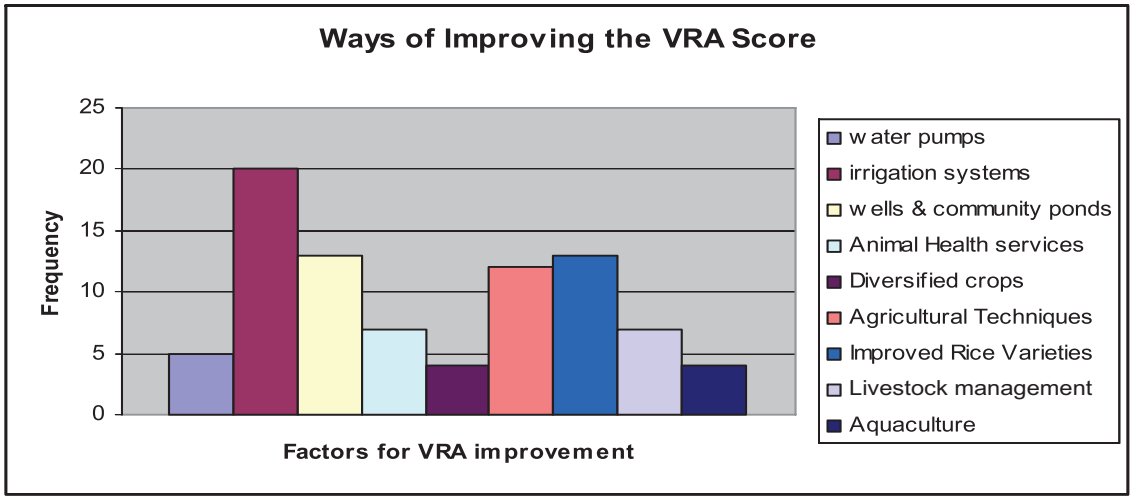
4.4 VRA Score

Based on the results above, the overall VRA index for Teuk Krahom commune is 4.04, which shows that the farmers perceive themselves as highly vulnerable to CC, in particular to droughts, which may become more frequent with climate change. In general, the villages have the same level of vulnerability although Chat Taing village seems to be the most vulnerable in the targeted commune, while Teuk Krahom village seems least vulnerable relative to other villages within the Teuk Krahom commune. The results also show that the villagers think that they will be even more vulnerable if there are increases in floods on the targeted villages, as seen by the higher score for Question 2.

4.4.1 Improving the VRA Score

In all the three questions, farmers were asked how the score given for each question can be improved. Since the answers are very similar, responses on how to improve the score were aggregated and the most recurring answers are captured in the chart below. The selection of answers below was also based on frequency of answers provided by at least three of the five villages.

Figure 4.5: Ways of Improving the VRA Score



In order of importance, farmers in Teuk Krahom felt that the VRA score can be improved by focusing on the following areas:

1. Rehabilitating irrigation systems, dams and canals
2. Providing access to improved rice varieties; community wells, and community ponds
3. Trainings in new agricultural techniques
4. Livestock management techniques
5. Provision of animal health services;

The focus on water resources as the main way of improving the VRA score mirrors the main barrier to CC adaptation (see chart below) and also the general sentiment that CC impacts negatively on water resources highlighted in Q1 and 2. In the chart above, all groups indicated that the vulnerability in their villages would improve if the irrigation systems were built or rehabilitated, depending on whether the village already has an irrigation system or not. Improved rice varieties and provision of perennial wells and community ponds were given equal importance. With regard to rice varieties, farmers indicated that the vulnerability in agriculture could improve if they had access to drought resistant, early maturing and high yielding varieties. Agricultural techniques in rice cultivation are also regarded as important in climate change vulnerability reduction. The techniques here also extend to diversified agriculture including diversified crops like vegetables, cassava, beans; livestock management (although farmers made no specific reference to the types of animals needed); and aquaculture.

Table 4.4: A comparison between barriers to CC and ways of improving the VRA score

Barriers	Improving the Score
1. Lack of access to water resources	1. By providing irrigation systems
2. Lack of money	2. By providing access to improved seeds; wells and community ponds
3. Lack of agricultural techniques	3. Agricultural techniques
4. Lack of institutional support	4. Animal health services; livestock management
5. Lack of information;	5. Livestock Management

The table above shows a comparison of barriers to CC adaptation and way of reducing CC vulnerability. Surprisingly, animal health services and livestock management, as a way of improving the VRA scores, was mentioned by only a few villagers despite that fact that farmers view climate change as have the most negative impact on livestock (see Figures 4.1 and 4.2 above). It is also possible that institutional support and lack of money which were mentioned as barriers to adaptation do not feature highly here because farmers would most likely be interested in the services provided by the NGOs rather than the NGO presence alone. Farmers would similarly be interested in services they can access with money rather than just having money.

4.5 Analysis of the Data Collected

Analysis of Vulnerabilities and Possible Areas for Project Interventions

1. WATER RESOURCES

1.1 CC Impact on Water Resources:

1.1.1 *Water for agriculture:* droughts affect water resources by drying out the water resources used by cattle and limit their ability to grow dry season vegetables and also inhibit irrigation during dry spells. Floods on the other hand destroy dams and irrigation systems as well with the same effect as droughts.

1.1.2 *Water for household use:* wells dry out in the drought years. And water from family ponds in the dry season reduce in quantity and quality resulting in health problems like diarrhoea.

1.2 Farmers' suggestions:

1.2.1 Building and rehabilitation of irrigation systems for crop irrigation during droughts and dry spells, watering animals and for vegetable growing in the dry season was mentioned by all farmers.

1.2.2 Community water pump machines were also mentioned by some farmers as a good way to reduce the impact of droughts in the area.

1.2.3 Farmers also felt that they are unable to cope with CC because they lack perennial wells which provide them with water throughout the year. Therefore they mentioned digging of wells and family ponds for domestic use as one way of dealing with the problem.

1.3 Project's Responses:

Although the project is not an infrastructure investment project, which cannot build dams and roads, it will demonstrate how to build climate-resilient irrigation systems that can withstand the impacts of increased climatic hazards like storms and floods. In this regard, O Khsan irrigation system has been identified in Teuk Krahom to demonstrate this.

Water pumping machines are needed by farmers to pump water but it would not be sustainable for the project to provide these. Instead the project will look at appropriate technologies which can deliver the same services at an affordable price. The project is already discussing with some local NGOs to conduct trials on wind powered pumps and possibly solar powered pumps

With regards to wells, the project will consult with the Department of Rural Development on how it can best provide clean water in a sustainable manner. The project can drill new wells or can explore means of brining clean water from the nearby mountains as suggested by some of the villagers. Nevertheless the project will not engage in family ponds as these activities would benefit individual households rather than the whole community, except in circumstances where the project demonstrates an appropriate technology.

