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Local Demonstration Projects on Climate Change Adaptation

Final report of the first batch project in Cambodia

Mekong River Commission

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Climate Change and Adaptation Initiative (CCAI) Demonstration Site Project in Prey Veng Province, Cambodia

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ACRONYMS & ABBREVIATIONS

CARDI	Cambodian Agricultural Research and Development Institute
CCAI	Climate Change and Adaptation Initiative
CCCSP	Cambodia's climate change strategic plan
CCD	Climate Change Department
DSSAT	Decision Support System for Agro-technology Transfer
GCMs	Global Circulation Models
GIS	Geographic Information System
MRCS	Mekong River Commission Secretariat
NAPA	National Adaptation Programme of Action
PCDM	Provincial Committee for Disaster Management
PDA	Provincial Department for Agriculture
PDH	Provincial Department of Health
PDRD	Provincial Department of Rural Development
RUA	Royal University of Agriculture
PDWRAM	Provincial Department of Water Resource and Meteorology
SAPA	Sub-National Adaptation Planning of Action
SRES	Special Report on Emissions Scenarios
UNFCCC	United Nations Framework Convention on Climate Change

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EXECUTIVE SUMMARY

Cambodia is highly vulnerable to the impacts of climate variability and climate change. The country's entire agricultural production system is dependent on the annual flooding and recession of Tonle Sap Great Lake, and is therefore particularly sensitive to potential changes in local climate and monsoon regimes. Records from 1982 to 2002 on droughts and floods clearly indicate that the provinces that are vulnerable to floods are equally vulnerable to droughts. Prey Veng Province is one of the provinces that is the most vulnerable to floods, hence also to drought.

The objectives of the *Study on Preliminary Climate Change Adaptation Planning for Implementation* in the four districts in Prey Veng Province were:

(i) to assess the impact of extreme climate events on socio-economic conditions, to assess climate hazards in order to assist and support the local authorities and stakeholders in local planning and decision making, and to provide supporting methods and tools for adaptation planning to address climate change;

(ii) to assess the vulnerability and adaptation in district level in order to develop action plan for adaptation to climate change for community based practice in integrating local knowledge and their experiences;

(iii) to build capacity and awareness raising on climate change, focusing on the vulnerability and adaptation assessment for the local authorities, the provincial departments and district levels and stakeholders, as well as on lessons learned and experience shared from the demonstration site project of MRC Climate Change and Adaptation Initiative (CCAI) for future national development.

The overall approach of the CCAI demonstration project focused on: (i) primary and secondary sources, such as data and information gathering from a review of publications such as reports, documents, policies and field surveys related to, inter alia, the status of the socio-economic situation, the demography, the natural resources, biodiversity, the environment, climate hazards and climate change activities in the province; (ii) the impact of extreme climate events on the district/community reflecting in the vulnerability index; (iii) climate modelling and downscaling from selection of both emission scenarios by climate data using reanalysis data from the PRECIS or MAGICC/SCENGEN program for the province; (iv) mapping of climate through the surfer mapping program including GIS in Prey Veng Province, which will be developed and used for the vulnerability and adaptation assessment; and (v) the SPSS (Statistical Package for the Social Sciences) program or Excel spreadsheets, which will be used for analysis from field survey data and information on climate hazards, economic activities and impacts, community-based adaptation practices and response to climate change.

The methodology was developed based on CCAI experience and principally involved six general steps:

- compiling information on Prey Veng Province and reviewing appropriate methods and tools for climate analysis and adaptation options;
- carrying out a Vulnerability and Adaptation Assessment in Peam Ro, Peam Chor, Preah Sdach and Mesang Districts through household survey and interviews;
- carrying out a Climate Change Impact Assessment of rainfall and temperature scenarios using two global circulation models and the PRECIS regional climate modelling system applied to Prey Veng Province;
- preparing the report on the Assessment on the Impact of Climate Change, Vulnerability and Adaptation in the Agricultural Sector, specifically for Rice Production;
- developing capacities of government, community and farmer stakeholders including exchange field visits with a focus on Pear Reang District, and Prey Veng provincial adaptation planning support;
- selecting the drought-prone Prey Kandeang village for reconstruction of a reservoir to store water for domestic water supply and irrigation in the dry season.

The main achievements of CCAI demonstration project included: (i) the identification of key problems, establishment of the baseline and compilation of supporting methods and tools for climate change adaptation assessment; (ii) the completion of a survey on the household and gender and a vulnerability and adaptation assessment in Peam Ro, Peam Chor, Preah Sdach and Mesang Districts, Prey Veng Province, Cambodia; (iii) the completion of the study on the Assessment of the Impact of Climate Change, Vulnerability and Adaptation on the Agriculture Sector, specifically for Rice Production in Prey Veng Province; and (iv) the application of the approach of the Climate Change Adaptation Planning initiative, which integrates adaptation planning into their provincial investment plans and department programmes and projects. In addition, five training workshops strengthened the capacities of stakeholders at the national and sub-national levels and three consultation meetings were held with stakeholders for the CCAI project.

The CCAI project had a positive impact on four districts – Peam Ro, Peam Chor, Mesang and Preah Sdech, including approximately 195 direct beneficiaries associated with pond restoration. The CCAI demonstration site project improved the capacity of the local authorities and stakeholders in Prey Veng Province to conduct an impact assessment of climate change and a vulnerability and adaptation assessment, and to draw on lessons learned from adaptation planning to assist

the stakeholders in strategy preparation and development in Prey Veng Province's Planning of Action.

The direct and indirect beneficiary stakeholders of the training workshops and awareness-raising activities on climate change adaptation included the poorest smallholder families, small land-holding families and women. They also included sub-national government officials from the Departments of Agriculture, the Environment, Rural Development, Water Resources and Meteorology as well as the Disaster Management Committee, the provincial Red Cross, the district authorities, commune councils, village chiefs and other local stakeholders.

In Prey Kandeang village, the CCAI team involved villagers in addressing critical water supply issues. The CCAI demonstration project presented a current adaptation demonstration linked to the future climate change adaptation at the sub-national level, which included an adaptation planning initiative for the province.

One of the final outputs was the *Adaptation Planning on Climate Change Initiative at the Sub-National Level (Prey Veng Province), February 2013*, a document that sets out a vision of resilience in the face of a changing climate to ensure that provincial departments involved continue to achieve their missions and programme goals, and to operate in a secure, effective and efficient manner in a changing climate. The process and mechanisms to implement the proposed provincial strategies need to be further defined and developed.

The key lessons from project reports related to the need to: (i) ensure greater local participation in adaptation design and implementation; and (ii) exchange experience and lessons learned from the project with other projects in the country and abroad. The main lesson to be drawn is that there are effective methods and tools to establish subnational climate change adaptation in Cambodia provided that there is widespread capacity development and local engagement. The project provided high quality analyses based on downscaled modelling and projections of local agricultural impacts at the provincial level. However, the approach requires further validation to determine replication potential for other provinces.

The final report presents five recommendations:

1. The MRC-supported CCAI local demonstration project can learn from other similar climate change adaptation projects under Cambodia Climate Change (CCCA) Trust Fund. Sharing experience from project to project in the country and abroad would enhance capacity and knowledge on effective approaches to adaptation.

2. The approach, methods and tools for subnational climate change adaptation that have been developed and tested in this project should be replicated and upscaled to other target areas of CNMC,

consistent with the National Adaptation Programme of Action to Climate Change (NAPA) and Cambodia's Climate Change Strategic Plan and in consultation with key stakeholders for the next batch of local demonstration projects.

3. The provincial adaptation planning framework should be further developed to integrate adaptation planning into provincial investment plans and department programmes. Projects will be based on: (i) a clear strategy and policy statement; (ii) an understanding of the best available, actionable climate change science; (iii) prioritization and implementation of adaptive capacity and actions; (iv) lessons learnt from monitoring and evaluation feedback on the effectiveness of actions; and (v) awareness raising at the national level.

4. Key stakeholders from different line agencies at the national and sub-national levels should identify and assess the effectiveness of appropriate measures based on local experiences in order to incorporate climate change adaptation considerations into planning processes at provincial departments in Prey Veng Province.

5. Follow-up monitoring, evaluation and adjustment should be undertaken at the project-sponsored community pond at Prey Kandeang village.

1. BACKGROUND

The Climate Change and Adaptation Initiative (CCAI) of the Mekong River Commission (MRC) resulted from a decision of the 14th MRC Council meeting in 2007, calling for a regional cooperation initiative to address the challenges of climate change. The MRC Joint Committee (JC) at its 29th meeting held in Thailand on 25-27 March 2009 endorsed the CCAI concept note and the logical framework. The Concept Note, which was prepared in early in 2008, sets out various initiatives on climate change adaptation activities. These include the development of a long-term MRC CCAI based on an extensive in the country and regional consultation processes to identify the current status of climate change adaptation, the gaps, and the priorities of Lower Mekong Basin (LMB) countries. The CCAI is a long-term initiative, which will continue until 2025 and is directly linked to the cycle of MRC's Strategic Planning process. The CCAI Framework Document provides a detailed design for the first two phases: an Intermediate Phase until the end of 2010 and the first, full five-year phase from 2011 to 2015. The following two five-year phases will be developed based on lessons learned from implementation from the previous phases.

Cambodia is highly vulnerable to the impacts of climate variability and climate change. The country's entire agricultural production system is dependent on the annual flooding and recession of Tonle Sap Great Lake, and is therefore particularly sensitive to potential changes in local climate and monsoon regimes (Ministry of Environment [MoE], 2001). The coastline, 435 km long, and large parts of the Mekong River flood plain could be severely affected by a rise in sea level. As a tropical country, Cambodia is vulnerable to a number of tropical diseases such as malaria and dengue fever. A weak health care system combined with widespread poverty and a high illiteracy rate make people more vulnerable to diseases that may become widespread due to climate change.

The occurrence of droughts, floods and windstorms is becoming more common in Cambodia. The risk of these disasters may increase with global warming. Extreme climate events have had severe impacts on the Cambodian people and the national economy. In 2000, for example, heavy flooding killed 362 people, most of whom were children. Damage caused by the 2000 flood amounted to US$157 million; the 2001 flood killed 62 people and resulted in an economic loss of around US$30 million. Further, it is estimated that the 2002 Mekong floods killed 29 people and caused a total damage of over US$12 million (Cambodian Red Cross [CRC], 2008). Under changing climate conditions, these multiple hazards may occur more frequently and mostly affect the poor.

Typhoon Ketsana caused storms and subsequent flash floods in 14 out of 24 provinces in 2009. It left 43 people dead and 87 people severely injured, and 49,787 families were directly affected by losing their home and/or livelihoods. As many as 180,000 people were affected (directly or indirectly), or 1.4 percent of the population. Most of the affected districts are among the poorest in the

country. The widespread damage to property, livelihoods and public infrastructure in these areas will have a long-term impact. The World Bank (2010) estimated a total of around US$132 million in damages and losses caused by Typhoon Ketsana, which US$58 million in damages and US$74 million in losses.

Prey Veng Province is bordered by Kampong Cham Province to the north, Kandal Province to the west, Svay Rieng Province to the east, and Viet Nam to the south. It is crossed by two major rivers of the country, the Mekong and Tonle Bassac. The capital is Prey Veng town. In 2008, it had a total population of 947,357. The total land area of the province is 4,883 km^2 (2.7%) of the total land area of Cambodia (181,035 km^2). This consists in 445.18 km^2, (9.12%) of human settlements, 3,100 km^2 (63.49%) of agricultural land use, 194.61 km^2 (3.99%) of forested area and 1,082.86 km^2 (22.18%) of public land, infrastructure and water bodies. The remaining 60.35 km^2 (1.24%) consists in unused areas.

According to records of droughts and floods from 1982 to 2002, Prey Veng Province is one of the provinces that is the most vulnerable to floods. Provinces that are vulnerable to floods are equally vulnerable to droughts. The vulnerability and adaptation assessment component of Cambodia's United Nations Framework Convention on Climate Change (UNFCCC) Second National Communication (SNC) has addressed the impact of vulnerability and adaptation (V&A) to climate change, and has identified gaps and needs concerning V&A assessments during the stocktaking exercise, taking into consideration the outputs of the National Adaptation Programme of Action (NAPA).

The CCAI project addresses adaptation in four districts – Peam Ro, Peam Chor, Mesang and Preah Sdech, including the involvement of approximately 195 direct beneficiaries in pond restoration. Direct and indirect beneficiaries through a number of training workshops included the poorest smallholder families, small land-holding families and women. In addition, beneficiaries include sub-national government officials from the Departments of Agriculture, the Environment, Rural Development, Water Resources and Meteorology, as well as the Disaster Management Committee, the Provincial Red Cross, the district authorities, commune councils, village chiefs and other local stakeholders. The direct beneficiaries played an important role in disseminating lessons learned and good practices to the other stakeholders and smallholder farmers in their communities. The CCAI National Project Team worked closely with all of the beneficiaries in this project implementation to ensure that the project was aligned with the priority issues and real needs of the local community.

2. GOAL & OBJECTIVES

The CCAI Cambodia local demonstration project was initiated as a *Study on Preliminary Climate Change Adaptation Planning for Implementation* in the four districts in Prey Veng Province. The goal was to demonstrate sub-national adaptation planning and action. The specific objectives were:

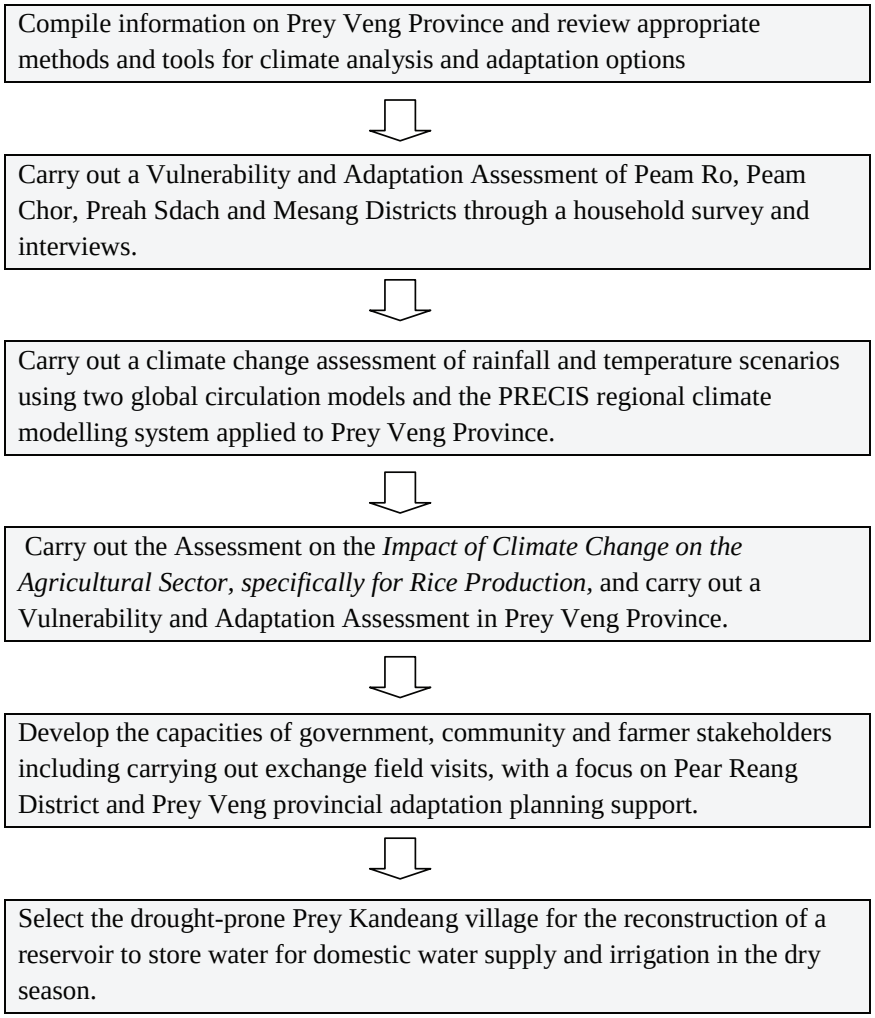
1. Assess the impact of extreme climate events on socio-economic conditions and climate hazards, assist and support the local authority and stakeholders in local planning and decision making, and provide methods and tools for adaptation planning to address climate change.

