FINAL REPORT for APN PROJECT
CBA2009-04NSY-Visarto

APN
Asia-Pacific Network for Global Change Research
CAPaBLE

- Making a Difference –

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

Workshop on Climate and Agricultural Risk Management, Phnom Penh, 2009

The following collaborators worked on this project:

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P L APN University of Western Sydney Australian Government AusAID THE CRAWFORD FUND

Project Reference Number: CBA2009-04NSY-Visarto
Final Report submitted to APN

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Table of Contents

OVERVIEW OF PROJECT WORK AND OUTCOMES

Preface

This final report is intended as a reference document on the role of climate change adaptation, which is took part in the workshop and international symposium held in Phnom Penh, Cambodia from 16th to 22 November 2009. It should be useful for climate change adaptation especially in agrarian sectors, particularly those who are interested in developing the climate adaptation farming system research approach to their work. In Cambodia, adaptation to climate change is the most priority. However, to be able to address the adverse impact of the climate change, Cambodia need to highly concern on capacity building, which this training workshop and International symposium is the first seed for Cambodian society.

Finally, a final report document such as this is in larger part a collaborative effort. The writer is grateful for the helpful comments, suggestion, and editorial input of their colleagues in the APN for Global Change Research secretariat, as well as for the comments of other friends and colleagues shown earlier drafts of the work, which helped immeasurably in improving.

Objectives

The main objectives of the project were:
1-Capacity building for promising young agricultural researchers in the Asia-Pacific region in the area of decision making based on weather and climate information.
2- Interactive discussions among CARM Network members for planning and implementing collaborative research programs.
3- Establishing regional research, development priorities, developing research concept notes.
4- Producing material suitable for Climate Field Classes.
5- Development of baseline study guidelines for Cambodia.

Amount received and number years supported

The Grant awarded to this project was:
US$ 30,000 for 1 Year 2009/2010:

Activity undertaken

Workshop on Climate and Agricultural Risk Management: Phnom Penh
Cambodia 15-22 November 2009.
Activities:

I. Training Activity-CAPaBLE funding
II. International Seminar-AusAID funding

I- 15-18 November 2009

Training Activity-CAPaBLE

- ✓ Participants from India, Bangladesh, Cambodia, Vietnam, Indonesia, Laos, PNG, Australia, USA, the Netherlands, WMO, ICRISAT
- ✓ Capacity building in the use of climate and agricultural risk management (CARM) and decision-making
- ✓ With particular reference to crop and disease models for decision making on crop management building on APN projects.

I.1-Activity on 16 Nov:

Each participant introduces:

a) Name, institution, discipline
b) Brief highlights of recent work/project
c) Expected outcome from this workshop

I.2-Key Resource People: 16 and 17 Nov:

Short presentation of their recent area of work to facilitate: engaging the participants including hands-on experience of climate, agricultural, crop and disease management decision-making.

I.3- Plenary Feedback, 18 Nov:

- ✓ Identification of gaps in information
- ✓ Policy, research, and extension strategies required to improve decision-making , economic and environmental outcomes
- ✓ Workshop recommendations
- ✓ Short field trip.

II-International Seminar:

Title: "Climate Risk Management in Rural Communities in Developing Countries of the Asia Pacific Region" 19-22 November including Field Trip from Phnom Penh to Siem Reap.

II.1- 19 November 2009
Opening ceremony

1-) Registration, National Anthem, Welcome remark by Dr Ouk Makara, Director of CARDI, and Mr. Pen Vuth, Director General, General Directorate of Agriculture;

2-) S. Huda: Project aims/objectives,

3-) Opening Ceremony with invited Dignitaries opening speech by Australian Ambassador HE Ms Margaret Adamson Opening Ceremony with invited Dignitaries and

4-) Opening speech by Secretariat of Sate Ministry of Agriculture Forestry and Fisheries, HE. Chan Tong IV.

II.2- 19th November 2009
Symposium

Samsul Huda: Leadership Building Capacity towards Developing Climate and Agricultural Risk Management Strategies.

Christian Roth: Bridging the gap between national climate change vulnerability and impact assessments and the farm level demonstration of adaptation interventions.

Brian Lund – OXFAM US: Bottom up adaptation in crop husbandry with implications for Climate Change adaptation and mitigation.

Jo Luck: An integrated approach to understanding the risks of climate change to plant bio-security.