2. AGRICULTURE PRODUCTIVITY

2.1 CC Impact on Agriculture:

2.1.1 Most farmers see droughts as having a substantial damage to agricultural production. This includes damage to rice seedling during the nursery season before the rice is transplanted; drought and water stress results in low milking of rice grains and consequently provide low yields. Some farmers also mentioned an increase in insect attack in relation to climate change.

2.1.2 Droughts also affect other crops, largely the inability to grow them when there is lack of water.

2.1.3 Lack of seed was also identified as being an issue; when seedlings are wiped out, there is no new seed available for replanting.

2.2 Farmers' suggestions:

2.2.1 *Crop diversification:* This spreads the risk of dependence in single crop, rice. Farmers asked for crops like cassava, beans, vegetables and fruit trees. They also mentioned livestock and fish-raising as other examples of diversified agriculture.

2.2.2 *Agriculture Extension:* In addition to crop diversification, farmers also felt that their vulnerability could improve if they were given the skills to grow rice better and to grow other crops and to raise livestock.

2.2.3 *Improved seeds:* Farmers also felt the improved rice varieties could also reduce their vulnerability. Here improvements made reference to high yielding varieties, early maturing and drought resistance.

2.3 Project's Responses:

Some of the suggestions on how the score can be improved have already been initiated in the planned project activities. For instance, the project is currently conducting trials on rice varieties resistant to droughts and floods. However the project could take a step further by including seed multiplication and seed selection so that the improved seed can reach more people more cheaply and easily. This would improve access to improved seed and increase the resilience of farmers' rice seed to droughts, in the case of Teuk Krahom commune. Farmers report that they have to buy new seed every three or four years as the seed get diluted through cross pollination and yields decline. The reason for this decline is the mixing of different rice varieties from the neighbouring fields. The early indications from the rice trails conducted with the Cambodian Agriculture Research and Development Institute (CARDI) show that farmers are very keen to access the improved rice seed.
The project could also do trials on early maturing and high yielding varieties in addition to flood and drought rice varieties.

In addition, the project plans to conduct an assessment study on rice farming practices best fit for drought-prone areas, like Teuk Krahom. Based on the findings, the project will demonstrate these farming methods and promote the methods best recommended by farmers. Furthermore, as the project is being implemented in partnership with the IFAD/

UNDP Rural Livelihood Improvement programme, extension services on improved farming practices of growing rice and other crops and vegetables can be done with assistance from the RULIP programme which is already engaged in some of these activities.

With regard to requests for livestock management and aquaculture, the project will demonstrate aquaculture through community and household ponds. The project will also explore the possibility of bringing in disease resistant animals, discussed under animal health below.

3. ANIMAL AND HUMAN HEALTH:

3.1 CC Impact on Health:

3.1.1 Farmers overwhelmingly felt that CC (droughts) causes animals to get sick. Although there have been many studies about the impacts of climate change on agriculture and human health, there is very little done on the impact of climate change on livestock. However, in the target areas, the negative impact of droughts featured highly in the responses from both women and men. The diseases mentioned by the farmers include Newcastle diseases in chickens, foot and mouth and haemorrhagic septicaemia in cattle and buffalos.

3.1.2 Climate change affects human health in form of diarrhoea, stomach problems etc. The farmers indicated that human health is exacerbated by lack of health centres, and lack of medicines.

3.2 Farmers' suggestions:

3.2.1 *Health centres:* Farmers felt that their health could be improved if a health centre was build in their area.

3.2.2 *Sanitation:* Some were; however, able to see the root causes of poor human health in a changing climate and asked for water filters for clean drinking water, clean water wells, latrines, and health care extension.

3.2.3 *Disease Resistant Animals:* With regard to animal health, farmers asked for disease-resistant animals. Chickens and pigs make up the bulk of animals raised in the target commune, although some cattle and buffalos also exist.

3.2.4 *Livestock management:* In addition to this, farmers also asked for more village animal health workers and vaccination programmes.

3.3 Project Response to the Problem:

The project has neither adequate funding to build a health centre nor the technical expertise to provide health services and so it will not be able to address this request. The project can; however, look at possibilities of providing water filters and clean water. However rather than providing these filters for free; the project can link the distribution of water filters with the saving groups. Money realised from the sale of these filters would contribute to savings funds. The project will further discuss with provincial project partners whether it should engage in health education considering that none of the collaborating partners are experts in public health. An alternative would be to link the farmers with NGOs engaged in this discipline. Farmers mentioned that some NGOs provide services in health and sanitation (medicines, latrines, water filters, health education) as well as in agriculture (vegetable seed, livestock management etc)

With regard to animal health, the project will collaborate with RULIP on how to improve the services on animal health. The RULIP is engaged in livestock management (chicken-raising and pig-raising) these activities could be extended to the NAPA Follow-up areas.

4. NATURAL RESOURCE MANAGEMENT

Although the impact of CC on natural resources like forest was not mentioned, farmers highlighted the importance of forest in coping with the impact of CC.

4.1 Farmers' suggestions:

4.1.1 Protected forests were mentioned particularly by farmers from Teuk Krahom and Chat Taing villages as one way farmers are able to cope with the impact of droughts on crop production. When there is food shortages, farmers go to collect rattan shoots, fruits for food and to sell.

4.1.2 These farmers felt that their vulnerability could be reduced if trees were re planted and if forests were managed better.

4.2 Project's Responses:

Forests can generate many goods and services which can assist communities living in and round forests to cope with the impacts of CC. Farmers are able to supplement their liveli hoods from agriculture with forestry products for food and income and forest resources can become even more important when primary livelihoods (agriculture) fail. In addition,

forest plays a key role in eco-systems services like water cycle regulation and water sheds, and soil protection which has a direct bearing on agriculture if eco-systems are disturbed or deteriorate due to CC. Decrease in forest goods and services could negatively impact on the community and increase their vulnerability to CC. Project activities would therefore have to take into account that protected forests play in providing alternative livelihoods and the environmental services in relation to agricultural productivity by ensuring that forests are maintained and protected.

The project could respond to this request by collaborating with another UNDP-funded project being implemented in the same commune. The Conservation Areas through Landscape Management (CALM) implemented by Wildlife Conservation Society (WCS) with the aim to respond to threats to the outstanding biodiversity of the northern plains and focuses on three key objectives: 1) strengthening biodiversity management by government at key sites; 2) Incorporating biodiversity considerations into provincial level land use planning; and 3) establishing incentives for communities and local businesses to support conservation. Further discussion with the project team and the CALM project staff could map out a way on how to collaborate on forest management.