   Conduct a vulnerability and adaptation assessment at the district level in order to develop an action plan for climate change adaptation for community-based practice in integrating local knowledge and experiences.

2. Build capacity and raise awareness on climate change focusing on the vulnerability and adaptation assessment among the local authorities, the provincial departments, district levels and stakeholders, and draw on lessons learned and share experiences from the demonstration site project.

3. METHODOLOGY

The overall methodology was developed based on CCAI experience and principally involved six general steps:



The project started by identifying the key problems, establishing the baseline and compiling supporting methods and tools for climate change adaptation assessment. Methods and tools were reviewed from available documents and other sources of research related to: (i) the status of socio-economic development, the natural resources and biodiversity in Prey Veng Province; (ii) the present situation and outlook of the development of strategies, policies, plans or programmes and institutional arrangements concerned in climate change adaptation; and (iii) supporting methods and tools for adaptation planning and for raising awareness among concerned provincial departments and all key stakeholders. A ranking system was used to select the districts and communes for a preliminary study.

The assessment of the impact of climate change, vulnerability and adaptation in the agricultural sector was initiated using two global circulation models (GCMs) and the PRECIS regional climate modelling system (UK Met Office) data covering the entire Mekong River Basin. The models were used to project rainfall and temperature, and to assess impacts on agriculture and water resources, and the vulnerabilities anticipated in Prey Veng Province. The technical analyses involved five steps, as follows.

The first step was to reconstruct long-term historical climate data using analysis data from PRECIS downscaling. This analysis was performed to compensate the data gap[1]. The second step was to validate the reconstructed data using observation data. The third step was to use the observation and reconstructed data to assess historical climate change. The fourth step was to develop climate change scenarios with two emission scenarios, the Special Report on Emissions Scenarios (SRES) A2 and B2. The GCM model was run by the Southeast Asia System for Analysis, Research and Training Regional Center (SEA START RC) with a resolution of 50 x 50 km. Finally, the fifth step was to map changes in past and future climate using GIS. The general process is outlined in Figure 1.

A local survey method was adopted to identify vulnerability and adaptation characteristics. The Vulnerability and Adaptation Assessment, a field survey of households, the local authorities, concerned institutions and gender, was based on questionnaires and observations, and also the use of Participatory Rapid Appraisal (PRA). The resulting report, *Household and Gender Survey and Vulnerability and Adaptation Assessment in Peam Ro, Peam Chor, Preah Sdach and Mesang Districts, Prey Veng Province, Cambodia,* represents a major effort inprofiling and assessing climate impacts in the four districts. The review of changes in the frequency and intensity of extreme events such as natural hazards, floods and droughts concentrated on an economic loss caused by flood and droughts, agriculture, husbandry, rural infrastructure and health as well as coping and climate change adaptation mechanisms.

The impact of changing climate on rice production in Prey Veng Province was evaluated using several steps of analysis. The first step was to analyse the trend of rice production in the main rice growing areas of the province. This analysis was performed using regression techniques using the year as the independent variable, and wet season and dry season rice productivity as the dependent variable.

[1]The PRECIS climate data used in the study are the future climate projection daily data for two scenarios (A2 and B2) provided by the Southeast Asia START Regional Center (SEA START Regional Center) based on the ECHAM4 GCM from the Max Planck Institute for Meteorology, Germany, and downscaled to the Mekong region using the PRECIS system with a 0.2 x 0.2 oC grid cell (22 km x 22 km) for the study area in Prey Veng Province.

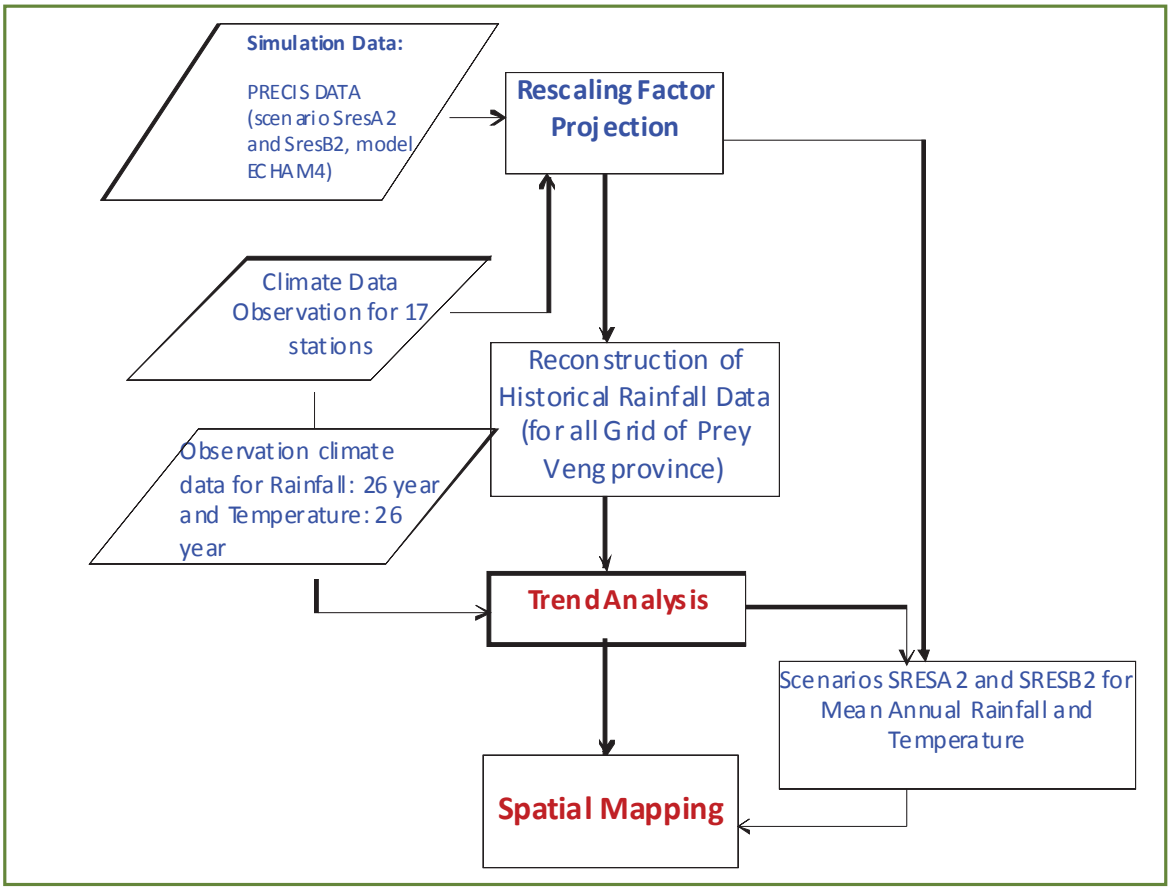


Figure 1:. *Climate Data Analysis Flow Chart*

The second step was a calculation of the anomaly of rice productivity (the difference between observation and estimated data derived from equation developed in step 1).

The third step was to develop a model for estimating anomalies of rice productivity from monthly rainfall in each province. Rainfall data from the two GCMs run under two emission scenarios of the PRECIS model were then used as inputs for the model developed in step three. This choice of analysis was motivated by the need to remove the impact of technology changes on rice productivity in the province. The outputs are documented in the report: *Assessment on the Impact of Climate Change, Vulnerability and Adaptation on the Agricultural Sector, Specifically Rice Production in Prey Veng Province*.

Capacity development of government, community and farmer stakeholders included carrying out exchange field visits to build capacity of institutions to help farmers better adapt to climate variability and change in an area in Pear Reang District, Prey Veng Province, with the assistance of the Royal University of

Agriculture (RUA) and Chea Sim University of Kamchaymear in cooperation with University of Queensland-Australia. The project also supported efforts to integrate adaptation planning into provincial programmes and plans in the *Adaptation Planning to Climate Change Initiative at the Sub-National Level (Prey Veng Province (February 2013)*. Sub-national key stakeholders were also encouraged to participate in project-level adaptation planning activities, capacity building and awareness raising on the important events of adaptation activities at the national and sub-national levels, as well as improving understanding of the adaptation planning process among provincial staff and officers in climate change adaptation planning.

Site selection criteria were developed to identify a specific demonstration site project based on consultation and focusing on the four targeted districts (Peam Ro, Peam Chor, Preah Sdach and Mesang). The criteria for selection included: (i) the presence of climate hazards such floods, droughts and windstorms; (ii) increased risk of extreme events and hazards; (iii) livelihoods that are the most vulnerable to climate hazard; (iv) agricultural activities mainly rice cultivation; (v) water use in the household and for other purposes *(agriculture and water resources, etc.)*; and (vi) the involvement of local government agencies, NGOs and stakeholders. Two possible local adaptation activity sites were identified, with CCAI National Project Team members visiting sites and interviewing commune council members and village chiefs. The discussions focused on a common set of problems including the impact of drought and flooding on rice production, and drinking water supply issues. This led to the selection of Prey Kandeang village for a field demonstration project due to floods and drought affecting rice yield and production, and severe water supply issues.

The proposed conceptual approach for adaptation planning for the province included a process to identify appropriate adaptation actions to respond to the risks identified in Prey Veng Province. Actions in this Adaptation Plan were determined by rescaling the climate change risk assessment and survey on vulnerability and adaptation assessment. Risks that had inadequate or no monitors in place were then evaluated, and appropriate actions were included in the Plan at the sub-national level for this specific province.

4. ACTIVITIES

The planned and the reported activities are summarised below.

Activity 1.1.1 *Conduct a review and collect information and data on the natural resources, biodiversity, the agricultural sector and current socio-economic conditions of Prey Veng Province.*

The CCAI national project team collected and reviewed documents related to the natural resources, biodiversity, agriculture and socio-economic status of Prey Veng Province. They prepared an outline of the key problems and baseline conditions, and reviewed the various methods and tools for assessing climate change adaptation.

Activity 1.1.2 O*rganise a consultation meeting with the local authorities and stakeholders, particularly provincial departments involved, in order to introduce the CCAI demonstration site project. This will also provide an opportunity to discuss in detail the key problems and issues for comments, recommendations as well as feedback to be verified at the specific site for communes and villages in four target districts of Prey Veng Province.*

The national project team organised a series of consultation meetings related to this activity such as: the kick-off meeting on "Implementation of the Demonstration Project in Prey Veng Province" (20 December 2010), Prey Veng Province; the CCAI Team Meeting on "Implementation of the Demonstration Project in Prey Veng Province" (20 May 2011), Phnom Penh; and the Sub-National Meeting on Site Selection of Demonstration Project in Prey Veng Province (29 July 2011).

Activity 1.1.3 *Review the current development of strategies, sectoral policies, plans and programmes related to key sectors in Prey Veng Province.*

The national project team reviewed a number of national documents such as: (i) the Strategic Plan of the Ministry of Environment (2009-2013) (MoE, 2009); (ii) the Strategic National Action Plan for Disaster Risk Reduction, 2008-2013 (SNAP) (NCDM & MoP, 2008); (iii) the Strategy for Agriculture and Water (2006-10), (2011-13) (MAFF & MoWRAM, 2007, 2010); (iv) the Rectangular Strategy for Growth, Employment, Equity and Efficiency in Cambodia (RGC, 2008) and other documents related to this activity.

Activity 1.1.4 *Synthesise all available, ongoing and planned activities of projects, programmes and initiatives related to climate change adaptation, climate hazards and disaster management in Prey Veng Province.*

The national project team also reviewed and summarised related ongoing and completed programmes and projects. It set the priorities of the districts in Prey Veng Province for 2009: climate hazards, national natural disasters, disaster management, consultation

meetings with the local authorities and stakeholders, and the development of the selection criteria fora specific demonstration site.

Activity 1.1.5 Analyse and assess information and data gathered to identify the key problems and establish the baseline for key target areas in Prey Veng Province.

The national project team analysed data and information collected in order to identify the key problem and establish the baseline for key target areas prior to conducting the V&A assessment of four districts. This was achieved through a consultation meeting with the local authorities and stakeholders, and from the information collected in the previous activity for the selection of the specific demonstration site.

Activity 1.2.1 Collect information and data on present and future climate change adaptation in Cambodia.

The national project team collected information and data on present and future climate change adaptation in Cambodia from the output of the Expert Meeting on National Adaptation Plans (NAPs) held in Vientiane, Lao PDR on 15-17 September 2011, which focused on: (i) the process to enable least developed countries (LDCs) to formulate and implement National Action Plans (NAPs), building on their experience in preparing and implementing National Adaptation Programmes of Action (NAPA); (ii) the modalities and guidelines for the LDCs and other developing country UNFCCC Parties to employ the formulated modalities to support future NAPs . The implications for Cambodia's climate change adaptation were taken into account based on NAPA and priorities for future NAPs.

Activity 1.2.2 *Review and synthesise current and planned strategies, sectoral policies, plans and programmes as well as available information and data related to climate change adaptation, in particular on the agricultural sector in Prey Veng Province.*

The national project team reviewed a number of documents related to climate, agriculture and water such as: (i) the agricultural sectoral policy and programme; (ii) the water resources sectoral policy, plan and programme; (iii) the three-year Investment Programme (2011-13) in Prey Veng Province; and (iv) the findings gathered by the Ministry of the Environment (MoE, 2009) in Prey Veng Province related to past and current climate change adaptation in Prey Veng (temperature and rainfall, extreme climate events, and infrastructure and social-economic impact by climate hazards and socio-economic impacts of extreme climate events).

Activity 1.3.1 *Review and select available outputs from available studies and assessments of the impact of extreme climate events and from the index of vulnerability.*

The national project team reviewed the assessments by the MoE (2010) on the data from the vulnerability index (VI) for the whole country including Prey Veng Province and changes in the vulnerability of communes from less vulnerable to extremely vulnerable during the 2006-08 period.

Activity 1.3.2 *Conduct a review and select the outputs of climate modelling and downscaling from PRECIS, MAGICC/SCENGEN or other programs for Prey Veng Province.*

The national project team reviewed and selected the outputs of climate modelling and downscaling from PRECIS or MAGICC/SCENGEN to be applied to Prey Veng Province by using past, current and future climate change in Cambodia. The review estimated average temperatures using the PRECIS model and change variance of monthly rainfall patterns.