Tran Van Hai: Management of Brown Planthopper transmitting virus diseases at community level: Synchronized cropping season combined with Brown Plant Hopper escape strategy on rice in the Mekong River Delta of Vietnam.

Saon Banerjee (Indrabrata Bhattacharya, S. A. Khan, and A.K.S. Huda)

Weather disease relationship of some major diseases in mustard and potato in the Gangetic West Bengal, India.

NV Viet: Rational exploitation the Hydro-meteorological information for serving the food security in Vietnam.

Kees Stigter: Coping with climate risk in rural communities in developing countries of the Asia Pacific Region: Policies for preparedness.
Report back in plenary with summary – Rapporteurs

II.3- 20th November 2009
Symposium (Continue)

LS Rathore and N.Chattopadhyay: Weather-based risk management in agriculture.

Md. Delowar Hossain, M. Asaduzzaman, and M.E. Rahman: Impact of climate change on crop diseases in Bangladesh.

GGSN Rao: Weather-based agro-advisories for enhancing agricultural productivity; N.C. Integrated Agro-met Advisory Services in India

S Desai: Decision support systems for disease forewarning in field crops.

Guillaume Lacombe: Climate and rainfall in Laos.

Ken Boote: Crop Modeling Approaches for Predicting Climatic Risk on Crop Production.

Kasis Inape –Impact of climate variability in agriculture and human health in PNG.

Surana: Strategic measures to adapt the variability of climate change related to water resources management in Lombok.

Chirantan Chattopadhyay- Sclerotinia rot and Alternaria blight forewarning models –new proposals in mustard.

Robert Spooner-Hart- Climate change: Insects, pest.

II.4- 21th November 2009
Symposium (Continue)

Giashuddin Miah- Climate change and anthropogenic activities: Impacts on natural resources and food security particularly in coastal region of Bangladesh.

N. Van Viet-The impact of climate change and disaster on food crop yields and some measures to cope with them for food security in Vietnam.

Yahya Abawi- Developing climate resilient systems in the Asia-Pacific region.

Peter Hayman- Communicating climate information for decision-making: Examples from Australia and the Philippines.

Closing Ceremony- Mr. So Khan Rithykun, Director General, General Directorate of Agriculture, Ministry of Agriculture Forestry and Fisheries.

Relevance to APN's Science Agenda and objectives

Adaptation research priorities

Two dilemmas for farm level adaptation research:

- Testing adaptation options today for unknown climate conditions in the future – efficacy/appropriateness of adaptation measures for future conditions intrinsically 'untestable' in on-ground experiments.

- Invariably evaluation of adaptation options needs to rely on robust modelling to extrapolate in time, introducing the uncertainty inherent in climate projections.
- Building adaptive capacity is predicated on overall improvement in livelihoods, which is dependent on increased productivity of farming systems through increased levels of inputs/intensification. This will increase GHG emissions.
- Need to focus on efficiency of adaptation in unit use of input factors e.g. water roductivity, nitrogen use efficiency, fuel/energy use per unit biomass produced etc.

Overarching research issues:

- Bridging the gap between national scale climate change vulnerability and impact assessments, and adaptation interventions at the household and community level.
- Development of multi-scale adaptation strategies and demonstration of processes that enable policy makers to deliver more effective climate adaptation programs.
- Determining the limitations to adaptation, i.e. test adaptation options with respect to their appropriateness under future, locally calibrated climate change scenarios or determining whether thresholds exist beyond which incremental adaptation will necessarily be replaced by more transformational adaptation.
- Assessing not just the risks of climate change, but also demonstrating avenues to capitalise on opportunities arising out of climate change.

Climate science:

- Analysis of historical climate datasets to determine characteristics of climate variability (all four countries) and to determine/confirm trends in climate change (particularly in Cambodia, Lao PDR).
- Use of statistical downscaling methods to 'localise' climate change projections.
- Development of innovative ways of communicating climate uncertainty and variability to

farmers and stakeholders.
- Improvement of the reliability of seasonal climate forecasts and their delivery (mainly in Cambodia, Lao PDR, Bangladesh)

Social and economic science:

- Development of more rigorous tools and frameworks to assess adaptive capacity at a range of scales (household to national policy levels).
- Making computer-based scenario analysis relevant to smallholders by evolving farming systems modelling into participatory livelihoods analysis.
- Determining the financial and economic costs and benefits of adaptation.
- Determining incentives for smallholder farmers to adapt to longer term climate change.