5. VRA FINDINGS FOR BOS LEAV COMMUNE

Kratie is known for regular floods and storms, but this province is now also experiencing more droughts .

5.1 Background

Bos Leav commune is located in Chit Borey district in Kratie province. It has a total of about 1503 people. The commune has a total of eight villages, namely Bos Leav Kroam, Bos Leav Leu, Lvea Tong, Preah Kunlong, Prek Ta Am, Prek Kov, Prek Ta Thoeung and Ta Lus. Two-hundred and fifty-three villagers (148 women) from all the eight villages participated in the VRA exercise representing just over 3.5% of the Bos Leav commune population. Some parts of the area cultivate rain season rice while others practice recession rice, which is rice planted after the flood water has receded.

Before conducting the VRA a trend analysis was done in order to assess if people had noticed changes in the climate over a period of time and also identify which climate change hazard affected people the most in Bos Leav commune. The trend analysis identified droughts, floods and storms as major threats to livelihoods in the commune.

5.2 Trend Analysis and types of climatic hazards

Villagers in Kratie-Bos Leav commune identified three main hazards that impact their lives and livelihoods:

Floods: The frequency and the length of floods on the targeted villages are high but they seem to have stayed steady since 1980s. In other words, farmers have not noted major increases in floods over the past 30 years. Nevertheless, floods negatively impact their livelihoods by destroying their crops. In this area, farmers noted that, like with floods, the impact on crops is high but also steady over the past years. In other words, the impact on crops has been high but the same over the past 20 years. In addition to destroying crops, floods also make roads inaccessible thereby disrupting the mobility of farmers and school-going children. Extreme flooding also affects homes, while animals and people have to be evacuated to higher grounds by the use of boats.

Droughts: The frequency and the length of droughts were noted as increasing over the past 30 years. The impact of droughts on crops also mirrors the increase reflected in the frequency and length. In some villages, the impact of floods on crops is as high as the impact of droughts and in some villages, they even surpassing that of droughts. It should be noted that all the villages rated the impact of droughts on crops extremely high in the last five years and this could have been influenced by the droughts that was experienced in 2010 at the beginning of the rainy season. The findings on droughts, however, have a bearing on the assumption made in the project strategy that CC resilience in floods conditions would be demonstrated in Kratie and drought conditions in Preah Vihear as two contrasting CC hazards. In this case the project will have to engage in activities that bring adaptive capacity to both floods and droughts in Kratie.

Storms: Storms, in form of heavy rains and high wind, were also cited by some of the village as a climatic hazard that affects their lives. Unlike the case with floods and droughts, villagers were not asked to rate the frequency of storms. However they noted that storm destroy their homes and sweep away their boats.

5.3 Climate Change Risks in Bos Leav

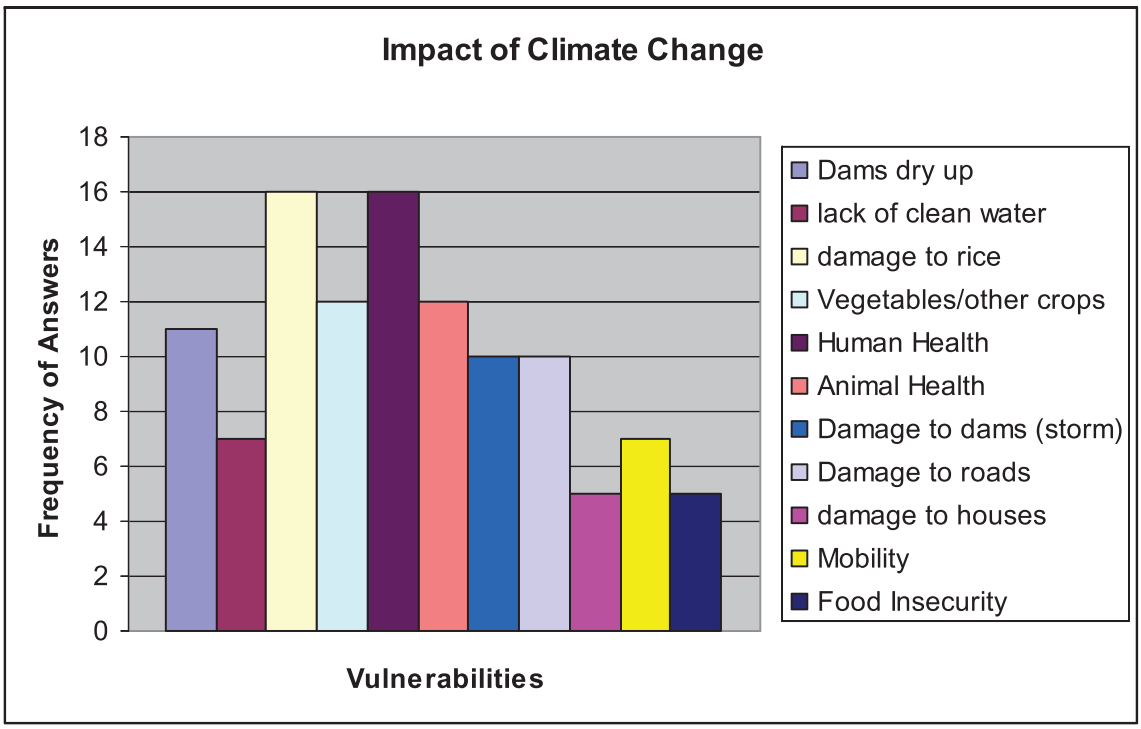
Question 1: **What current experiences do you face because of climate change? And what is the effect on your lives?**

Six main areas, based on the frequency of answers provided by the villagers, were identified as being most impacted by climate change, specifically by droughts and dry spells:

1. Damage to rice;
2. Negative impacts on human health;
3. Negative impacts on animal health;
4. Damage to other crops;

5. Irrigation systems dry and impacts on water availability for irrigation
6. Damage to infrastructure (dams and roads)

Figure 5.1: Impacts of Climate Change on Bos Leav Commune



As indicated in the figure above, men and women in all the eight villages, see CC as posing the biggest threat to rice yields as well as human health. Farmers indicated that droughts and floods scorch seedling in the nursery and in the field. While floods submerge and kill rice. In addition, droughts and dry spells during the milking stage, affect the grain development resulting in low yields. With regard to animal health, most farmers link floods with increased incidences of malaria and dengue, both of which are mosquito-borne diseases. The second area to be affected by CC is animal health and damage to other crops. For the later, farmers mentioned that droughts and floods negatively affect vegetables, maize, sesame and bananas which are also grown in the target areas. Droughts and heat also result in sickness and high deaths of buffalos, cattle, pigs, chickens and ducks. In addition floods and storms also sweep away animals particularly where farmers have no high ground to shelter their animals.