Activity 1.3.3 *Identify and develop appropriate methods and tools of climate modelling and downscaling for adaptation planning in the province.*

The national project team produced the outputs from MAGICC/SCENGEN from modelling and downscaling. The output of the PRECIS data was produced by the SEA START Regional Centre for 2,225 grid cells covering the entire Mekong River Basin with a 0.2 x 0.2 degree resolution (equivalent to around 22 km x 22 km) and a 0.5 x 0.5 degree resolution (50 km x 50 km), which were considered appropriate for the Prey Veng Province impact assessment, risk and adaptation planning.

Activity 1.3.4 *Identify and develop appropriate methods and tools for assessing climate hazards, community and economic activities, infrastructure and adaptation options including the gender perspective.*

The national project team identified and developed appropriate methods and tools for analysing the climate model outputs, including rainfall data used for determining evapotranspiration potential. In order to evaluate the impact of climate change, the median of rainfall and temperature data of the 14 GCM models and the PRECIS model were run under two emission scenarios and three time periods as inputs for the soil water balance model for agriculture and water related to economic activity in agricultural production in the local community.

Activity 1.3.5 *Introduce and disseminate methods and tools for adaptation planning to concerned provincial departments and local authorities and other stakeholders.*

The national project team introduced and disseminated the appropriate methodology and tools for adaptation planning to stakeholders including: (i) the Guidebook for Community Vulnerability, Risk and Adaptation Assessment of the Impact of Climate Change (Inmuong, 2011); (ii) the report on Mainstreaming Climate Change Adaptation: Understanding Climate Change and Mainstreaming Climate Change Adaptation Practice and Tools for Mainstreaming Climate Change Adaptation (CARE, 2009); and (iii) A Toolkit for Designing Climate Change Adaptation Initiatives (UNDP, 2010).

Activity 1.3.6 *Summarise the results from methods and tools for adaptation planning.*

The national project team summarised the tools and methods for adaptation planning in order to evaluate climate change impacts, vulnerability and adaptation. The Tools and Methods Report was taken into account in adaptation planning in Prey Veng Province in: (i) the Guidebook on the Assessment of the Impact of Community Vulnerability, Risk and Adaptation to Climate Change; (ii) Mainstreaming Climate Change Adaptation: A Practitioner's Handbook; and (iii) A Toolkit for Designing Climate Change Adaptation Initiatives.

Activity 2.1.1 *Conduct a field survey on the impact of climate change as well as an assessment on vulnerability and adaptation to climate hazards (floods, droughts, windstorms, etc.) in Prey Veng Province, focusing on the four targeted districts.*

Activity 2.1.2 *Conduct a survey on assessing the impact of climate change, vulnerability and adaptation of the agricultural sector, focusing on the four targeted districts.*

(Activities: 2.1.1 and 2.1.2) The national project team conducted a field survey, the Household and Gender Survey, and Vulnerability and Adaptation Assessment in Prey Veng Province, Cambodia (CNMC, 2012b). The objective of the survey was to: interview, collect data and information on households and gender vulnerability and adaptation to climate change; assess vulnerability and adaptation of households; and integrate outputs into the preliminary climate change adaptation planning for implementation in the four districts in Prey Veng Province. The survey involved 172 respondents in four districts on 5-11 November 2011 (60% were head of households and 40%, members of households). The evaluation of the changes in the frequency and intensity of extreme events, such as natural hazards, floods and droughts, focused on the economic loss on agriculture, husbandry, rural infrastructure and health, as well as on mechanisms for coping and adaptation to climate change.

Activity 2.1.3 *Analyse data and information on climate hazards, economic activities, the agricultural sector, climate change impacts and community-based adaptation practices from field surveys and responses to climate change.*

A freelance consultant with support from the national project team analysed data and information using the SPSS programme and then an Excel spreadsheets based on a series of questionnaires. He consulted and helped draft a report on the field survey whose key findings are shown in Section 5 Results below.

Activity 2.1.4 *Assess an adaptive capacity and design adaptation planning.*

A freelance consultant with support from the national project team designed adaptation plan for Prey Veng Province, carried out an assessment on the following: Conference of the Parties (CoP 18) modalities of the NAP process; Climate Change Strategy Development Plan; Plan for Adapting to Climate Change; the Framework for Climate Change Adaptation Planning; Adaptation Planning and the Strategic Sustainability Performance Planning Process and Coordination; sharing lessons learnt; and development of common approaches. See the report, Climate Change Adaptation Planning Initiative at the Sub-National Level (Prey Veng Province) (CNMC, 2013).

Activity 2.2.1 *Develop the selection criteria and identify specific demonstration site activities based on consultation outputs focusing on the four targeted districts.*

The national project team developed the selection criteria and identified a specific demonstration site project based on consultation outputs focusing on the four targeted districts. The criteria for the selection of communes and villages focused on: (i) the presence of climate hazards such as floods, droughts and windstorms; (ii) increased risk of extreme events and hazards; (iii) livelihoods that are the most vulnerable to climate hazard; (iv) agricultural activities mainly rice cultivation; (v) water use in the household and for other purposes (agriculture and water resources, etc.); and (vi) the involvement of local government agencies, NGOs and stakeholders.

Activity 2.2.2 *Conduct a survey on climate hazards, economic activities and the impact of agriculture sector.*

Activity 2.2.3 *Assess climate change impacts, and conduct a vulnerability and adaptation assessment for the specific demonstration site.*

Activities 2.2.2 and 2.2.3. The national project team supported by the freelance consultant conducted the survey and assessed the impact of climate change on agriculture, including the target area. The assessment is presented in

the report, Assessment on the Impact of Climate Change, Vulnerability and Adaptation on the Agricultural Sector, specifically for Rice Production, in Prey Veng Province (CNMC, 2012a).

Activity 2.2.4 *Conduct adaptation planning as appropriate at the demonstration site with all stakeholders including the local authorities and communities in order to identify and select priority adaptation options to respond to climate change.*

At Prey Kandeang village, the CCAI team visited and consulted with beneficiaries. The team met with villagers who had dry-season rice fields and assessed the feasibility of rehabilitating an existing micro-canal for rice cultivation during dry season. After the site visit the CCAI team proposed a budget and action plan involving three steps.

Activity 2.2.5 *Set up the demonstration site project to rehabilitate community irrigation schemes or ponds in order to provide sufficient water for rice farming and households and to reduce the risk of crop failures due to water shortage for four districts in Prey Veng Province, Peam Ro, Peam Chor, Mesang and Preah Sdech.*

The national project team completed pond restoration in Prey Kandeang village. The CCAI team carried out in-depth consultations with villagers, local communities and stakeholders on addressing urgent water needs for households and rice farming to reduce risks caused by climate change for 195 beneficiaries on the site. The project was finished at the end of 2012, based on the urgent need of the local community for the pond restoration within the village. Subsequently, it carried out awareness raising to hand over the responsibility of managing the pond to the beneficiaries.

Activity 3.1.1 *Develop a stakeholder engagement and capacity-building plan at each level in the early stages of developing the tools and implementation of the demonstration project in order to target appropriate stakeholders.*

The national project team developed a stakeholder engagement and capacity-building plan, stakeholder engagement plan at national institutions and others; stakeholder engagement plan in the demonstration site; and stakeholder engagement plan in civil society. See details in the report, Assessment on the Impact of Climate Change, Vulnerability and Adaptation on the Agricultural Sector, specifically for Rice Production, in Prey Veng Province (CNMC, 2012a).

Activity 3.1.2 *Conduct awareness-raising campaigns on climate change, adaptation and gender mainstreaming for provincial key stakeholders and local communities, climate change concepts. Also, carry out an assessment on the impact of climate change, vulnerability and adaptation.*

The national project team raised awareness on climate change adaptation for provincial key stakeholders and local communities. In addition, the team strengthened awareness on adaptation to climate change and disseminated materials and documents related to climate change adaptation, including terminology, organize an official handover of the demonstration site on pond restoration to the local community in Prey Kandeang village.

Activity 3.1.3 *Follow nationally defined priorities, provide training/field visits to pilot sites in Prey Veng Province.*

Activity 3.1.4 *Conduct a number of exchange visits and on-site training for national demonstration project team.*

Activity 3.2.3 *Conduct a focused series of exchanges and field exercises for Cambodia as a visit to another river basin organisation to discuss and share experiences on climate change and adaptation for the next step.*

Activities 3.1.3, 3.1.4 and 3.2.3. The national project team exchanged field visits on 23-25 December 2012 to build capacity of institutions to support farmers to better adapt to climate variability and change in Prey Veng Province. See the report Field Exchange Visits for Building Capacities of Institutions to Help Farmers Better Adapt to Climate Variability and Change in the Cambodian Demonstration Project, Prey Veng Province (CNMC, 2012c).

Activity 3.1.5 *Increase technical capacity in the demonstration national project team (NPT) and target group at provincial level through training workshops and on-the-job training to build their capacity in using the above methods and tools reflected in innovation in adaptation measures to climate change.*

Activity 3.1.6 *Organise a provincial workshop on climate change and adaptation planning for all stakeholders for their better understanding and knowledge in order to develop the provincial action plan of climate change adaptation.*

Activities 3.1.5 and 1.3.6. The national project team organized a provincial workshop on climate change and adaptation planning for all stakeholders. See Workshop Proceedings: Strengthening Provincial Capacity in Policy Making and Planning for Climate Change Adaptation at Different Levels, Prey Veng Province, 19-20 October 2011 (CNMC, 2011)

Activity 3.2.1 *Train the national demonstration project team in application of the monitoring framework for assessing and reporting on the status of adaptation in Prey Veng Province.*

Activity 3.2.2 *Ensure mentoring and training by implementing partners of national experts in monitoring and reporting.*

Activities 3.2.1 and 3.2.2. The national project team organised a training workshop for national demonstration project team and provincial departments. See training workshop proceedings: Capacity Building for the Monitoring and Reporting Progress, and Lessons Learned on Climate Change Adaptation Planning in Prey Veng Province, 26-27 March 2012 (CNMC, 2012d).

Activity 3.2.4 *Enhance capacity and skills of national and local experts in communicating climate change messages in English and local languages.*

The national project team raised awareness and built capacities on climate change adaptation among provincial key stakeholders and local communities, using the local language for posters and other materials related to climate change adaptation dissemination, and ensure posters were designed in Khmer language.

Activity 3.2.5 *Clarify climate change terminology using national and local experts, and ensure translations into the national language.*

Climate change terminology was produced and submitted to CCAI.

Activity 3.2.6 *Prepare and finalise the final project report in collaboration with the MRC CCAI project team and experts associated with the next phase.*

The national demonstration project team drafted a final project report, which was submitted to the MRC's CCAI project team.

Activity 3.2.7 *Organise a workshop to present the result findings and lessons learned order to share the results with local, national and the MRC Member Countries as well as development partners.*

The national project team organized a final project workshop on the CCAI Demonstration Project on sharing the results and lessons learned of CCAI demonstration project with local, provincial and national stakeholders, and increasing awareness of climate change adaptation for provincial key stakeholders and local communities in Prey Veng Province, 25-26 March 2013.

5. RESULTS

5.1. Outputs

Seven key outputs were planned and produced:

1. The Report on Identifying Key Problems, Establishing a Baseline and Compiling Supporting Methods and Tools for Climate Change Adaptation Assessment.

2. The Report on the Household and Gender Survey, and the vulnerability and adaptation assessment on Peam Ro, Peam Chor, Preah Sdach and Mesang Districts, Prey Veng Province, Cambodia.

3. Report on Assessing the Impact of Climate Change, Vulnerability and Adaptation of the Agricultural Sector, specifically for Rice Production, in Prey Veng Province.

4. The adaptation plan and actions for Prey Veng Province.

5. The pond rehabilitation project in Prey Kandeang village.

6. Training workshops and an exchange field visit of the national project team to other CCA projects.

7. Development of capacities to monitor and report on progress and performance, and share lessons learned on climate change and adaptation including the Climate Change Glossary in both English and Khmer.

Each of the Outputs is described below.

Output 1.1: *Status of socio-economic development, the natural resources and biodiversity in Prey Veng Province for identifying key problems and establishing baselines related to activities*

This output was a broad overview of climate change-related conditions in Prey Veng Province, which was completed in 2011, as discussed in the preceding section. It provided the background information to set out the current context and main issues for climate change adaptation.

Prey Veng Province is located in the south-east, around 90 km from Phnom Penh. It is located in the Mekong River flood plain; the Mekong River forms the western border in most of the province. In 2010, the population was estimated at 1,143,211. Female-headed households accounted for approximately 20 percent of households in the province. The population density is 233 people per km2, with an average number of people per family of 4.6. Over 99 percent of the population living in the province are Khmer citizens; only 1.13 percent are the ethnic minorities, including Vietnamese, Islam and Laotian. There is severe poverty in the province, with 53 percent of the population living under the poverty line compared to 36 percent nationwide (Prey Veng Council, 2010, 2011; RDC & Winrock Int, 2007).

The province is located on the east bank of the Mekong River, which is the backbone of agriculture and the main transport route. It covers 2.5 percent of Cambodia's land area

and is one of the largest rice production areas in the country. It also produces other crops and also has significant fish, poultry and pigs (USAID, 2008). Prey Veng Province has two seasons: the dry and the rainy season. The rainy season generally starts in May and ends in October, and is followed by the dry season from November to April. During the rainy season, winds from the southwest carry heavy rains, which account for 90 percent of annual precipitation of the country. The dry season, which associated with the northeast monsoon, brings drier and cooler air from November to March and then hotter air in April and early May.

Earlier global climate models indicated that in Cambodia: mean annual temperatures could increase between 0.3 and 0.6°C by 2025 and 1.6 and 2.0°C by 2100; and mean annual rainfall could increase between 3 and 35 percent by 2100 with the magnitude of change varying with time and location. Lowland areas will have a higher increase in rainfall than highlands.

The average mean temperature from 1997 to 2010 was 28.3°C; the minimum mean temperature was around 23.6°C; and the maximum mean temperature was around 32.9 oC (Figure 2). Based on the results of rescaling temperature data of all grids from PRECIS, it emerged that the rate of mean monthly temperature increase ranged from 0.013 to 0.036°C per year depending on the location (SNC, 2010 [a draft]). The rate of temperature increase is high in low altitude areas such as in the central and in the north-east of Cambodia (0.036°C per year), and low in the high altitude areas such as in the South-West (0.013°C per year).

The average annual rainfall from 1984 to 2010 fluctuated between 949 mm and 1,859 mm (Figure 3). However, over the past decade, some inland provinces had less than 600 mm of rainfall annually, and coastal areas, around 3,800 mm.

A survey of 443 households included questions on floods, droughts and windstorms. Without exception, all respondents stated that they were victim of floods, droughts and/or windstorms; The main hazards experienced were floods and/or droughts. In seven of the 12 districts, over 50 percent of the respondents stated that they were victims of both floods and droughts: Ba Phnom, Preah Sdech, Pear Reang, Peam Chor, Kampong Leav, Peam Ror and Svay Antor (Prey Veng). In Kanhchrearch, Kampong Trabaek and Kamchay Mear Districts, most of the respondents stated that droughts were more recurrent than floods. In general, floods commonly occurred around September, while droughts occurred around July. Considering that many farmers have been victim of droughts prior to the wet season, this suggests that they are often subject to 'false rains' in which isolated rainfall events around the expected onset date do not signal the sustained onset of the monsoon.