Farming systems analysis:

- Improvement of the capability of farming systems models to simulate rice-based cropping systems and better capture the reality of farmer practices.
- Determining the impact of climate variability and change on whole-of-farming systems response (crops and livestock).
- Determining trade-offs between cropping, livestock production and other sources of rural livelihoods.
- Identification and testing of technically feasible, economically viable and socially acceptable farm level adaptation options across the spectrum of farmers' livelihoods.
- Evaluation of adaptation options with respect to input efficiency, added GHG emissions and avoidance of mal-adaptation.

Self evaluation

The workshop and symposium were successfully conducted with the effort of all participant countries and agencies. In that great opportunity, young Cambodian scientists had a great chance for exchange and learn from the expert who came from different levels of experiences and skills relevant to the climate change. As Cambodia is a least developed agrarian country thus it is vulnerable to climate change due to its low adaptive capacity to the changing climate condition. However, starting from this project Cambodia is one step into climate change matter. The participants of the workshop and symposium (project), especially young Cambodian scientists gained knowledge on climate adaptation even it is too far for Cambodia. Since then, Cambodia actively participates in the global GHG emission mitigation, including CDM project in order to minimize future adaptation costs. However, Cambodia set its policy for the most priority on adaptation to climate change. This project is bridging the gap between national scale climate change vulnerability and impact assessments, and adaptation interventions at the household and community level.

The workshop and symposium is a starter driven force that the development of multi-scale adaptation strategies and demonstration of processes that enable policy makers to deliver more effective climate adaptation programs. Furthermore it can determine the limitations to adaptation, i.e. test adaptation options with respect to their appropriateness under future, locally calibrated climate change scenarios or determining whether thresholds exist beyond which incremental adaptation will necessarily be replaced by more transformational adaptation. The seven days' activities of this project were relatively short, but can achieve an optimum of assessments not just the risks of climate change, but also demonstrating avenues to capitalise on opportunities arising out

of climate change.

It is a great opportunity for me as well as Cambodian scientists that can seat down with famous scientists from difference parts of the world (Asia-Pacific including Europe countries) to discuss and share the knowledge and experiences related to the climate change adaptation. However, due to time limited and my own basic knowledge on this subject the final report is delayed to complete till today. I am frankly, requested for your kind apology of any inconvenient arising from my final report or any circumstances.

Potential for further work

Proposed approach in planned ACIAR adaptation project

General project parameters-Developing multi-scale climate change adaptation strategies for farming communities in Cambodia, Laos, Bangladesh and India

- Project to operate in four countries: Cambodia, Laos, India and Bangladesh
- 4.5 year duration; planned start 1st April 2010
- Commissioned Organisation is CSIRO, through its Climate Adaptation Flagship
- Partners:
  -CARDI, GDA, IRRI, BARI, ICRISAT, OXFAM,

Publications **(please write the complete citation)**

References

1- Agricultural growth in India since 1991' brought out by the Department of Economic Analysis and Policy, Reserve Bank of India, August 2008.
2- MPWT/JICA (2002)

Acknowledgments

We gratefully acknowledge APN for Global Change Research, AusAID - the Australian government's overseas aid program, the Australian Centre for International Agricultural Research (ACIAR) and the Crawford Fund for funding, Agricultural experts from India, Bangladesh, Viet Nam, Cambodia, Indonesia, Papua New Guinea, Tonga, Australia, the USA, and the Netherlands are participants. This is sponsored by the Asia-Pacific Network for Global Change Research (APN), The University of Western Sydney, Australia, the General Directorate of Agriculture (GDA)/Plant Protection Sanitary and Phytosanitary Department, MAFF, Cambodia, and the Cambodian Agricultural Research and Development Institute are for supporting and coordinating the workshop activities.

Overview of Project Work and Outcomes

Project Works:

1- Workshop on Climate and Agricultural Risk Management, 16-18th November 2009.

2- International Symposium: Climate Risk Management in Rural Communities in Developing Countries of the Asia-Pacific Region, 19-22 November, Phnom Penh:

Country papers:

Progress arising from previous APN project on decision making on disease and pest management (India, Bangladesh, Cambodia, Australia, the Netherlands, USA).