The third area highly affected by CC is water resources. Although Kratie is endowed with natural lakes and dams, water resources dry up due to droughts. Some farmers also mentioned that the dams are drying up because they are becoming too shallow because of increased siltation due to deforestation. The shallower the dam, the less water it can hold and consequently the less water availability irrigation during dry spells and in the dry season. Fourthly, floods negatively affect rural infrastructure in the target areas. Dams and roads are the most commonly affected, although houses too are destroyed. Ruined dams can

no longer hold water while submerged roads impede the mobility of school-going children, and of farmers trying to access to markets to sell agricultural produce.

The VRA answers for this question has some differences between women and men groups particularly in relation to CC impact on irrigation systems, animal health and rural infrastructure. Men see CC, particularly droughts, as drying up irrigation systems in the target areas. In addition more men than women see CC related droughts and heat as attributing to animal sickness and death. Women on the other hand mentioned floods and storms as causing infrastructural damage to canals, roads and homes.

The H-Form below shows an aggregate of all common answers provided by the men and women groups from all the eight villages.

Table 5.1: A summary of most frequent answers provided for Q1

Reasons for negative answers	Question 1	Reasons for positive answers
1. Low yields due to damage to rice by floods, droughts resulting in food insecurity. 2. People's health is affected negatively 3. Animal health is affected negatively. 4. Water resources dry up, affecting the quantity and quality of water for irrigation and household use is affected. 5. Damage to infrastructure (dams & roads). 6. Damage to house & loss of boats from storms. 7. Mobility for people, school children, and animals are affected by floods.	**What current experiences do you face because of climate change? And what is the effect on your lives?** **Score** **3.87** **How can the score be improved?** 1. By rehabilitating dams/lakes. 2. By improving access to early maturing, high yield and drought resistant varieties. 3. Agriculture techniques for rice and other crops, animal-raising & vegetable gardening, fish-raising. 4. By rehabilitating roads & bridges. 5. By clean water through providing water filters & wells. 6. Improved animal health services & vaccination (VAHW).	1. There are some village Animal Health Workers (VAHW). 2. There are many NGOs providing humanitarian aid like seeds, boats, houses, mosquito & fishing nets. 3. There is a health centre although some are far. 4. Some of the villages have evacuation shelter and grounds. 5. Existence of many dams and lakes. 6. Institutional support from government. 7. Access to improved seed like Sen Pidor, IR66.

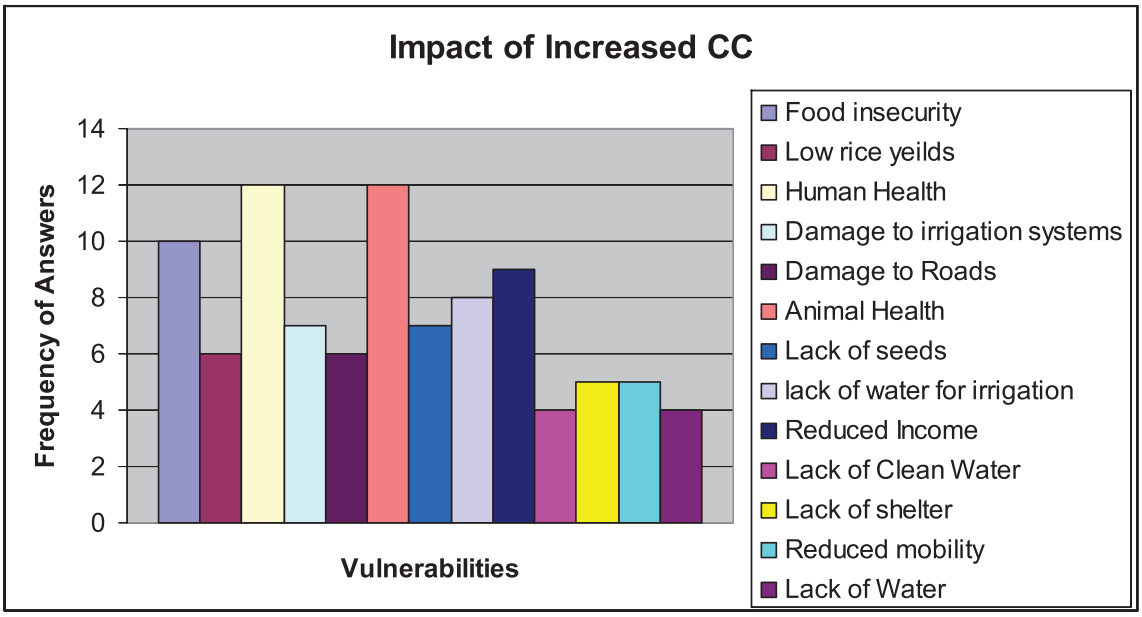
The middle section shows that VRA score for question 1, which is 3.87, on the scale of 1 to 5. Below the score, the H-Form shows farmers views on how the score of 4 above can be improved. A summative response on how the score for Q1, 2 and 3, and positive responses on the impact of CC are discussed below.

Question 2: **What would happen if droughts / floods were twice as frequent? How would this affect you and your community?**

Q2 tries to identify how people lives and livelihoods will be impacted upon if there are an increase in incidences and frequency of climatic hazards, (floods and droughts). In order of importance, farmers felt that increase in drought would negatively affect the following areas:

1. Human and animal health would be negatively affected
2. Increase in food insecurity due to low yields
3. Reduced income from low yields
4. Higher scarcity of water resources for people and animals

Figure 5.1: Potential Impact of Increased Climate Change



The graphic presentation of climate change impacts is captured in the figure above. Firstly, the impact of increased incidences of CC-related droughts and floods on human and animal health is rated as the highest by the villagers. Secondly, farmers also foresee higher food in security if droughts and floods increase as a result of CC. Food insecurity would stem from low rice yields. Thirdly, for the same reason as

crop failure from CC, farmers anticipate that their income would also reduce seriously. Fourthly, farmers expect water for crop irrigation to get scarcer if droughts persist.