A study conducted by CARE found that the severe 2000 flood affected rice yield in two ways: (i) the flood occurred earlier than usual and damaged the dry season crop that was almost ripe for harvesting; and (ii) the flood

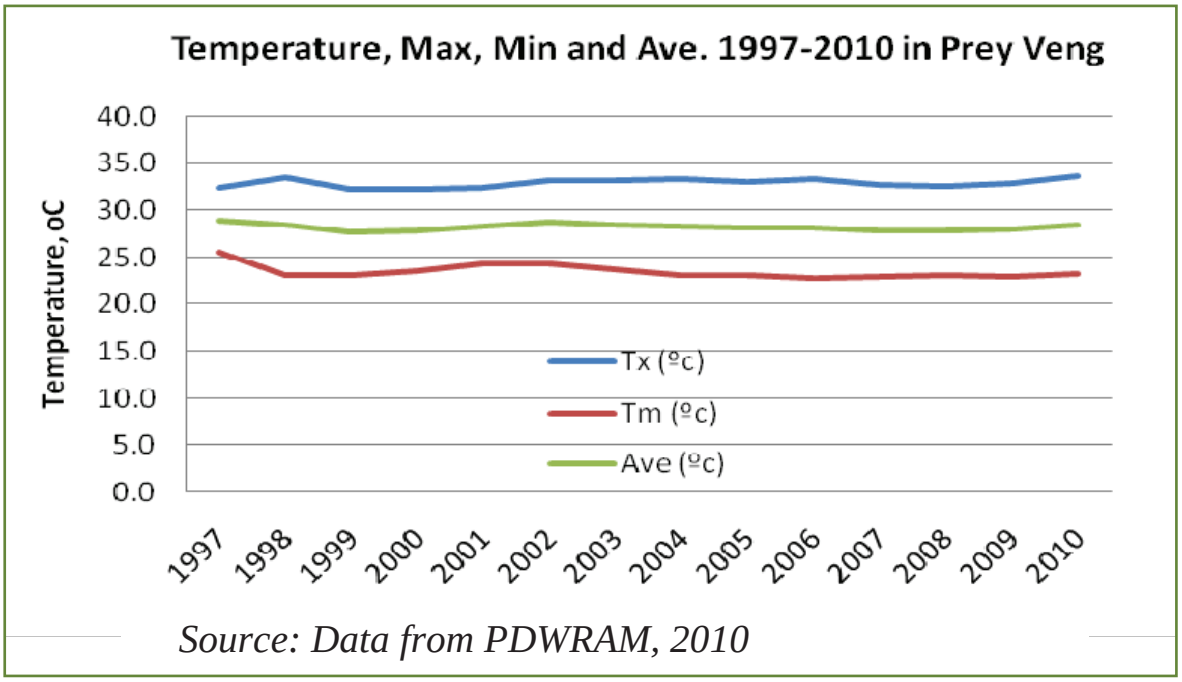


Figure 2. *Maximum, Minimum and Average Temperatures, Prey Veng Province, 1997 to 2010*

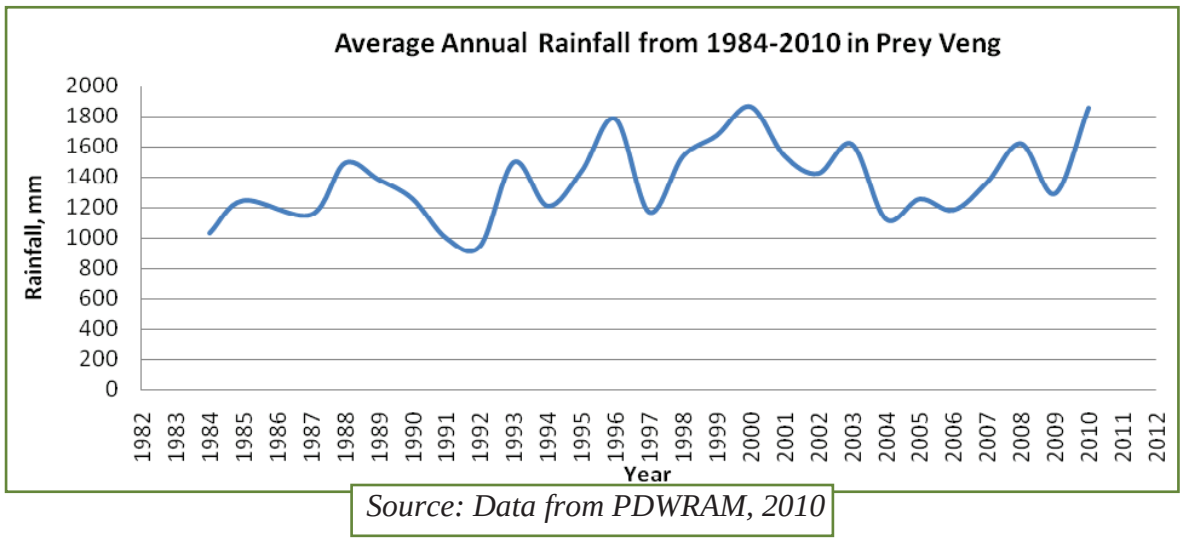


Figure 3: *Average Annual Rainfall in Prey Veng Province, 1984-2010*

duration was much longer than usual, forcing farmers to delay planting the 2001 dry season crop for at least a month, which caused damage to seedlings for the dry season planting.

The CCAI study reviewed the climate modelling tools. Rainfall data were used for estimating evapotranspiration potential (ETP), and then for filling soil water and the remaining

calculated as run-off. When rainfall is less than the evapotranspiration, soil water was used partly to meet the need, thus water in the soil was lost (having evaporated through soil surface and crops). The amount of loss is called potential water loss (PWL). If this condition continues, the loss of water from soil will also continue until it reaches the permanent wilting point (PWP). When this PWL is accumulated, it is called the accumulated potential water loss (Acc PWL). In order to evaluate the impact of climate change, the median of rainfall and temperature data of the 14 GCM models and PRECIS model were run under two emission scenarios, and three time periods were used as inputs into the soil water balance model. To increase the level of confidence, the analysis was refined applying the downscaling method to the GCM outputs.

The project organised a consultation meeting with the local authorities and stakeholders, including provincial departments in order to introduce the CCAI demonstration site project and discuss key problems and issues. The tentative prioritized villages or target villages based on the discussions were identified.

Output 1.2: *Current and future development of strategies, policies, plans and programmes as well as institutional arrangements, available information and data related to climate change adaptation in the Lower Mekong River in Prey Veng Province, Cambodia*

A report synthesises the current and future strategies, sectoral policies, plans and programmes, and available information and data related to climate change adaptation, particularly in the agricultural sector in Cambodia. This study performed three types of analysis:

- an assessment of the optimum planting times for wet season rice (rainfed system) and dry season rice (irrigated rice) by running the model under 24 different planting times throughout the year. This analysis aimed to understand the potential yield reduction if the crop is planted at an inappropriate time;

- an assessment on the impact of climate change under two emission scenarios in 2025, 2050 and 2080 on rice yield in the nine provinces;

- evaluation of the balance between rice supply and demand in 2025, 2050 and 2080 under different climate change scenarios and different government programmes for increasing rice yield.

In order to assess the impact of climate change in rice production in Cambodia, this study used the dynamic crop simulation model, the Decision Support System for Agro-technology Transfer (DSSAT). The model was run only in nine main rice growing provinces, because the soil data required for this model were only available in these sites. Climate data used for running the model were historical and future climate data generated by 14 GCMs from Masutomi et al. (2009). The future climate data were generated under two emission scenarios, SRESA2 and SRESB1. The changes in CO2 under

the two different scenarios were used as input for the DSSAT model.

By using all data downscaled by the PRECIS regional climate model for the Mekong River Basin over the land area, 30-year periods of records were averaged from 1960 to 2099 (SEA START RC, 2009). The results of the analysis showed a clear increasing trend in mean temperature data: a rapid increase in temperature is expected to occur after 2030 and variation of mean temperature may also increase in the future.

Changing patterns of rainfall were identified over previous and projected decades. Rainfall variability of some regions may decrease or increase depending on the time horizons.

Output 1.3: *Supporting methods and tools for adaptation planning, such as for climate hazards including flood- and drought-risk mapping, determining the impact of climate change, conducting a vulnerability and adaptation assessment, and raising awareness among provincial and community-based stakeholders as well as among concerned provincial departments and all key stakeholders*

The key methods and tools that were taken into consideration together with local and provincial departments and authorities and other stakeholders included:

- A guidebook for assessing communevulnerability and risk-adaptation to climate change. These methodologies for vulnerability, risk and adaptation assessment have been reviewed from a number of documents and reports from several organizations that worked on related issues at the community level. It emerged that the combination of the following data collection methods were needed for the assessment (Inmuong, 2011).

- Mainstreaming Climate Change Adaptation: A Practioner's Handbook (2009) by CARE International in Viet Nam *(Understanding Climate Change; Mainstreaming Climate Change Adaptation in Practice; and Tools for Mainstreaming Climate Change Adaptation)*.

- A Toolkit for Designing Climate Change Adaptation Initiatives: (i) Key Principles of Adaptation to Climate Change; (ii) Key Components in Designing an Adaptation Initiative; (iii) Obtaining a Stakeholder Consensus for Designing an Adaptation Initiative; and (iv) Key Tools and Methodologies for Designing an Adaptation Initiative (UNDP, 2010).

The report identified the appropriate methods and tools for assessing climate hazards, community adaptation options for introducing adaptation planning, including selected climate modelling and downscaling parameters (from PRECIS and MAGICC/SCENGEN), and relevant gender perspectives. These methods and tools were disseminated to the concerned provincial departments, local authorities and other stakeholders. The general methods and tools for adaptation planning are shown in Table 1.

Table 1 General methods and tools for adaptation planning

No.	Tools and Methods Description	Website
1.	Assessment of Impact of Climate Change, Community Vulnerability, Risk and Adaptation	Environmental Health Science, Faculty of Public Health, Khon Kaen University
2.	Mainstreaming Climate Change Adaptation	www.careclimatechange.org www.ngocentre.org.vn/node/5457
3.	A Toolkit for Designing Climate Change Adaptation Initiatives	http://www.undp.org/climatechange
4.	IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations	http://www.ipcc.ch/publications_and_data/publications_and_data_reports.htm
5.	UNDP Adaptation Policy Framework (APF)	http://www.undp.org/climatechange/adapt/apf.htm
6.	Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC)	http://www.aiaccproject.org/
7.	Guidelines for the Preparation of National Adaptation Programmes of Action (NAPAs)	http://unfccc.int/fi les/cooperation_and_support/ldc/application/pdf/annguide.pdf
8.	IIPCC-TGCIA Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment	http://www.ipcc data.org/guidelines/TGICA_guidance_sdciaa_v2_fi nal.pdf
9.	The Climate Impacts LINK Project	http://badc.nerc.ac.uk/data/link/
10.	Statistical Downscaling Model (SDSM)	https://co-public.lboro.ac.uk/cocwd/SDSM/
11.	MAGICC/SCENGEN	http://www.cru.uea.ac.uk/~mikeh/software/
12.	PRECIS (Providing Regional Climates for Impacts Studies)	http://precis.metoffi ce.com/other_links.html
13.	Adaptation Actions	http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=286
14.	Community-based Risk Screening Tool – Adaptation and ...Adaptation and Livelihoods (CRiSTA)	http://www.cristaltool.org/
15.	Community-Based Disaster Risk Management Field Practitioners' Handbook	http://www.adpc.net/pdr-sea/publications/12Handbk.pdf
16.	Natural Disaster Mitigation in Drinking Water and Sewerage Systems: Guidelines for Vulnerability Analysis	http://www.paho.org/English/DD/PED/natureng.htm

No.	Tools and Methods Description	Website
17.	Decision Support Systems Linking Agro-Climatic Indices with GCM-Originated Climate Change Scenarios	http://cres.anu.edu.au/outputs/anusplin.php#1
18.	Process Crop Models: Decision Support System for Agro-technology Transfer (DSSAT)	http://www.icasa.net/

Output 2.1: *Assessment on the impact of climate change, vulnerability and adaptation, and adaptation planning practices for Prey Veng Province*

The field survey, involving 172 interviews in four districts, provided important data on the status of climate change risks, vulnerabilities and coping and adaptation strategies in the province. In the survey areas, the most severe and the most frequent climate hazards occurring in the district, commune and village are floods (55% of respondents) and droughts (38% of respondents), followed by pests (7% of respondents). Drought occurred more frequently than floods (53% of respondents). The agricultural sector is the main sector affected by droughts and floods, with 64 percent of respondents stating that lowland rice was the main crop affected, while 34 percent identified other hazards such as infrastructure damage.

In the most damaged area, the average loss affected less than or equal to 0.5 ha. In areas of high frequency events, losses amounted to $1,030-2,500 whereas in areas of low frequency events, losses amounted to $90-375 (rice crops). On average, losses amounted to $327 per household from floods and $375 per household from droughts. Approximately 90 percent of the household losses were due to crop failure, and the remaining due to property damage. The average household value of loss of rice crop due to floods and droughts was $30 and $150, respectively.

Most of farmers in the surveyed target area (98.3% of respondents) cultivated more rice during the wet season than in the dry season (82.6%). This is because the source of water for irrigation is more easily obtained during the wet season. It appears from the survey that 31 percent of respondents planted rice/paddy from November to February, 29 percent from December to March, and 16 percent from January to April. During the wet season, around 50 percent of respondents cultivated rice/paddy from June to November, 24 percent from August to January, and 14 percent from May to August.

For the wet season:

- 87.2 percent of respondents were engaged in farming;
- most respondents spent US$45-160 on preparation and planting, and required 1-15 days of labour;

- most respondents spent $25-375 on maintenance, which required 121-180 days for 55.2 percent of respondents, 60-90 days for 30.8 percent of respondents, and 91-120 days for 1.2 percent of respondents;
- the majority of respondents (87%) spent $20-200 on labour for the harvest over a period of 1-5 days.

For the dry season:

- 62.7 percent of respondents were engaged in farming during the dry season;
- most respondents spent $42-500 on preparation and planting, and 62 percent of respondents required 1-15 days;
- the majority of respondents spent US$25-350 on maintenance, and 62 percent of respondents required 60-90 days;
- the majority of respondents (62%) spent $20-150 on labour for harvesting over a period of around 1-5 days, 0.6 percent of respondents required 11-15 days and the remaining 38 percent of respondents gave no answer.

The survey found that 53 percent of respondents incurred damages from floods on their agricultural land: 7.6 percent of respondents incurred less than 25 percent crop damage from flooding; 9.9 percent, 25-50 percent crop damage; 16.3 percent, 51-75 percent crop damage; and 19.2 percent, over 75 percent. Most damage affected 0.1 to 0.5 ha for each proportion of agricultural land area.