Other inputs invited if participants have any experience in this field. Simulation models for crop growth-predicting crop development from weather, climate and other inputs (Boote & others).

Weather and climate data (seasonal only) for predicting disease and insect development (by Luck/Entomologist). Weather and seasonal climate data for better water management (Yahya Abawi). Availability and reliability of weather and climate data (Rathore & others).

Farmer/Research/extension interaction in Decision Making (Stigter)

CARM Workshop: (Hayman, Coughlan, & others)

Interactive workshop on improving decision making using crop growth, disease epidemiology and weather/climate data (could be expanded to include other agronomic decisions, such as planting, fertilizer application).

Challenge to experts from participants: How useful is all this information in MY situation? Is sufficient data available-meteorological?

Group discussions:

Field research and extension specialists- What information do we need to make better decisions? What collaboration between famers, technologists and policy makers will improve decision making?

CARM Workshop (cont)

Discussion groups and Plenary Feedback

What are the gaps in information? What policy, research and extension strategies are required to improve decision making and economic and environmental outcomes?
Workshop recommendations.

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The way ahead- Time line for current program and development of new project proposal
Developing a plan for the data collection and validation during the current year as well as for the second year for formulation of a mega project proposal. The proposal should address on main three points:

- Roles and responsibilities (crop-wise and country-wise)
- Model selection, generation, testing and validation
- Funding and other resource needs

Inputs for final workshop:

- Plenary and small group discussions to determine collaborative research groups and priority activities for different geographic/river basin areas in the Asia Pacific Region
- Development of concept notes for activities, and suggestions for possible funding sources
- Draft Seminar recommendations, including in the policy and strategy areas

Agricultural experts from India, Bangladesh, Thailand, Viet Nam, Cambodia, Indonesia, Papua New Guinea, Tonga, Australia, the USA, and the Netherlands are participants. This is sponsored by the Asia-Pacific Network for Global Change Research (APN), AusAID - the Australian government's overseas aid program, the Australian Centre for International Agricultural Research (ACIAR) and the Crawford Fund. The University of Western Sydney, Australia, the General Directorate of Agriculture (GDA)/Plant Protection Sanitary and Phytosanitary Department, MAFF, Cambodia, and the Cambodian Agricultural Research and Development Institute are hosts.

2-Outcomes:

2.1-Increased knowledge on how access to improved medium-term weather and seasonal climate forecasting can enhance the capacity of both farmers and rural communities to adapt to climate variability, including climate change. For Climate Change, our concentration is on adaptation rather than mitigation.
2.2- Concept notes for collaborative research projects for major agricultural areas in South Asia and South-East Asia on managing climate risk and adapting to climate change.
2.3- Recommendations for policies and strategies will increase the uptake of research findings and decision-making tools by stakeholders in rural communities.
2.4- A viable and active Network with effective working relationships encourage collaboration and information exchange between scientists, policy makers and farmer organisations.
2.5- Knowledge of how access to seasonal climate forecasting can enhance farmers' capacity to adapt to climate change.

It is a starter driven force that the development of multi-scale adaptation strategies and demonstration of processes that enable policy makers to deliver more effective climate adaptation programs. Furthermore it can determine the limitations to adaptation, i.e. test adaptation options with respect to their appropriateness under future, locally calibrated climate change scenarios or determining whether thresholds exist beyond which incremental adaptation will necessarily be replaced by more transformational adaptation.

Future Directions

- PRAtique-7th EU framework (2008-2011)
- Development of more efficient risk analysis techniques for pests and pathogens of phytosanitary concern
- Asia Pacific Network for Global Change (2009-2011)
- Investigating the effects of climate change of pests and diseases of the Asia Pacific (India, Bangladesh, Australia)

Non-technical summary

The training-cum- symposium aims to improve the management of climate associated risks in agriculture, including modified risk profiles associated with climate change scenarios. The training-cum-symposium consists of two parts: 1) A three-day training activity in the area of climate, crop, disease and pest modeling, thus building on the outputs of the original APN project (16-18November). 2) A four-day international symposium on "Climate Risk and Agricultural Management" which focus on information exchange and regional priority setting (19-22 November). A combination training-symposium is jointing supported from APN for global change research (CBA2009-04NSY-Visarto), AusAiD International Seminar Support Scheme and Crawford Fund. Workshop and Symposium on Climate and Agricultural Risk Management project involves 11 participating countries and two organizations; WMO and ICRISAD.