There were some gender-related differences between answers provided by women and men. For example, women groups from four villages foresee increased incidences of climatic hazards as impacting on the availability of water for human and animal consumption. However none of the men mentioned this concern. Men on the other hand anticipate that shelter for animals (high ground) could become more of a problem if the frequency of floods increases, but only one woman group see this as a problem.

Table 5.2: A Summary of the Most Frequent Answers Provided for Q2

<table>
<tr><th>Reasons for negative answers</th><th>Question 2</th><th>Reasons for positive answers</th></tr>
<tr><td rowspan="2">1. More water resources would dry up leading to lack of water for irrigation, animals and household use.
2. Food and money shortages and debts as a result of low rice yields.
3. People's health would be affected more negatively.
4. Animal health would be affected negatively more.
5. Lack of seed for replanting.
6. Damage to irrigation systems.
7. Damage to roads.</td><td>What would happen if droughts and floods get worse?

Score
4.79</td><td rowspan="2">1. There is government support through PDA, PDOWRAM, PDOH etc.
2. Some villages have evacuation shelters.
3. There are many NGOs working in the target areas.
4. There are some Village Animal Health Workers (VAHW).</td></tr>
<tr><td>How can the score be improved?
1. By rehabilitating/building lakes & dams for irrigation.
2. By improving access to early maturing, high yield and drought resistant varieties.
3. By providing farming techniques for vegetable, animal and aquaculture.
4. Animal health through vaccines & medicine
5. Start-up stock for fingerlings, climate resilient animals & vegetable seeds.</td></tr>
</table>

Overall, farmers in Bos Leav commune feel that their current vulnerability of 3.87 (VRA score in

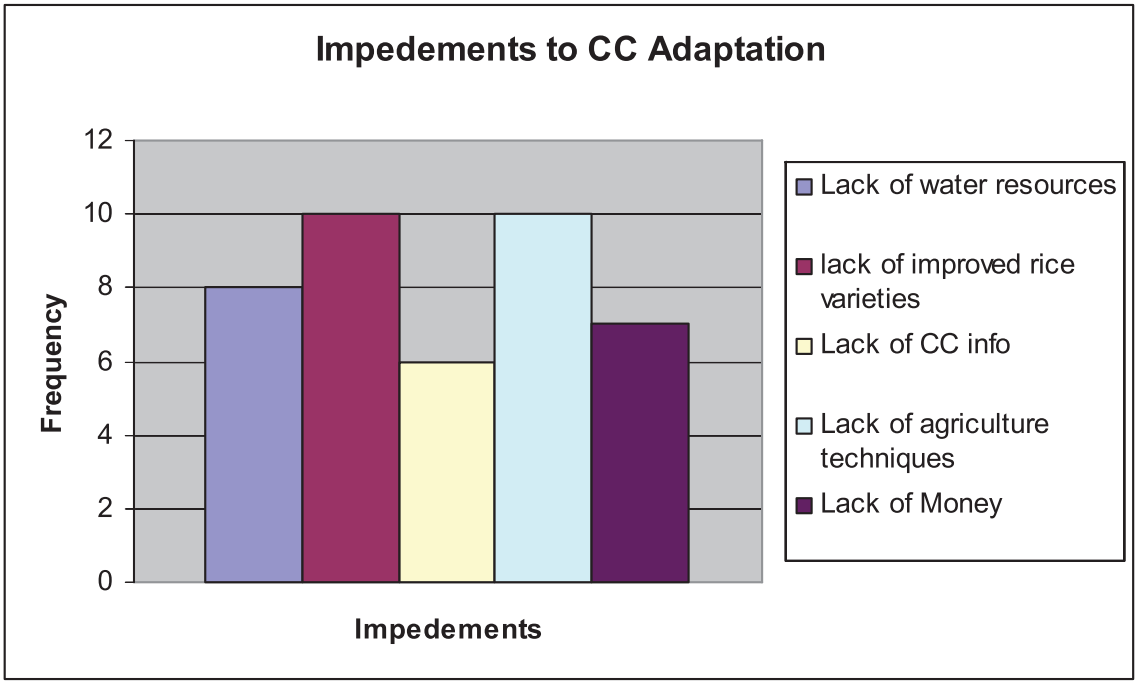
Question 1) could increase to 4.79, if drought and flood incidences are to increase because of climate change. How to improve this score is discussed below.

Question 3: **What stands in the way of adapting to increasing droughts? What means do you and your community have to manage events occurring more frequently?**

Overall main barriers include:

1. Lack of improved rice varieties;
2. Lack of agricultural techniques
3. Lack of water resources
4. Lack of money
5. Lack of information

Figure 5.3: Barriers to Climate Change Adaptation



Unlike the first two questions, answers to barriers that stop farmers from adapting to CC are less homogeneous. Nevertheless, lack of improved rice varieties is the highest impediment as it was mentioned by seven villages. Accordingly, farmers felt that their vulnerability could decrease if they had high yielding varieties, early maturing and rice seeds resistant to floods and droughts. Linked to improved rice varieties, farmers also felt that their vulnerability could reduce if they possessed the right agricultural techniques. Some farmers lamented the fact they have never received extension from government or NGOs. Concerning agricultural skills, farmers mentioned new techniques in growing rice, vegetables, raising-animals, as well as also fish culture.

Lack of water resources for irrigation systems, dams and family ponds are seen as another important hurdle that stops farmers from coping with CC in agriculture. Water would enable farmers to irrigate rice and other crops when there is a drought, dry spell or in the dry season. It should be noted that; however, unlike Teuk Krahom, most farmers here have access to dams and natural lakes. However, most of these are very shallow and dry up in the dry season. In addition the canals that carry water to the farmers' fields have also become shallow due to siltation. Lack of money was mentioned as a high barrier to CC adaptation. Farmers cited that they lack money to buy improved rice varieties; to practice diversified agriculture; to buy fuel for water pumps; to buy boats to use during high floods. Lastly, lack of CC related information is also seen as an impediment to climate change adaptation. Lack of information here relates to knowledge on agricultural practices, how to cope with floods and storms and early warning information for floods and droughts.

Table 5.3: A Summary of the Most Frequent Answers Provided for Q3

Reasons for negative answers	**Question 3**	**Reasons for positive answers**
1. Lack of improved rice varieties. 2. Lack of modern agriculture techniques and practices. 3. Lack of water resources for irrigation when farmers experience droughts. 4. Lack of money to cope with CC 5. Lack of farming knowledge on how to cope with droughts and floods.	**What prevents you from adapting to climate change?** **Score** **4.18** **How can the score be improved?** 1. Farming techniques for rice, pest management & livestock. 2. By improving access to early maturing, high yield and drought resistant varieties. 3. By providing support from government. 4. Through community participation. 5. By rehabilitating lakes, dams and ponds & enlarging flood gates for irrigation. 6. Providing early warning infomation. 7. Access to seed for other crops.	1. Access to improved seed. 2. Government support through PDA/PDORWAM. 3. Presence of NGO (CRC, PADEK) providing rice and vegetable seeds. 4. Presences of dams and lakes. 5. Community participation. 6. Community User groups. 7. Early warning information through radio. 8. Income generating activities like chicken raising; some climate change information is provided on provincial radio.