Around one-quarter of respondents who operated a livestock breeding business incurred losses due to death caused by water-borne diseases or livestock gone missing due either to flooding or drought. Around 14.5 percent of respondents stated that damage to their homes amounted to 1-2.5 of incurred damage,

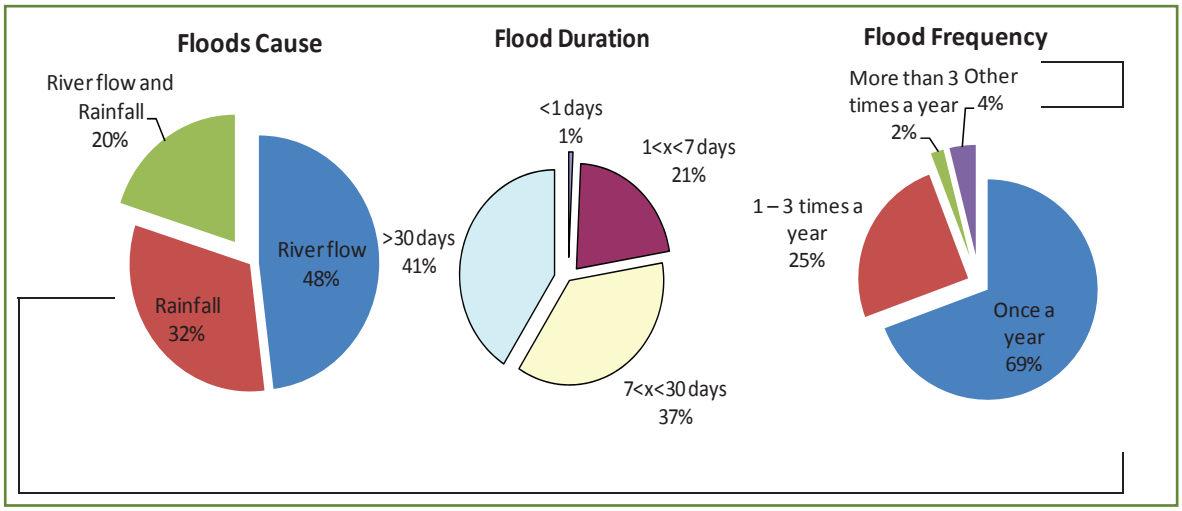


Figure 4. *Cause, Duration and Frequency of Floods*

and the remaining 85 percent of respondents did not answer. Moreover, 7.6 percent of respondents stated that infrastructure such as access roads, ponds and wells were damaged by floods; 9.3 percent of respondents stated windstorms in their districts, communes and villages caused losses, especially to rice crops.

The main causes, duration and frequency of flood events are shown in Figure 4. River flooding was the biggest cause; some 41 percent experienced flooding for more than a month, generally once a year.

The flooding events have distinct peaks and their year-to-year increase is of concern. The survey indicated that during severe floods, homes and rice fields were inundated. The majority of respondents stated that they experienced flooding of their homes (30.8%) and of their fields (8.7%), at a depth of less than 0.5 m. Flooding of homes (29.7% of respondents) and of fields (19.2%) affected 0.5-1 m. However, as many as 32 percent of respondents experience flooding of their homes and 64.5 percent of respondents experienced flooding of their fields, both of over 1 m depth.

A total of 96.5 percent of the respondents considered that the most vulnerable sector in the surveyed target areas was the frequency of drought. The most vulnerable areas to droughts were rice fields (61.6%). The last drought occurred for 1-3 months for 72 percent of respondents and for more than three months for 26 percent of respondents. According to 56 percent of respondents, the most severe droughts lasted 1-3 months; 44 percent of respondents stated that the most recent drought lasted over three months, as shown in Figure 5.

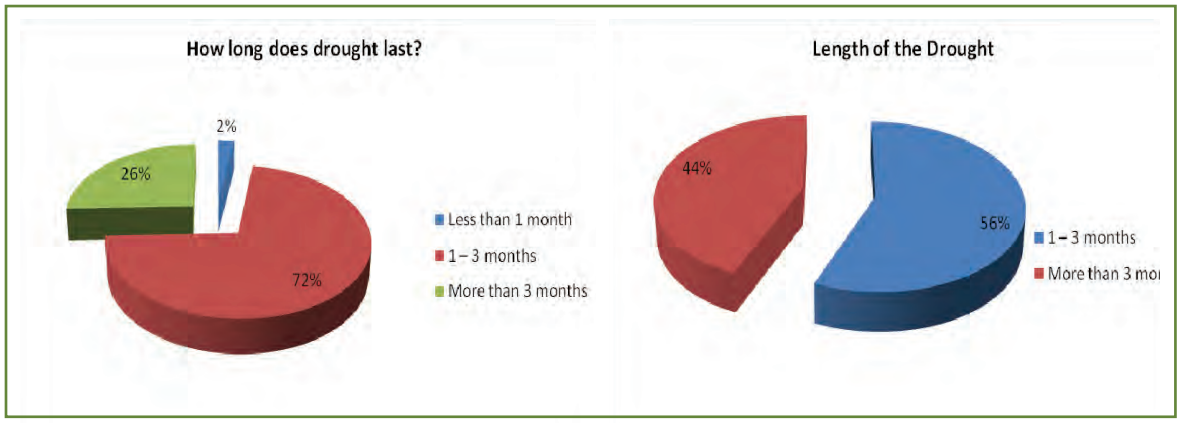


Figure 5. *Drought Characteristics*

Table 2 Priority beneficiary village according to ranking of vulnerability to climate extremes

Village	Commune	District	Total score	Ranking/priority
Ampovprey	Koh Sampov	Peam Chor	12	1
Prey Kandeang	Prey Kandeang	Peam Ro	7	2
Viel Robong Krom	Angkor Ang	Peam Chor	4	3
Neak Loeung	Neak Loeung	Peam Ro	4	3
Sang Ke Chong	Kraing Svay	Preah Sdach	3	5
Kdey Skear	Chey Kampork	Preah Sdach	2	6
Piey Niey	Kraing Svay	Preah Sdach	2	6
Prek Tasar	Neak Loeung	Peam Ro	2	6
Prek Thom	Neak Loeung	Peam Ro	2	6
Prey Koy	Tro Paing Sre	Me Sang	2	6
Thmey	Peam Mean Chey	Peam Ro	2	6

The survey scored and ranked climate extremes in survey villages, as shown in Table 2, with two villages showing the highest ranking.

According to 65.1 percent of respondents, domestic water is very difficult to access in March and April. For 67.4 percent of respondents, difficulties in their livelihodds occur due to insufficient water availability and remoteness from the water sources. Some 43 percent of respondents had difficulty in accessing water during the dry season and had to buy clean water. Costs ranged from less than $1 to $200; with a typical cost of $25.

During floods and droughts, as many as 96 percent of respondents did not receive financial support from the government, NGOs or any other institution. If floods become more frequent, 33 percent of respondents propose engaging the community to work together (checking the dam and the canal, repairing dykes, etc.); 33 percent of respondents would adjust the planting strategy and use the climate forecast information; 18 percent of respondents would move to less vulnerable areas, and the remaining 16 percent of respondents did not provide an answer (Figure 6).

This is only some of the key information derived from the Household and Gender Survey. Much more detailed information is provided in the survey report on damages due to natural hazards (principally flood and drought) and water scarcity in households, estimates of loss caused to the agricultural sector (specifically rice cultivation) by floods and droughts and to the animal husbandry sector, the rural infrastructure sector and the human health sector. The report also explores the various coping and adaptation measures to respond to natural disasters and agriculture water stress.

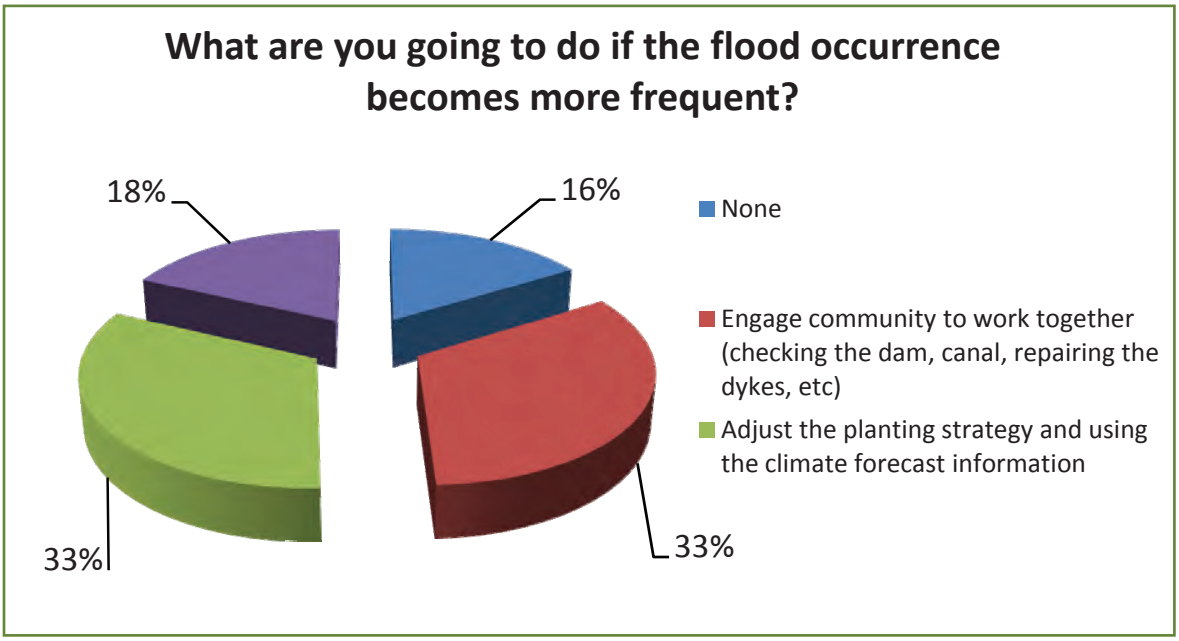


Figure 6. *Response to Flooding*

A Gender and Climate Change Survey was also completed involving 32 respondents conducted over seven days on 5-11 November 2011. The role of women and men in household and community activities was studied. The survey found a high proportion of households where the men are absent during varying periods due to off-farm work. According to the respondents, 81 percent of households suffered from disease during and after a natural disaster such as flood, drought and windstorm. They often suffered from fever, cold, diarrhoea, cholera, cough and typhoid. Only 56 percent of respondents indicated that their family had enough water for agriculture primarily due to dependence on rainfall. The household budget is mostly managed by women (91% of respondents). Moreover, 56 percent of respondents stated that husbands participated in community activities.

It was concluded that, in the study area, men and women have the same role in a variety of household activities under normal conditions, as well as during climate hazards of flooding and drought. However, some activities such as cooking, washing and cleaning, child care, health care and shopping are performed by women. Also, activities such as land preparation (rice/crop cultivation) and artisanal fishing, involvement in society organization activities, and implementing disaster management plans are performed by men. The survey suggests that in the study area there is gender equality in the households.

Output 2.2: *The demonstration site project for assessing the impact of climate change, vulnerability and adaptation, and adaptation planning practices for Prey Veng Province focusing on the four target districts*

Prey Veng Impact Assessment

A key output was the report, An Assessment of the Impact of Climate Change, Vulnerability and Adaptation on the Agricultural Sector, specifically Rice Production in Prey Veng Province (November, 2012). The report discusses the impact in Prey Veng Province of extreme climate events, past and future climate change and impacts on rice production, adaptation options, stakeholder engagement and a capacity-building plan.

The approach to assessing impacts is outlined in Figure 7. In this study, the increase in yield in the future was based on historical yield trend, potential rice yield projection of rice varieties, and government projections on yield increment and climate variability according to the PRECIS model under two climate scenarios in Prey Veng Province. Rice production was estimated by multiplying the yield with the expected cultivated area.

The cultivated area in 2015, 2025, 2050, 2075 and 2099 was estimated based on the government target. In 2010, it was shown that rice production in this province was insufficient to meet the demand, which resulted in a deficit of around 540,173 tonnes of rice production exceeding demand.

The change in crop productivity under changing climate is not only due to changes in rainfall, but also from increasing CO_2 concentration in the atmosphere. Under elevated CO_2, crop productivity would increase, whereas under increasing temperatures, crop productivity would decrease due to the shortening of the growing season for non-photoperiod sensitive crops. The analysis showed that when daily temperature increased by 3°C, and CO_2 doubled, the crops developed more rapidly. Thus, the growing season was shorter, and the potential grain yield was only 15 percent larger than in the control, but maturity occurred 30 days earlier. A combination of +4.5°C and a doubled CO_2 resulted in the temperature and CO_2 factors almost cancelling out, so that the potential grain yield was only 8 percent larger than the control (MoE, 2001).

The impact of climate change on the yields of wet-season rice is significant because it is projected that rainfall will continuously decrease until 2099 and the low emission SRESB2 scenario will be increased. A change in the current level of productivity is expected in the future. Under the high emission SRESA2 scenario, rice production of Prey Veng Province will be sufficient to meet the domestic demand and have a surplus for import/export from 2015 to 2099. Efforts to increase rice production consist in implementing various programmes, such as extensification, intensification and diversification. These programmes can maintain the rice production level in the province by increasing the planting index and expanding irrigated areas for dry-season rice.

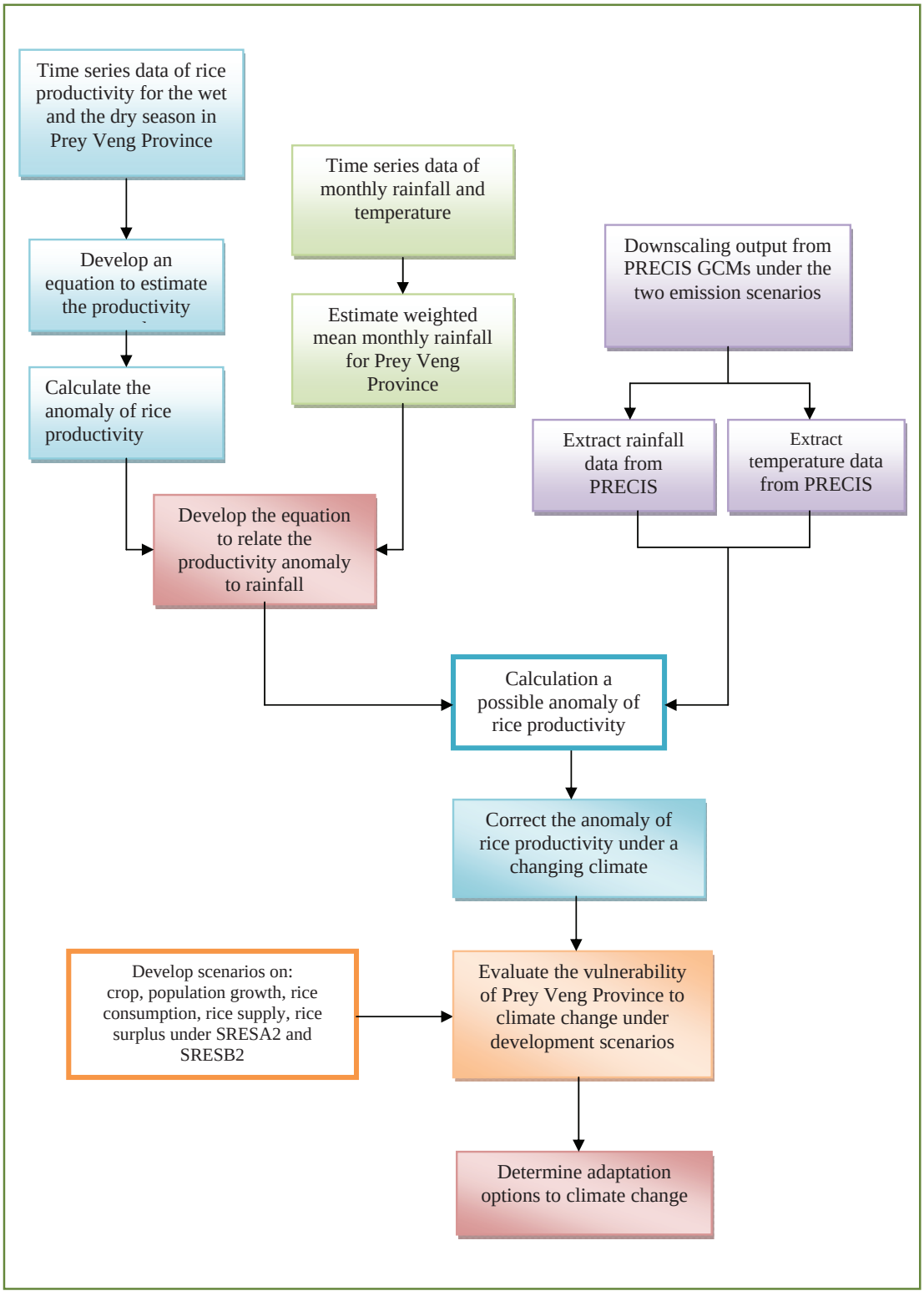


Figure 7. *Steps of Analysis for Assessing Vulnerability and Defining Adaptation Options of Agricultural Rice Production in Prey Veng Province*

Rice production in Prey Veng Province, according to the modelling, will exceed current demand under a changing climate. It was projected that rice production will exceed demand from 2025 to 2099. Projection of rice production indicates increases of provincial demand of 26.16 percent, 25.69 percent, 22.50 percent and 14.99 percent (at the current level under the high emission SRESA2 scenario) in 2025, 2050, 2075 and 2099, respectively. As concerns provincial demand, this is predicted to be -2.36 percent by 2015, with positive increases of 42.69 percent, 1.23 percent, 1.65 percent and 14.33 percent at current conditions in 2025, 2050, 2075 and 2099, respectively. These projections are shown in Figure 8.