The seven days of training-cum-symposium shared and discussed on climate variability and change creates challenges for agriculture, natural resource management and the subsequent social and economic well-being of associated communities. We identified that there have been improvements in understanding, analysis and forecasting climate variability, data, and developments in climate change, however, we need to formulate new concepts to introduce into the community and apply on a wider scale.

Methodology to deal with such challenge mentioned above is proposed sound educational materials and process for stakeholders in natural resource management, agriculture, water and urbanization, will improve knowledge and skills to better manage the variable climate and in adapting to climate change. Apply of these methodologies it we expected to have a better knowledge and skills and enhancing among stakeholders of decision making. Moreover, in sound of reducing climate risk exposure leading to more sustainable resource use and improved quality of life.

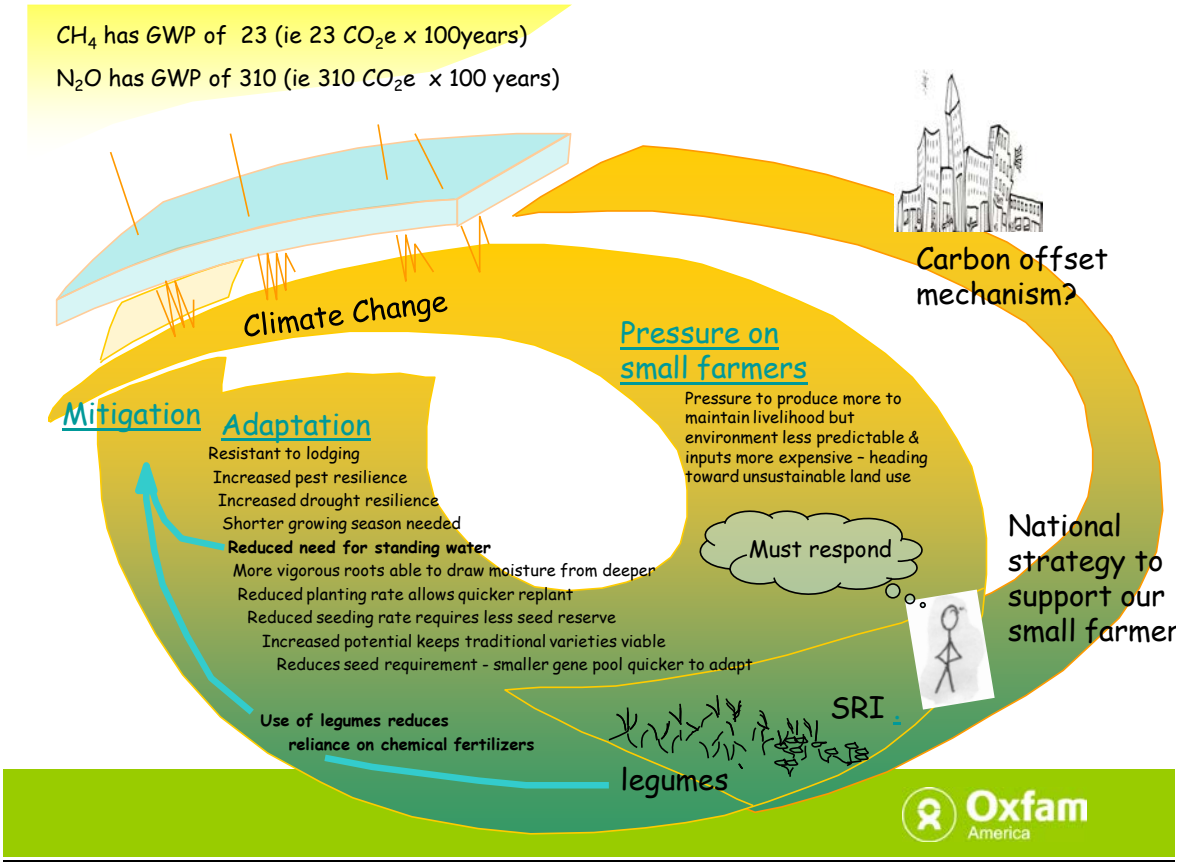
Results & Discussion

The workshop on climate change issue is paid much attention by local and International Organization. In this opportunity, the Oxfam-American in Cambodia has shared the idea and their