The H-Form above shows that the VRA score for Q3 is 4.18. This score mean that farmers in Bos Leav perceive themselves as highly vulnerable when they consider their capacity in adapting to CC

Question 4: **Rate your confidence that the project activities will continue after the project period?**

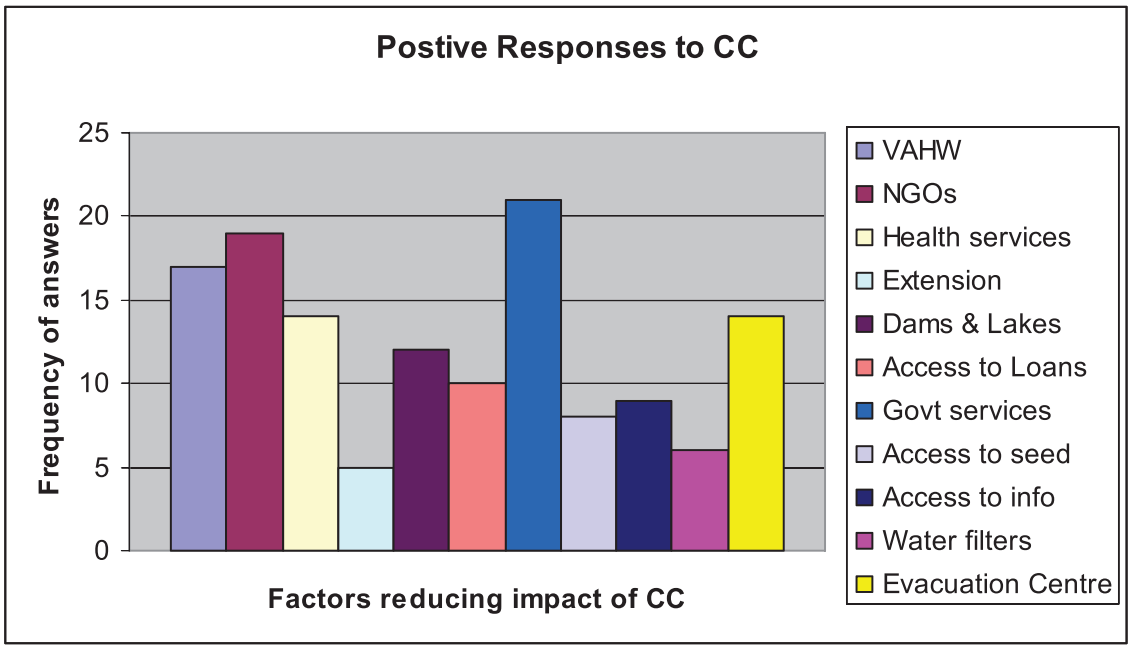
As is the case with Teuk Krahom commune, Question 4 was ignored.

5.3.1 Reasons for Positive Answers

Farmers in Bos leav pointed out the following areas as ameliorating the impact of climate change. (See figure below)

1. Government services
2. NGO presence and services
3. Village Animal Health Workers
4. Health services
5. Evacuation centres
6. Presence of dams and lakes
7. Access to loans

Figure 5.4: Factors Reducing the Negative Impact of Climate Change



Farmers in Bos Leav overwhelmingly felt that the activities engaged by different government entities play a key role in cushioning the impact of CC. PDA and PDoWRAM were cited as key government

institutions that provide seed and extension, and rehabilitate irrigation systems and provide water pumps respectively. Similarly, farmers appreciated the services provided by different organisations that operate in the area. Many NGOs[2] provide humanitarian aid relief in forms of boats, houses, water filters, seeds, fishing nets etc. Some of the activities extend beyond relief and include agriculture extension, health education, loans among other activities. Bos Leav has a larger number of NGOs operating in the area than Choam Khsan and engaged in disaster risk management because the area is also flood and storm-prone.

Most of the villages have village animal health workers who provide animal health services. Most villages seem to have access to health services although some villages mentioned that the health centres are too far. Evacuation centres were also provided by some NGOs and these serve both humans and animals in time of high floods. From the responses, it was noted that all the interviewed villages have access to some type of evacuation centre.

The target areas are also endowed by natural lakes, streams and man-made dams. Farmers view these resources as important in helping them cope with droughts and cultivation of dry season rice. Farmers also mentioned that they have access to loans through formal banks like ACLEDA bank, AMK bank; saving groups; and loans provided by NGO like PADEK, PRASAC etc.

5.4 VRA Score

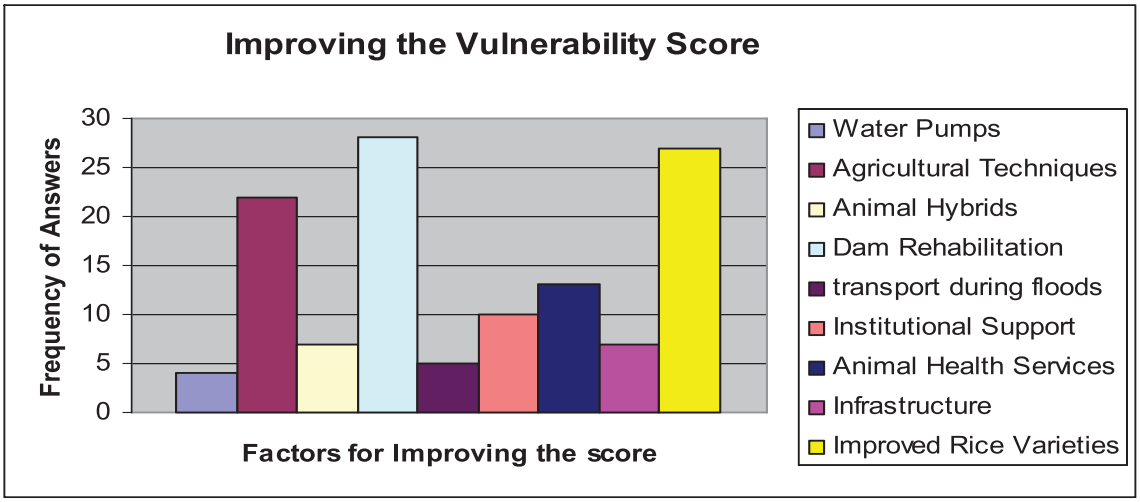
Based on the average VRAs of all eight villages, the VRA Index for Bos Leav commune is 4.28, which shows the villages are very vulnerable to floods, droughts and storms. All the villages have VRA score above an average of 4, with Preak Tatheong at 4.03 as the least vulnerable among the five villages and Bos Leav Leu and Preak Thkov at 4.57 as the most vulnerable among the eight villages. The results also show that the villagers who participated in the VRA think that their vulnerability will increase close to the maximum point 5 if there is an increase in floods, droughts and storms due to CC.