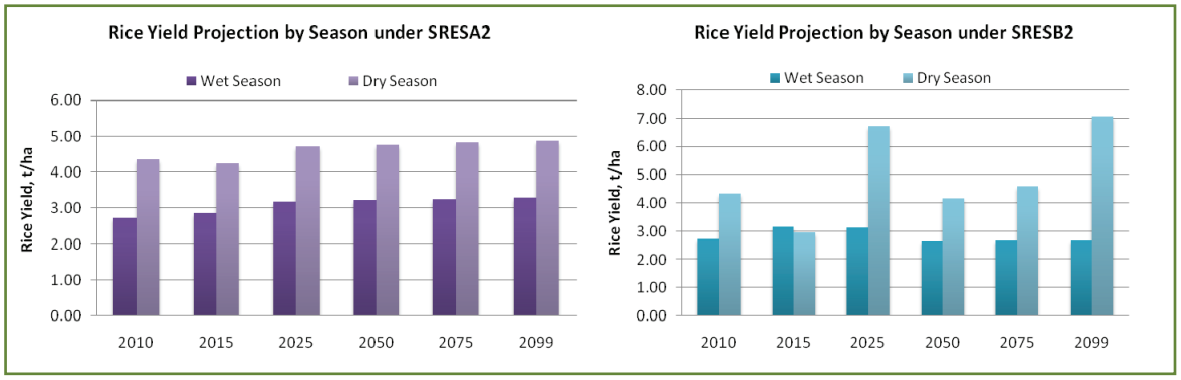


Figure 8. *Prey Veng rice yield under low and high emissions scenarios*

The report notes the efforts in rice production extensification, intensification and diversification in Prey Veng Province would allow to maintain its rice production level. If the diversification programme does not achieve its goal, and rice consumption per capita remains constant at the 2010 base year level (143 kg/capita/year by 2020), more efforts are required to maintain Prey Veng Province as a higher rice-producing province for Cambodia. The province needs to evaluate and prioritise programmes to ensure cost-effectiveness for managing the impact of climate change on rice production.

Under changing climate conditions, including higher frequencies of climate hazards, the selected priority activities in NAPA adopted by the Royal Government of Cambodia (MoE, 2006) has identified 20 prioritized short- and long-term programmes. Sixteen of the 20 programmes are aimed at reducing the risk of climate hazards to rice farming and improving crop management. All of the programmes are relevant in increasing the resilience of Cambodian rice farming to climate change. However, financial support to implement the programmes is still very limited. Some programmes have been implemented at a small scale in various districts, and most of them are NGOs and community initiatives.

Sixteen of the NAPA priority programmes require an implementation cost of around $124.5 million; in one programme the required

cost is US$1-5 million. Only three programmes require high investment, namely: (i) the development and improvement of community irrigation systems; (ii) rehabilitation of Upper Mekong and provincial waterways; and (iii) construction of water gates and water culverts. All of these three programmes aim to reduce the risk of flood and drought, and to improve crop management.

Programmes that can be implemented to increase rice productivity include:

- For short-and medium-term programmes for improving climate risk management and community livelihoods: (i) improving new high-yielding varieties; (ii) improving crop management and traditional cultural practices; (iii) strengthening capacities to adapt to the current extreme climate such as developing an early warning system for extreme climate and producing maps showing the provinces of rice growing areas that are prone to flood and drought; (iv) implementing adaptation measures and agricultural strategies, which also contribute to emission reduction, such as the introduction of technologies that increase water use efficiency for agricultural activities; (v) developing the irrigation system in many parts of lowland areas; and (vi) increasing the rice planting index in suitable areas in province.
- For the long-term, important activities include: (i) institutionalising the use of climate information in agriculture management and development; (ii) prioritising structural intervention programmes that are in place to minimise the impact of increasing climate risk such as constructing dams and setting up irrigation systems; and (iii) developing and implementing long-term research on climate modelling and adaptation technologies.

Pond rehabilitation project in Prey Kandeang village

As part of the practical orientation of the project, Prey Kandeang village was selected for the reconstruction of a pond for household, domestic and agricultural use. The rainwater harvesting pond is expected to serve a critical need for household water. Since the water supplies are disbursed in the village, the pond fills an important gap, especially given the apparent poor quality and reliability of the groundwater. Fencing and planting vegetation along the top and sides of the berm still need to be completed. The commune council has reportedly organized beneficiary contributions to support the pond fencing, but there is still a shortage of funds. It was suggested that further awareness and capacity building of the community organisation are also needed to manage the pond.

A general concern about the sustainability of the community pond was expressed in comments in the participant evaluations. It was suggested that the project should include other adaptation measures such as improved seeds, adaptive cropping practices and tree planting. Significant agro-forestry and horticulture have been used successfully around similar ponds in other flood-prone areas, which could be promoted provided that they do not interfere with the primary objectives of domestic water supply. Technical expertise in community pond management is clearly needed. Degradation of the irrigation canal system and encroachment into canals were noted as problems in Prey Veng Province.

Output 3.1: *Provincial capacity strengthened and awareness raised in policy making and planning for climate change adaptation at different levels*

Training and Capacity Development

The Capacity Development Plan prepared under this output proposed:

- the development of an introductory training course that introduces the basic concepts of climate change, with the aim of establishing a basic level of understanding on climate change such as cause and effect, and response and adaptation measures;
- development of strategies and tools for awareness raising with key stakeholders;
- provision of training on specific themes such as understanding specific impacts and adaptation strategies;
- application of participatory planning and research tools to address climate change;
- monitoring and evaluation of climate change adaptation;
- strategies for adapting programmes and on how to apply it at the grassroots level;
- support for mainstreaming climate change adaptation approaches/ methods or tools through an adaptation programme of CNMC (CNMC, 2012a).

To this end, the project sponsored several workshops:

- Training Workshop on Strengthening Provincial Capacity in Policy Making and Planning for Climate Change Adaptation at Different Levels, Prey Veng Province, 19-20 October 2011;

- Training Workshop on Capacity Building to Monitoring and Reporting Progress, and Lessons Learned on Climate Change Adaptation Planning, Prey Veng Province, 26-27 March 2012;

- A two-day training workshop on Capacity Building for Monitoring and Reporting Progress and Lessons Learnt on Climate Change Adaptation Planning", organized by the Cambodia National Mekong Committee, Prey Veng Province, 26-27 March 2012;

- Building Capacity of Institutions to Help Farmers Better Adapt to Climate Change and Variability in Cambodia, Pear Reang District, Prey Veng Province of the Royal University of Agriculture (RUA) and Chea Sim University of Kamchaymear, Cambodia, in cooperation with University of Queensland-Australia, 23-25 December 2012.

Sub-national Adaptation Planning

One of the final outputs was the *Climate Change Adaptation Planning Initiative at the Sub-National Level (Prey Veng Province)*, February 2013, which set out a vision of resilience in the face of a changing climate and set a goal for Prey Veng's adaptation planning to ensure that provincial departments continue to achieve their missions and programme goals, and to operate securely, effectively and efficiently in a changing climate.

The demonstration site project aimed to build the capacities of the local authorities and stakeholders in Prey Veng Province to conduct the assessment on the impact of climate change, vulnerability and adaptation as well as to draw lessons learned from adaptation planning practices to assist stakeholders in th preparation and development of a strategy in Prey Veng Province's Sub-National Adaptation Planning of Action (SAPA). The key principles of climate change adaptation planning included:

- **Appropriate integrated approaches:** Cambodia's climate change strategic plan (CCCSP), which includes adaptation, should be integrated into core policies, planning, practices and programmes at the national and sub-national levels for Prey Veng Province.

- **Prioritisation of the most vulnerable areas:** Adaptation plans should prioritize places and infrastructure, and helping local people that are the most vulnerable to climate hazards or climate impacts. They should also be designed and implemented in the most vulnerable provinces, taking into consideration climate change impacts and adaptation.

- **Science-based adaptation:** Adaptation should be grounded in best available scientific understanding of climate change risks, impacts and vulnerabilities in their communities. Adaptive actions should take into consideration climate change impacts, and plans and actions should be adjusted while understanding of climate impacts on the community is enhanced.

- **Building partnerships:** Adaptation requires coordinating cross-sectors. Geographical scales should build on current efforts and on the local knowledge of stakeholders that had been applied on the ground in local communities. Since impacts, vulnerability and needs vary by province, local adaptation will be most effective.

- **Application of risk-management methods and tools:** A risk management approach can be an effective way to assess and respond to climate change because the timing, likelihood and nature of specific climate risks are difficult to predict. Risk management approaches are already used in many critical decisions at present (e.g. for droughts, floods, windstorms, pests, disease outbreaks) and allow to understand the potential consequences of inaction as the options for risk reduction in their communities.

- **Continuous evaluation of performance:** Adaptation plans should measure the goals and performance metrics to continuously assess whether adaptive actions are achieving desired outcomes. The measurements will be qualitative and more information is needed to evaluate outcomes quantitatively.

The report presents a structure for following up on sub-national adaptation. *A Conceptual Framework for Sub-national Adaptation Planning of Action (SAPA)* was proposed for implementation by provincial departments in Prey Veng Province. The local planning process involves key stakeholders of provincial departments and local authorities, such as those at the provincial, district and commune levels, civil society organizations, the community, vulnerable groups and poor households. The adaptation planning process starts at the grassroots level and will be consolidated in order to ensure it will be mainstreamed in development efforts of the government and civil society.

This follow-up structure will be engaged in decision making and will participate in the design and delivery of adaptation processes, as presented in Figure 9.

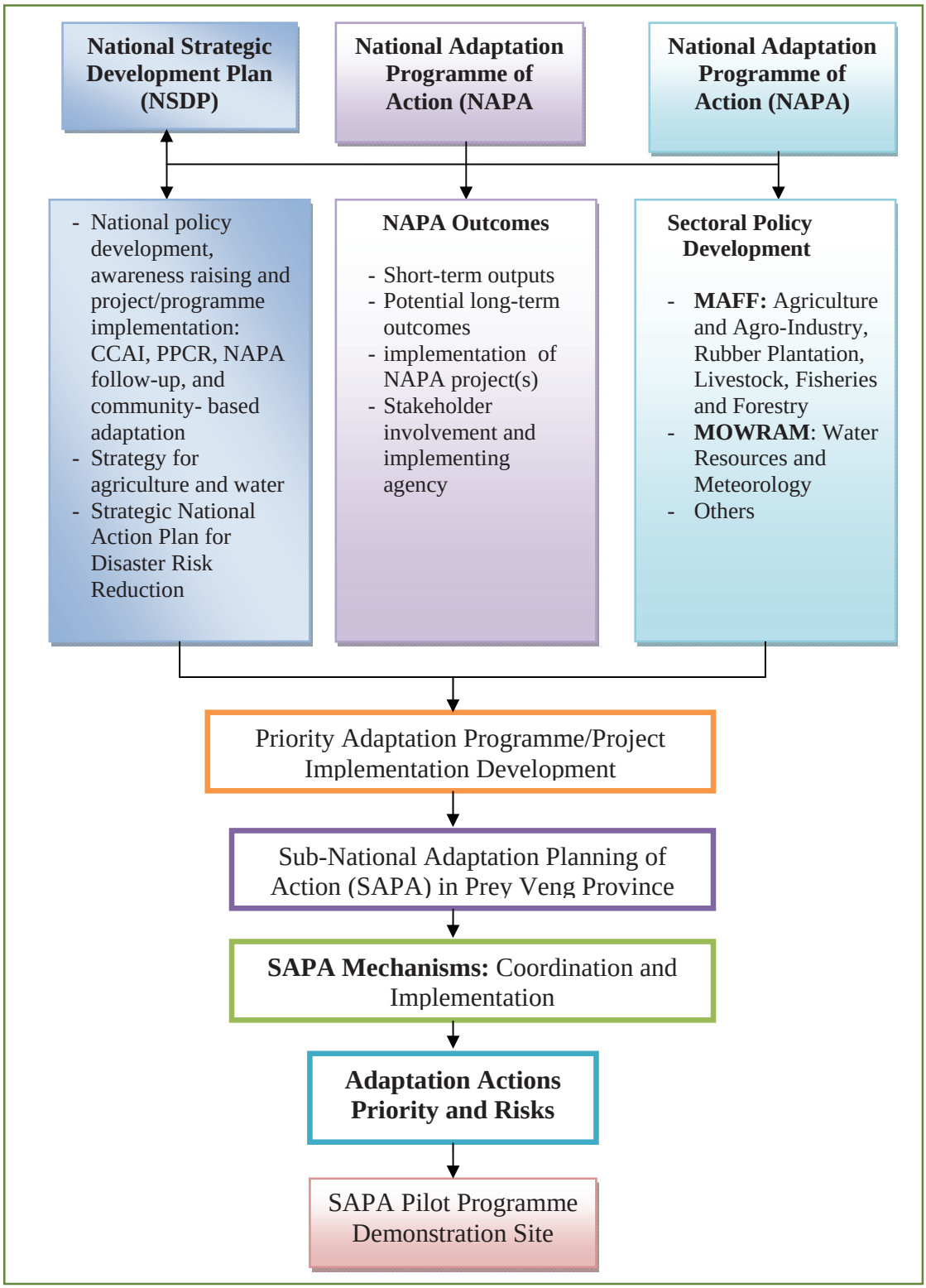


Figure 9. *The Structure of the Sub-national Adaptation Planning of Action*

CCAI's national project team proposes to identify priority areas and set goals for its own climate change adaptation plans. It is also critical that it coordinate with other appropriate key line agencies at the sub-national level in Prey Veng Province and with inter-agency national planning efforts on adaptation issues. Basically, this adaptation planning will be designed and developed based on the national climate change strategy and plan. It will recommend developing national adaptation strategies for assistance programmes and cross-cutting issues, including agriculture and water resources management. The national plans will be coordinated with sub-national adaptation planning, and lessons learned will be drawn from sharing their adaptation plan experiences. Coordination at the regional level from MRC is also important for effectively implementing activities.