activities related to the climate change in Cambodia to the workshop; the Climate Risk Management in Rural Communities in Developing Countries-Adaptation in crop husbandry with implications for adaptation Assisting poor communities achieve sustainable livelihoods is at the core of Oxfam's work. Empowering the community to identify, decide and act on options that affect their lives is at the core of Oxfam's work. Oxfam seeks to work in partnership with the communities and stakeholders that share similar goals. The Oxfam-America in Cambodia has identified the principal approaches on weather forecasting: the forecasting of weather should be operated at state level and need a strong collaboration among national inter-ministerial level such as MoE, MAFF and MoWRAM. Weather forecasting system should response to the community level's comprehension and must be friendly information for the appropriated users. Thus the release of weather information must be by extension experts. The activities related to the field of climate change adaptation in Cambodia set up by Oxfam-American in Cambodia is on the goal which to joint donors and Oxfam affiliates in increasing Cambodia rice farmers' ability to address the effects of climate change on their agricultural practices. To reach that goal, speaker highlighted with three objectives: 1) to collect, analyze, and effectively disseminate timely and user friendly weather information, 2) to build a national-level civil society network and 3) to launch a mass media campaign for raising awareness targeting the general public.

To response the three objectives mentioned above, Oxfam-American has determined two groups of hypothesis; they are adaptation and mitigation.

The adaptation hypothesis are included resistant to lodging, increased pest resilience, increased drought resilience, shorter going period needed, reduce need for standing water, more vigorous roots able to draw water from deeper, reduced planting density allows quicker replant, reduced seeding rate requires less seed reserve and reduced seeding rate means smaller gene pool & quicker gene pool adaptation. And the mitigation hypothesis has discussed in this workshop are 1) Reduced need for standing water – reduced methane, 2) Smarter use of fertilizer – less waste and less N2O and 3) Potential for increased soil assimilation of Carbon.



The adaptation and mitigation approaches are jointly gathering the efforts by Oxfam and her partners to deal with the climate change impacts. Their activities can be a barriers and /or complementary. There are very often, they share the resources for the extension of methodologies, capacity building for amongst actors and assist to develop strategic plan at national institution level. For example, Oxfam-American in Cambodia with her partners, directly or indirectly jointing in the System of Rice Intensification (SRI) Board, which this board has his own function on seeking to have a national strategy that is able to provide guidance to all stakeholders and able to facilitate bottom-up adaptation. Furthermore this board act as a body that can assist to the relevant partners on developing research design, reporting and extend their results with a high quality.

The activities conducted by Oxfam-American in Cambodia are under the following policy and strategies such as invest in agriculture, investment in extension, invest in validating bottom-up innovation, invest in women, encourage private sector and capitalize on productivity improvement (marketing/storage).

The actions for bridging of the gap between national level climate change vulnerability assessments and farm level adaptation interventions are presented by Christian Roth, a research scientist from CSIRO, Australia. He indicated that under climate change theme the projection are available for four countries. The projections should address on arising in temperature, wetter monsoons and decreased rainfall in dry season. In his presentation, Roth also mentioned about the data of changes in rainfall variability scarce and very uncertain.

In the mean time, Roth has observed that the analysis of historical climate data in India and Bangladesh generally consistent with projections, although rainfall trends probably still within