5.4.1 Improving the Score

After rating their own vulnerability, farmers were asked to give suggestions on how their vulnerability could improve. Below is a chart summarising the most frequent responses provided by the farmers.

2 NGOs operating in the area include: Cambodian Red Cross (CRC), Oxfam, PADEK, ACK, CHEK, CGA, PFP, ACUK and SCS.

Figure 5.5: Ways of Improving the VRA Score



In order of importance, farmers in Bos Leav feel that the VRA score can be improved by focusing on the following areas:

1. Rehabilitation of irrigation systems, canals & natural lakes
2. Access to improved rice seed varieties
3. Agriculture techniques
4. Access to animal healthcare
5. Institutional support from government and NGOs

In the chart above, both women and men groups from all villages indicated that the vulnerability in agriculture would improve if irrigation systems were rehabilitated. Irrigation systems here refer to natural lakes, man-made dams, canals, dykes and watergates. This is understandable when on considers that Kratie has quite substantial recession rice which requires irrigation in the dry season. Just like Preah Vihear, access to improved rice varieties featured as the second most important factor in improving adaptive capacity to CC in agriculture. Improved rice varieties include drought resistant, early maturing and high yielding varieties. Farmers in Bos Leave Kroam also asked for high-value rice seed. These are scented rice varieties, which sell for a higher price and usually destined for urban markets. The high importance put on access to improved rice varieties and water resources as main ways of improving the VRA score mirrors the main barriers to climate change adaptation (see table below) and also the general sentiments that CC impacts negatively on rice production highlighted in Question 1 and 2.

The third most important area for improving the score is acquisition of agricultural techniques in rice cultivation. The techniques here also extend to diversified agriculture including diversified crops like vegetables but also skills in livestock management and fish culture. In addition, some farmers asked to learn techniques in pest management and compost-making. Fourthly, farmers felt that improved access

to animal health care could reduce vulnerability to CC. Animal health care was expressed as vaccination for the animals, but also provision and training of Village Animal Health Workers (VAHW). The mention of animal health workers mirrors the vulnerability that farmers attach climate change to animal health as depicted in Question 1 and 2. Lastly, farmers felt that the VRA sore could be improved if there was more institutional support from both NGOs and government institutions. This opinion could stem from the fact that most of disaster risk response is done by the NGOs in these villages and so they could be seen as key in reducing the vulnerability of the villages.

The table below shows a comparison of barriers to CC adaptation and way of reducing CC vulnerability:

Table 4.4: A comparison between barriers to CC and ways of improving the VRA score.

Barriers	Improving the Score
1. Lack of improved rice varieties	1. By rehabilitating irrigation systems & lakes
2. Lack of agricultural techniques/skills	2. By providing access to improved rice varieties
3. Lack of access to water resources	3. Provision of agricultural services
4. Lack of money	4. Provision of animal health services
5. Lack of CC adaptation information	5. Institutional support

Surprisingly, access to health services, as a way of improving the VRA scores, was mentioned by only a few villagers despite the farmers viewing CC as having the most negative impact on human health (see charts 1 and 2 above). It is also possible that lack of money which was mentioned as a barrier to adaptation does not feature highly as a way of improving the score because farmers would most likely be interested in services they can access with money rather than just having money as an end in itself.

5.5 Analysis of the Data Collected

1. AGRICULTURAL PRODUCTIVITY

1.1 CC Impact on Agricultural Productivity

1.1.1 *Floods:* Villages along the Mekong in Kratie experience floods each year and farmers have adapted to these seasonal floods. As a result, rice is normally planted before or after (recession) the floods. However un-seasonal floods have a negative impact on the productivity of rice and other crops. Floods affect the rice when the floods are too high and the rice rots under water or un-seasonal floods.

1.1.2 *Droughts:* Droughts on the other hand seem to pose greater problems to the farmers. Droughts scorch seedlings if they occur during the earlier part of the

growing season. Farmers are usually able to replant; however, access to new seed for replanting was mentioned as a barrier to adaptation. Droughts and dry spells occurring in the middle of the growing season results in rice becoming water stressed, which in turn affects the milking and grain development resulting in low yields.

1.1.3 *Heat:* As discussed below under health, droughts and high temperatures also affect the health of livestock in the target villages.

1.2 Farmers' suggestions:

1.2.1 *Crop diversification:* Farmers mentioned that they would like to diversify their dependence on rice by cultivating other crops like vegetables, beans and maize, cassava and fruit trees. They also requested livestock and fish-raising as other examples of diversified agriculture.

1.2.2 *Agriculture extension:* In addition to crop diversification, farmers also felt that their vulnerability could be improved if they were given the skills in how to grow rice better; grow other crops; raise livestock, as well as aquaculture. They also requested skills in compost making and pest management. Some farmers mentioned that they have never received extension.

1.2.3 *Improved seed:* Farmers also felt the improved rice varieties could also reduce their vulnerability. Here improvements made reference to high yielding, early maturing and drought resistance varieties. Farmers mentioned rice varieties like Sen Pidor and IR66 as examples of improved seed. Some farmers also requested for high value rice seeds. These are aromatic rice varieties that fetch a higher price on the market. Access to these seeds is a high priority for farmers and in particular having access to extra seeds for replanting when their seedlings are wiped out.

1.3 Project's Responses:

1.3.1 *Diversified agriculture:* The project could do demonstrations in aquaculture in a way that benefits several families rather than individual households. However, a stable source of fingerlings would have to be established before engaging in aquaculture. The project could also encourage dry season cultivation through vegetable growing trials with women groups. This can be done in combination with drip irrigation allowing farmers to have an extra source of income during the dry season. The project could engage in livestock-raising and management, especially how to manage the bovine, poultry and piggery disease in partnership with the RULIP programme.