Climate change hazards in Prey Veng Province include floods, droughts, windstorms and pests. The selection of these hazards was determined by results on the gaps and policy analysis, and the household survey on vulnerability and adaptation assessment in Prey Veng Province. A proposed Adaptation Plan included an Action Plan to identify appropriate adaptation actions to respond to the remaining risks identified in the Prey Veng Province. This Adaptation Plan was established by rescaling the climate change risk assessment through a survey on vulnerability and adaptation in order to reduce the impact of climate change and risk, and determine their level of severity. Risks that had inadequate or no monitors in place were then evaluated, and appropriate actions were included in the Adaptation Plan at the sub-national level for a specific province such as Prey Veng.

Adaptation Actions for Prey Veng Province were listed under key themes linked to specific risks (see Annex 1), prioritized under three categories: high, medium or low, according to the level of risk and controls in place to manage risk, as follows:

Key Theme 1: The promotion of the integrated household farming system at the sub-national level.

Objective: To increase agricultural productivity and to improve farmers' incomes, food security and livelihoods in the areas affected by flood and drought.

Most Cambodian farmers in Prey Veng Province depend on subsistence rainfed rice farming, which is vulnerable to climate hazards such as floods and droughts. Official records indicate that their frequency and severity have increased in recent years. Increased crop losses, this has led to food shortages. The promotion of household integrated farming, which includes multi-cropping, livestock raising and aquaculture, will assist farmers in generating higher incomes and improve food security and rural livelihoods.

Key Theme 2: Improvement of rice production to help farmers better adapt to climate variability and change.

Objective: To improve rice varieties and other crops, and reduce the impact of climate change in rice crop production.

Key Theme 3: Protection from climate hazards at the provincial level including the local community.

Objective: To address climate change impacts of climatology of temperature and rainfall change.

Key Theme 4: Using water responsibly and efficiently in the local community.

Objective: Develop a water management plan, water resource research, set up water tank and provide climate change adaptation training or education on water consumption and conservation, and introduce new technology.

Key Theme 5: Development and rehabilitation of a flood protection dyke in priority areas.

Objective: To protect settlements and agricultural rice fields from floods.

Many existing flood protection infrastructures are not fully functional and require rehabilitation. The lack of adequate protection makes settlements and agricultural fields vulnerable to floods. By changing climate conditions, the frequency and intensity of floods may increase.

Key Theme 6: Strengthening of community disaster preparedness and adaptation capacity.

Objective: To ensure preparedness and response to climate hazards at the community level and to reduce climate hazard, climate change impacts, risks for provincial and local communities.

The capacity of Cambodian governmental institutions to assist local communities in preparing and responding to climate hazards is restricted to post-disaster rehabilitation and relief. The adaptation capacity of the local authorities and communities to prepare for and respond to climate hazards is very limited.

Key Theme 7: Improving the efficiency of water gates and culverts construction in priority areas.

Objective: To regulate flood water around the newly rehabilitated road network and to minimize road and crop damage caused by floods.

The road network throughout the provinces has been rehabilitated in recent years without due consideration for hydrological aspects, and climate change adaptation and resilience as a result of disruption of natural flooding patterns. This has caused increased damage and loss to agricultural crops and infrastructure in the local communities.

Key Theme 8: Water supply for rural communities and agricultural purposes.

Objective: To provide safe water in sufficient quantities for rural communities and agriculture, and to reduce the risk of contracting water-related diseases.

Water supply for rural communities and agricultural purposes remains critical for rural areas, which would enable them to better adapt to changing climate conditions. The problem has been aggravated by the prolonged droughts that have occurred more frequently in recent years.

Key Theme 9: Development and improvement of provincial irrigation systems.

Objective: To provide sufficient water for the rice farming system; to reduce the risk of crop failure from water shortages; and to strengthen food security and poverty reduction of rural people.

In Cambodia, and specifically Prey Veng Province, agriculture is mainly based on rainfed rice and mixed crops. Based on evidence, there has been an increase in the intensity and frequency of extreme weather, floods, droughts and windstorms in Asia (IPCC, 2007). Cambodia has experienced increased rainfall in the wet season and prolonged drought in the dry season.

Output 3.2: *Capacity to monitor and report on progress and performance strengthened, and lessons learnt on climate change and adaptation in Prey Veng Province at all levels drawn*

The above output aimed to: (i) increase technical capacity of national project team and target group at provincial level in the monitoring framework for assessing and reporting on the status of adaptation by implementing partners of national experts in Prey Veng Province; (ii) exchange and conduct field exercises at the demonstration site based on field survey results; and (iii) enhance capacity and skills of national and local experts in communicating climate change messages and discussing and sharing experiences on climate change and adaptation for the next step.

The project provided training to the national project team and implementing partners in application of the monitoring framework for assessing and reporting on the status of adaptation. The project also exchanged with another river basin organisation to discuss and share experiences on climate change and adaptation. Capacities and skills of national and local experts were enhanced in communicating climate change messages in English and local languages. A Glossary was prepared to clarify climate change terminology using national and local experts, and was translated into the national language.

Two workshops served to disseminate adaptation skills, knowledge and lessons learnt:

- Capacity Building for Monitoring and Reporting Progress and Lessons Learned on Climate Change Adaptation Planning, A two-day workshop held on 26-27 March 2012 in Prey Veng Province, and organised by the Cambodia National Mekong Committee.

- Disseminating and sharing the results and lessons learned of the CCAI demonstration project with local, provincial and national stakeholders,

and enhancing awareness of climate change adaptation among provincial key stakeholders and local communities in Prey Veng Province, 25-26 March 2013.

5.2 Outcomes

Significant achievements resulted from the array of activities under the three project outcomes related to: (i) testing methods and tools; (ii) impact assessment and adaptation planning; and iii) capacity development and awareness raising at all levels. A model process for sub-national assessment and planning of climate change adaptation was developed through the application of selected tools to define the key problems, determine the baseline conditions, assess projected climate change impacts, and identify appropriate adaptation options relevant to the four targeted districts in Prey Veng Province. The technical methods and tools included downscaling of global circulation models to the provincial level, detailed household and gender surveys, and a specific analysis of the effects of climate change and implications for rice production. Local adaptation methods were tested through pond rehabilitation and rainwater harvesting at a high priority site in the province – Prey Kandeang village.

Capacities were developed at the national, provincial, district and community levels for a wide range of responsible agencies and stakeholders as well as the 195 beneficiaries at the Prey Kandeang demonstration site. The five training workshops and three local consultation meetings expanded on adaptation practices. The project also contributed to knowledge sharing with the other Mekong countries.

The CCAI project had a positive impact on the Peam Ro, Peam Chor, Mesang and Preah Sdech beneficiaries. Direct and indirect beneficiaries through a number of training workshops include the poorest smallholder families, small land-holding families and women. They also include sub-national government officials from the Departments of Agriculture, the Environment, Rural Development, Water Resources and Meteorology as well as the Disaster Management Committee, the provincial Red Cross, commune councils, district authorities, village chiefs and other local stakeholders. The direct beneficiaries played an important role in disseminating lessons learned and practices to the other stakeholders and smallholder farmers in their communities. The CCAI national project team also worked closely with all beneficiaries to develop this project implementation in order to ensure that the project was in line with the priority issues and the real needs of local community.

The key outcomes of the project were summarised in the project's Final Workshop:

- capacities of adaptation climate change were strengthened among the local populations and relevant stakeholders through training, case studies and/or field visits;

- lessons learnt, experiences and approaches were used to help local communities to adapt and reduce their vulnerability to climate change;
- the local authorities were supported in developing climate change adaptation planning;
- documents were produced to assist climate-resilient, local community development;
- a community pond was set up for household and domestic use.

The project developed an outline for adaptation planning in Prey Veng Province, which is based on a flexible planning framework with options developed over time by each provincial department through planning, case studies, a field demonstration site, and lessons learnet from climate change adaptation experiences. In addition, the provincial planning framework will help stakeholders of provincial departments identify climate change impacts through a vulnerability and adaptation assessment. This aims to set priorities, implement climate change adaption measures, carry out monitoring and evaluation, share experiences and draw on lessons learnt from other demonstration activities on climate change adaptation. This process includes the following:

- **Developing a strategy and policy:** Effective adaptation planning and implementation require a strategy and policy statement with clear objectives as well as the issuance of a policy statement to which the national strategy is committed and that supports the sub-national strategy of climate change adaptation planning.

- **Understanding climate change:** Understanding will be enhanced on the best-available, actionable climate change science with the aim of learning how to respond to the following questions: What aspects of the climate are changing, and over what spatial scale at the global, national, regional and local levels.

- **Prioritising and implementing adaptive capacity and actions:** The development and implementation will be carried out by key stakeholders at the sub-national level of Prey Veng Province responds to climate change risks and opportunities. This is a starting point, which will lead to the development of a comprehensive set of potential climate change adaptation measures. Criteria for selecting priority adaptation activities and projects will vary according to provincial departments and stakeholders in the local community, the authority and their plans or programmes.

- **Drawing on lessons learnt on monitoring and evaluation:** Successful climate change adaptation requires ongoing monitoring and evaluation of efforts in order to continually assess the effectiveness of actions and adjust as necessary. Climate change impact projections, climate change responses, and understanding of the different

types of adaptive actions are evolving. Adaptation plans allow for a feedback mechanism, knowledge and information management and lessons learned at the sub-national level.

- **Raising awareness:** Awareness will be raised at the national level to ensure the short-, medium- and long-term effectiveness of adaptation planning, implementation, and evaluation at the sub-national level in Prey Veng Province. Building awareness and skills will require capacity building and education through training workshops, meetings or events.

The proposed approach is to integrate adaptation planning into the provincial investment plan and department programmes and projects. With their knowledge of climate change and its impacts, provincial departments staff and officers at all levels can assess how these impacts may affect their plans and programmes, and their implementation. This includes understanding global, regional and national climate change trends, carrying out a detailed assessment of priority plans and programmes, and identifying specific programme- and project-level actions to respond to climate change in Prey Veng Province.

Further development of measurable targets and commitments in the future for Prey Veng Province can be based on:

(i) a NAPA follow-up document that sets priority programmes and projects as well as activities;
(ii) more refined vulnerability and adaptation assessments;
(iii) specific adaptation actions to minimise risk, encouraging more detailed vulnerability assessments and implementing specific actions to further incorporate adaptation into their programmes, policies and implementation in a specific area in the province.

Furthermore, sub-national key stakeholders are also encouraged to participate in project-level adaptation planning activities, build capacity and raise awareness on the importance of adaptation activities at the national and sub-national levels, and to improve understanding of adaptation planning among provincial staff and officers involved in this activity.

The CCAI's National Project Team (NPT) concluded that key stakeholders from different line agencies at the national and sub-national levels should identify appropriate measures based on local experiences in order to incorporate climate change adaptation considerations into existing planning processes at provincial departments in Prey Veng Province. This should entail the development of measurable goals and adaptation efforts, and assessment should be conducted on whether efforts are achieving the desired outcomes. Regular evaluation of the success in directly implementing and supporting adaptation efforts is crucial for continuously refining and

improving adaptive capacity approaches including their performance and evaluation process.

Adaptation planning options included performance plans and an evaluation of contribution factors of climate change risks and vulnerabilities to manage the effects of climate change implementation in both the short and long term. An initial adaptation planning was proposed based on the technical guidelines for the national adaptation plan process from the Conference of the Parties (COP) 18 decision. Because climate change adaptation planning is a necessary and important part of sustainability planning, some line government agencies and provincial departments including the local authorities may choose to incorporate adaptation planning directly into their sustainability investment plan at the sub-national level. Adaptation planning for priority sectors such as agriculture and water resources can address the implementation issues and also include policy and programme considerations and responses on how climate change may impact on their sector.

6. CONCLUSIONS

This CCAI local demonstration project presented a focused approach to real and current adaptation issues in four districts of Prey Veng Province and laid the foundation for strategic interventions at the sub-national level. The effects of the project were evident in helping farmers and local communities to adapt to climate change, and in guiding provincial and local authorities toward a specific action strategy for climate change adaptation. The results not only improved the capacity of national and sub-national level stakeholders, but also addressed an urgent need in Prey Kandeang village. This project approach could be replicated and upscaled to other target areas with high climate vulnerability in Cambodia.

The project has provided a useful pilot for further development of the subnational climate change adaptation processes. Ongoing application of the skills and capacity developed by the project and with stakeholders will be needed to maintain sustainability of the results. Further improvements can be made as suggested below.

The project has been highly relevant to the country and local needs, particularly the technical and vulnerability studies. The uncertain linkages between adaptation sector strategies and local area strategies were noted in the evaluation discussions. The role of the *Adaptation Planning Initiative* produced by the project could be usefully explored with respect to the extensive *Cambodia Climate Change Strategic Plan (CCCSP)*, which covers priority sectors and cross-cutting issues, and engages multiple government institutions in sectoral plans. The CCAI project's contribution towards the strategic plan and the major national climate change programmes in the country has yet to be determined.

7. RECOMMENDATIONS & LESSONS LEARNT

Recommendations

1. The MRC-supported CCAI local demonstration project can draw lessons learned from other similar climate change adaptation projects under the Cambodia Climate Change (CCCA) Trust Fund. Experience sharing from project to project in the country and abroad would enhance capacity and knowledge on effective approaches to adaptation.

2. The approach, methods and tools for sub-national climate change adaptation that have been developed and tested in this project should be replicated and upscaled to other target areas of CNMC, consistent with the NAPA and Cambodia Climate Change Strategic Plan. This upscaling should be carried out with key stakeholder consultations for the next series of local demonstration projects.

3. The provincial adaptation planning framework should be further developed to integrate adaptation planning into provincial investment plans and department programmes and projects based on: (i) a clear strategy and policy statement; (ii) understanding of the best available, actionable climate change science; (iii) prioritization and implementation of adaptive capacity and actions; (iv) lessons learned from monitoring and evaluation feedback on the effectiveness of actions; and (v) awareness raising at the national level.

4. Key stakeholders from different line agencies at the national and sub-national level should identify and assess the effectiveness of appropriate measures based on local experiences in order to incorporate climate change adaptation considerations into existing planning processes at provincial departments in Prey Veng Province.

5. Follow-up monitoring, evaluation and adjustment should be undertaken at the project-sponsored community pond in Prey Kandeang village.

Lessons Learnt

The overall lesson learnt is that there are effective methods and tools to establish sub-national climate change adaptation in Cambodia provided that there is widespread capacity development and local engagement. The project provided high quality analyses based on downscaled modelling and projections of local agricultural impacts at the provincial level. The approach requires validation to determine replication potential for other provinces.

An integrated process for climate impact assessment, a local vulnerability survey, adaptation options analyses, and implementation and financing strategies have yet to emerge for sub-national adaptation in Cambodia. A combination of top-down climate modelling and bottom-up vulnerability and adaptation assessment needs to be carefully managed to provide meaningful adaptation

actions that are integrated with the national, provincial and local disaster management and development processes and priorities.