1.3.2 *Access to improved seed:* The project has already started conducting trials on rice varieties resistant to droughts and floods with CARDI. However the project could take a step further by including rice trials for high yielding varieties and high value varieties as requested by farmers e.g. Sen Pidor and IR66. In addition, seed multiplication of the farmer-preferred varieties could also improve access to climate resilient hybrids at a cheaper price as well as increase the resilience of farmers' rice seed to droughts and floods.
Seed multiplication can be combined with rice seed bank which allows farmers to have access to extra seed in cases where their seedling or rice fields are destroyed by floods and droughts and then need to sow rice again.

1.3.3 *Agriculture extension:* The project would have to ensure that extension is reaching the farmers as most Bos Leav farmers indicated that they do not receive any extension information. In response to farmers' demands, the project could also support PDA in providing extension on improved farming methods like SRI, deep placement fertiliser, the use of organic manure.etc for rice and other crops in collaboration with RULIP. Extension services would also have to include fish culture, fruit tree cultivation and livestock management. These activities could be incorporated into the current Farmer Field School curriculum spearheaded by RULIP. The proposed study on climate resilient farming practices will also shed more light on what the project could do in rice extension.

2. HUMAN AND ANIMAL HEALTH

2.1 CC Impact on Health

2.1.1 In Bos Leave commune, farmers felt that CC affects human health in form of malaria, dengue and diarrhoea. The farmers indicated that human health is exacerbated by lack of clinics or clinics being too far and lack of medicines.

2.1.2 Farmers also felt that CC (droughts[3]) also caused animals to get sick. Most of the diseases cited include foot and mouth and haemorrhagic septicaemia.

2.2 Farmers' suggestions:

2.2.1 *Sanitation:* despite human health currently being the most impacted by CC, very few villagers suggested health centres. Instead, farmers highlighted the need for clean water through water filters.

3 Droughts here are associated with high temperature and extreme heat which have also being experienced in Cambodia. Farmers have noted that diseases increase when temperatures are high and some animals seem to just die with the heat.

2.2.2 *Animal healthcare:* farmers felt that improved access to animal health care could reduce vulnerability to CC. Animal health care was expressed as vaccination for the animals, but also provision and training of Village Animal Health Workers (VAHW).

2.2.3 *Disease resistant animals:* In addition to vaccination and strengthening of VAHW, farmers also felt that access to disease resistant animals would improve their vulnerability.

2.3 Project's Responses

2.3.1 *Human health:* The project can look at the possibilities of providing water filters. However rather than providing these filters for free; the project can link the distribution of water filters with the savings groups to ensure sustainability. The money realised from the sale of these filters contribute to savings funds. With so many NGO active in the target area, water filters could alternatively be distributed through them as they will still be engaging with the local population after the project is closed.

2.3.2 *Animal health:* With regard to animal health, the project will collaborate with RULIP on how to improve the services on animal health. The RULIP is engaged in rural livelihood programme which includes livestock management (chicken-raising and pig-raising) these activities could be extended to bovine animals, as well the strengthening of VAHWs.

3. WATER RESOURCE MANAGEMENT

3.1 CC Impact on Water Resources

3.1.1 *Water for agriculture:* Farmers noted that droughts dry up natural lakes, dam and irrigation systems, which affects the amount for water available for irrigation for rice and other crops during dry spells and in the dry season. Storms and heavy rains also damage irrigations systems, which mean that the stored water for irrigation is lost. However the biggest problem in Bosleav seems to be siltation of irrigation systems as a result of erosion from the surrounding fields. This makes the dams shallow over time and therefore can only hold a limited amount of water.

3.1.2 *Water for Household Use:* Unlike Teuk Krahom, which is drier and has fewer

rivers, very few villages cited the drying up of well as an impediment to access to water for household use. However most of the villagers mentioned the deterioration of water quality during droughts and in the dry season as the main problem. And as a result water filters were mentioned as a possible solution to this problem.

3.2 Farmers' suggestions:

3.2.1 *Water for Irrigation:* Rehabilitation and deepening of lakes, dams, water gates and canals for irrigation, watering animals and for dry season cultivation was mentioned by all villages. Four villages mentioned the need for water pumps as a mean of reducing vulnerability to CC in water for agriculture.

3.2.2 *Water for Household use:* Farmers also highlighted the deterioration on water quality during the dry season and suggested water filters as a solution for clean water.

3.3 Project's Responses:

3.3.1 *Improved irrigation:* The activities under water resources management will have to be done in conjunction with agriculture. In other words, rehabilitation of irrigation dams would have to lead to increased crop production, either through irrigation during dry spells or irrigation for vegetables and other crops during the dry season. It should also be noted that unlike Preah Vihear, rehabilitation of irrigation dams is more linked with deepening of the systems which have become shallow due to siltation and so any work on irrigation systems should be accompanied by conservation of the dam and its surrounding areas. Although the project is not an infrastructure investment project and so can not build dams and roads, it will demonstrate how to build climate resilient irrigation systems that can withstand the impacts of increased climatic hazards like storms and floods. In this regard, Prek Ta Thoeung irrigation system has been identified in Bos Leav commune to demonstrate climate change resilience. In response to the request to pump water for dry season irrigation will explore appropriate technologies alternatives which can deliver the same services at an affordable price. The project will conduct trials on wind powered pumps and solar energy if affordable.

3.3.2 *Water for household use:* The project should first take note of which NGOs are providing these services and in which villages, where there are gaps the project could engage in the provision of water filters or could collaborate with appropriate NGOs to provide this service.

6. MAIN LESSONS LEARNED

This VRA collected major farmers' vulnerabilities to climate change and contributed to the project's action plans.

(i) In an ideal situation, VRA should be conducted before the formulation of a project document in order to reflect the views and the needs of the targeted communities. In this case the VRA was conducted after project design; however findings show that the project can still respond within the scope of the project framework, by modifying project work plan activities to meet the needs of the farmers.

(ii) VRA should as much as possible adapt to the local calendar. The project conducted the VRA during the growing season, which means that some of the most economically active people could not attend. And as a result their views may not have been well captured.

(iii) It is important to spend time to with the VRA facilitators to go through the VRA questions in the vernacular to ensure that the same level of understanding of questions and the terminologies used in the VRA. Terminologies like 'adapt' and 'predict' for example were not easily confused by the facilitators which in turn confused the villagers.

(iv) Question 4 should be asked during the midterm evaluation of the progress against vulnerability reduction. Asking the villagers if they have confidence in a project they have not yet seen or participated in its activities fully does not make sense.

Promoting Climate Resilient Water Management and Agriculture Practice in Rural Cambodia

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