Some useful lessons can be drawn by the project. During the CCAI programme evaluation, a short questionnaire was distributed to the national project team members to draw on lessons learned. The key lessons concerned the need to: (i) ensure greater local participation in adaptation design and implementation; and (ii) share experiences and lessons learned from the project with other projects both in the country and abroad. Questionnaire responses noted the need for more participation from key relevant agencies at both the national and provincial levels, an effective scoping mission to visit the target province (e.g. a vulnerable district or village) to gather key information on the project from the local authorities, a clear project implementation plan and logical framework, and sufficient staff capacity for project implementation. The close involvement of the CCAI team was also suggested.

The efficiency of implementation could be improved through enhanced scoping and work planning. The duration of the project was planned for at least 12 months from the date of the agreement, but the actual time required from the proposal to the final report was around 2.5 years.

The process and mechanisms to implement the proposed provincial strategies remain to be defined and developed. Although the general approach is to integrate adaptation planning into provincial investment plans and department programmes, guided by a *Conceptual Framework for Sub-national Adaptation Planning of Action (SAPA)*, it is not yet clear, for example, how the CCAI-funded initiative will be utilised by the authorities and how implementation will be linked to other relevant departments and development processes.

The community pond in Prey Kandeang village is expected to serve a critical need for household water, although further work is needed to test the pond, complete the bank stabilisation, and monitor performance and use by community beneficiaries. Water supplies are dispersed in the village, and the pond appears to fill an important gap, especially given the apparent poor quality and reliability of the groundwater. Fencing and planting vegetation along the top and sides of the berm as well as further awareness and capacity building of the community are also important aspects for maintain the pond.

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Annex 1 CLIMATE CHANGE ADAPTATION PRIORITIES FOR PREY VENG PROVINCE

Key Theme 1: Promotion of integrated household farming system at the sub-national level.
Objective: To increase agricultural productivity and to improve farmers' incomes, food security and livelihoods in the areas affected by flood and drought.
Risk1.1: Potential land use conflicts and land availability, weak social capital in local communities and water availability

Priority	Adaptation Action	Risk	Time frame	Responsible Party	Budget estimate
High	Identify areas suitable for the project or pilot programme in priority areas	1.1	Short-term	Climate Change Department (CCD), Cambodia National Mekong Committee (CNMC), Provincial Department for Agriculture (PDA) and the local authorities	Minor
Medium	Select households for pilot demonstration site implementation	1.1	Medium	CCD, CNMC, PDA and the local Authorities	Minor
High	Build capacity in selected farmers on sustainable farming, livestock, and aquaculture technologies, etc.	1.1	Medium-to long-term	CCD, CNMC, PDA, the local authorities and NGOs	Moderate
Medium	Assess the production performance of selected forage crops for raising livestock in order to diversify income	1.1	Medium	CCD, CNMC, PDA, the local authorities and NGOs	Moderate
Medium	Introduce and improve forage crops for feeding livestock (cows and buffalos)	1.1	Medium	CCD, CNMC, PDA, the local authorities and NGOs	Moderate
Medium	Set up the pilot demonstration site in selected priority areas	1.1	Medium	CCD, CNMC, PDA, and the local authorities	Significant
Medium	Disseminate and exchange experience by introducing appropriate technologies to target areas	1.1	Medium-to long-term	CCD, CNMC, PDA, the local authorities and NGOs	Moderate
Medium	Build adaptation capacity and adaptation technology to householder farmers	1.1	Medium	CCD, CNMC, PDA, the local authorities and NGOs	Moderate
Medium	Monitor and evaluate the integrated household farming system	1.1	Medium	CCD, CNMC, PDA, the local authorities and NGOs	Moderate

Key Theme 2: Improvement of rice production to help farmers better adapt to climate variability and change
Objective: To improve rice varieties and other crops for farming and reduce the impact of climate change in rice crop production
Risk 2.1: Vulnerable areas by climate hazard such as floods, droughts and windstorms

Priority	Adaptation Action	Risk	Time frame	Responsible Party	Budget estimate
High	Implement the rice variety Chul' Sa and other rice varieties from outsources	2.1	Medium-term	Royal University of Agriculture (RUA), PDA and the local authorities	Moderate

Hight	Study of local rice crop yield by comparison between CARDI fertiliser and traditional farmer practices	2.1	Medium-term	Cambodian Agricultural Research and Development Institute (CARDI), RUA, PDA and the local authorities	Moderate
High	Analyse cost and benefit of the different seeding rate options	2.1	Medium-term	CCD, RUA, PDA and the local authorities	Moderate
Medium	Assess the performance of the improved Cambodian new rice varieties against floods and droughts	2.1	Medium-to long term	CCD, RUA, PDA and the local authorities	Significant
Medium	Improve local climatology (temperature and rainfall) by installing appropriate equipment	2.1	Short-term	CCD, RUA, PDA and the local authorities	Minor
Medium	Select and apply appropriate technology to help farmers adapt the climate change and improve resilience	2.1	Medium-term	RUA, PDA and the local authorities	Moderate
High	Disseminate and exchange experience by introducing new rice variety to other farmers	2.1	Medium-to long-term	CNMC, CCD, RUA, PDA and the local authorities	Significant
Medium	Carry out exchange field visits to other provinces and other countries (i.e. Member Countries) concerned with rice farming system	2.1	Medium-term	CNMC, CCD, RUA, PDA and the local authorities	Moderate
Medium	Monitor and evaluate the implemention of rice production to help farmers better adapt to climate change	2.1	Medium-term	CNMC, CCD, RUA, PDA and the local authorities	Moderate

Key Theme 3: Protection from climate hazards at the provincial level including the local community
Objective: To address climate change impact of temperature and rainfall change.
Risk3.1: Increased temperatures pose a health risk to the community. Changes in average rainfall can increase the risk of blockage and damage to the drainage system. Changes to average rainfall and temperature will increase the risk of degradation to the ground level (soil degredation)

Priority	Adaptation Action	Risk	Time Frame	Responsible Party	Budget estimate
High	Identify and implement climate change adaptation projects that assist local communities and ensure food security	3.1	Medium-term	CCD, CNMC, the local authorities and NGOs	Moderate
Medium	Integrate climate change adaptation information and emergency management into relevant provincial departments work plans at all levels to respond to and recover from events	3.1	Medium-term	PCDM, CNMC, CCD, Provincial Department of Water Resource and Meteorology (PDWRAM), and the local authorities	Moderate

Medium	Develop dissemination and education campaigns advocating preventative practices prior to floods, droughts and storm events among community members	3.1	Medium-to long-term	Provincial Committee for Disaster Management (PCDM), CNMC, CCD, PDWRAM, and the local authorities	Moderate
Low	Implement management plans for other non-irrigated lands to ensure ongoing availability of water for the wet and dry seasons during periods of low rainfall and high temperatures	3.1	Short-term	PCDM, CNMC, CCD, PDWRAM and the local authorities	Minor
Medium	Implement the local community resilience to drought based on the sub-national investment plan	3.1	Medium-term	CCD, CNMC, the local authorities and NGOs	Moderate
Medium	Monitor and evaluate the implementing climatology of temperature and rainfall change	3.1	Medium-term	CCD, CNMC, the local authorities and NGOs	Moderate
Key Theme 4: Using water responsibly and efficiency in the local community ***Objective:*** Design a water management plan, carry out water resource research, set up a water tank, provide climate change adaptation training or education on water consumption and conservation, and introduce new technology ***Risk4.1:*** Changes to average temperature and rainfall will reduce water availability.					
Priority	**Adaptation Action**	**Risk**	**Time Frame**	**Responsible Party**	**Budget estimate**
High	Develop an integrated water management plan that addresses climate change considerations and incorporates strategies for water design and development	4.1	Medium-term	CNMC, CCD, PDWRAM, and the local authorities	Moderate
High	Investigate undertaking research with RUA on the feasibility and safety of injection	4.1	Medium-term	RUA, PDA and the local authorities	Moderate
Medium	Install rainwater tanks, investigate high storage capacity to supply water during shorter more intense periods of rainfall	4.1	Medium-to long-term	CNMC, CCD, PDWRAM, and the local authorities	Significant
High	Provide climate change adaptation training/ workshop or education programmes and investigate incentives to encourage community water consumption and conservation	4.1	Medium-term	CNMC, CCD, PWRAM, and the local authorities	Moderate
High	Disseminate and exchange lessons learned by introducing appropriate technologies to climate change adaptation and resilience	4.1	Medium-term	CNMC, CCD, PDWRAM, and the local authorities	Moderate
Medium	Monitor and evaluate the implementation by using water responsibly and efficiently in the local community	4.1	Medium-term	CNMC, CCD, PDWRAM, and the local authorities	Moderate

Key Theme 5: Development and rehabilitation of flood protection dykes in priority areas.
Objective: To protect settlements and agricultural rice fields from floods.
Risk5.1: Insufficient coordination among concerned ministries/institutions and provincial departments, limited participation of the local communities, land use conflict and limited hydrological data

Priority	Adaptation Action	Risk	Time Frame	Responsible Party	Budget estimate
High	Identify priority areas in the province for flood protection infrastructure development	5.1	Short-term	PDWRAM, PPWT, the local authorities and NGOs	Minor
Medium	Develop and rehabilitate flood protection dykes	5.1	Medium-to long term	PDWRAM, the local authorities and NGOs	Significant
Medium	Establish a community team for the maintenance of the community dykes	5.1	Short-term	The local authorities and NGOs	Minor
Medium	Share experiences with the local community and authorities on important dykes	5.1	Medium-term	PDWRAM, CNMC, and the local authorities	Moderate
Medium	Monitor and evaluate the implementation of the development and rehabilitation of flood protection dykes in priority areas	5.1	Medium-term	PDWRAM, CNMC, and the local authorities	Moderate

Key Theme 6: Strengthening of community disaster preparedness and adaptation capacity.
Objective: To ensure preparedness and response to climate hazards at the community level and to reduce climate hazards, climate change impacts, and risks for provincial and local communities.
Risk6.1: Weak coordination among stakeholders, limited participation of the local populations in the project or programme, and difficulty of access to remote areas.

Priority	Adaptation Action	Risk	Time Frame	Responsible Party	Budget estimate
High	Raise awareness and increase understanding of climate change impacts among the local communities and authorities through the mass media	6.1	Medium-to long-term	PDH, PCDM, the local authorities and NGOs	Moderate
Low	Develop an individual settlements, flood hazards and response map	6.1	Short-term	PCDM, CCD, the local authorities and CNMC	Minor
Medium	Train local communities and authorities on preparedness and response to climate hazards and storms	6.1	Short-term	Provincial Department of Health (PDH), PCDM, the local authorities and NGOs	Moderate
Medium	Build capacities of the local authorities on relief coordination, rescue operations and emergency assistance	6.1	Medium-to long term	PDH, PCDM, the local authorities and CNMC	Significant

Medium	Monitor and evaluate the implementation process for strengthening community disaster preparedness and adaptation capacity	6.1	Medium-to long term	PDH, PCDM, the local authorities and CNMC	Significant
Key Theme 7: Improving efficient water gates and culverts construction in priority areas. ***Objective:*** To regulate flood water around the newly rehabilitated road network and to minimize road and crop damage caused by flood. ***Risk7.1:*** Insufficient coordination among concerned ministries/institutions and provincial departments, potential land use conflict and limited long-term data on floods.					
Priority	**Adaptation Action**	**Risk**	**Time Frame**	**Responsible Party**	**Budget estimate**
Medium	Identify areas affected by flood subsequent to road rehabilitation	7.1	Short-term	PPWT, CNMC, PDWRAM and the local authorities	Moderate
Medium	Rehabilitate water gates and culverts for climate resilience	7.1	Medium	PPWT, CNMC, PDWRAM and the local authorities	Significant
Medium	Build the capacities of community members in the maintenance and operation of water gates and culverts for climate resilience	7.1	Medium-to long term	PPWT, CNMC, the local authorities and NGOs	Significant
Medium	Monitor and evaluate the implementation of the improvement of the efficiency of water gates and culverts construction in priority areas	7.1	Medium-term	PPWT, CNMC PDWRAM and the local authorities	Significant
Key Theme 8: Water supply for rural communities and agriculture **Objective:** To provide safe water in sufficient quantities for rural communities and agriculture, and to reduce the risk of contracting water-related diseases. *Risk 8.1:* Potential land use conflict, weak social capital of the local communities and limited data on groundwater resources and local hydrology					
Priority	**Adaptation Action**	**Risk**	**Time Frame**	**Responsible Party**	**Budget estimate**
High	Construct or restore wells and ponds	8.1	Medium-to long-term	PDH, Provincial Department of Rural Development (PDRD), CNMC, the local authorities and NGOs	Significant
Low	Establish local water user committees for efficient water use	8.1	Short	PDH, PDRD, CNMC, the local authorities and NGOs	Minor
Medium	Build capacities of community members in the maintenance and operation of wells and ponds	8.1	Medium-to long-term	PDRD, CNMC, the local authorities and NGOs	Significant
Medium	Deliver locally made water filters for household use	8.1	Medium	PDRD, CNMC, the local authorities and NGOs	Moderate
Medium	Monitor and evaluate the implementation of water supply provision for rural communities and for agricultural purposes	8.1	Medium-term	PDRD, CNMC, the local authorities and NGOs	Moderate

Key Theme 9: Development and improvement of provincial irrigation systems.
Objective: To provide sufficient water for rice farming system; reduce the risk of crop failures. from water shortage; and strengthen food security and poverty reduction in rural people.
Risk 9.1: Land use and irrigation conflict, limited social capital in province and local communities

Priority	Adaptation Action	Risk	Time Frame	Responsible Party	Budget estimate
High	Rehabilitate community irrigation schemes	9.1	Medium-to long term	PDWRAM and PDA local authorities and NGOs	Significant
High	Construct new community irrigation systems	9.1	Medium-to long term	PDWRAM and PDA local authorities and NGOs	Significant
Low	Establish a local water user committee for efficient water use	9.1	Short	PDWRAM and PDA local authorities and NGOs	Minor
Medium	Build capacities of community members on the maintenance and operation of irrigation systems	9.1	Medium-term	PDWRAM and PDA local authorities and NGOs	Moderate
Medium	Monitor and evaluate development and improvement of provincial irrigation systems	9.1	Medium-term	PDWRAM and PDA local authorities and NGOs	Moderate

Annex 2 SUPPLEMENTARY DOCUMENTS

1. Identification of Key Problems, Establishing a Baseline and Determining Methods for the CCA assessment
2. Vulnerability and Adaptation Assessment: Household and Gender Survey for Prey Veng Province
3. Impact of Climate Change and V&A Assessment for Rice Production in Prey Veng Province
4. Adaptation Plan for Prey Veng Province
5. Climate Change Glossary in both English and Khmer
6. Report on the Exchange field visit of the National Project Team to other CCA projects
7. Brochure on the first series of demo-project in Cambodia
8. Information on Pond in the target village of the demonstration site
9. PowerPoint Presentation and Training Workshop Proceedings on Strengthening Provincial Capacity in Policy Making and Planning for Climate Change Adaptation at Different Levels, Prey Veng Province, 19-20 October 2011
10. Proceedings of a Training Workshop on Capacity Building for Monitoring and Reporting Progress and Lessons Learnt on Climate Change Adaptation Planning in Prey Veng Province, 26-27 March 2012

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