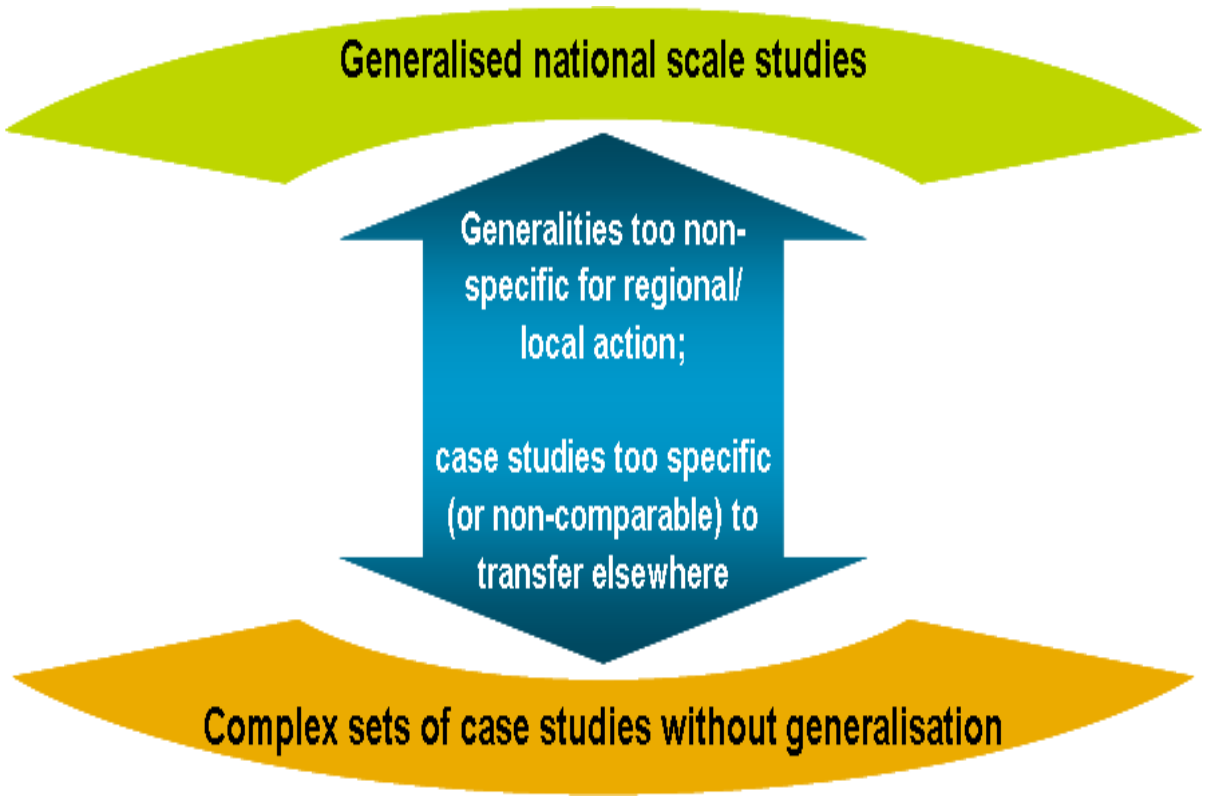
current variability bounds. However, there is no systematic analysis of historic climate data in Cambodia and Lao PDR. For better understanding and managing for current climate variability should be considered as an important entry point for farm level climate adaptation.

Base on results from Bangladesh and India what they used a modelling of climate change impacts mainly temperature and CO_2 fertilisation on major staple crops showing inconsistent responses; thus prediction the impact on rice-based farming systems can be considered. Despite inconclusive impact modelling results that many assertions of major decreases in yields of all major staple crops. However, the impact analysis on cropping systems was not response. Thus, they focussed only on single crops. Furthermore in livestock components there is no data for analysing on it production, which it's impacted by climate change. The impact assessments generally framed in the context of risk and negative impacts. So far it is failing to assess for opportunities. In the future, the impact assessments need to reflect farming systems reality, take into account 'local' climate change and assess opportunities as well as risks.

Regarding to information delivery system, Oxfam-American has shared the successfully of NGOs in Bangladesh and India implemented in the previous, their works are concentrated in climate adaptation and strongly focus on livelihoods. With the exception of the Department of Agricultural Extension in parts of Bangladesh, government extension services not providing any explicit climate adaptation related advice to farmers. While all countries generate medium range and long range climate forecasts (of unspecified reliability), with the exception of India there are currently no dissemination procedures in place to deliver climate information to farmers. In all developing countries, most priority they need to tight with significant awareness raising and capacity building such as improving the skill of forecast, designing effective dissemination pathways and packaging of seasonal forecast information in ways that are meaningful to farmers a major need. However, there is a higher level of basic knowledge existing on farm adaptation in India and Bangladesh, but in Cambodia and Lao PDR they need to set that approach at the priority as it is identified at weak level.

The past adaptation research primarily focussed on national impact and vulnerability assessments to underpin policy and investment prioritisation, as well as on breeding new climate resilient varieties. Conversely, farming households are constantly adapting to change; although change and adaptation within a risk management framework is nothing intrinsically new to farmers, indigenous knowledge is hardly being recognised and utilised. Despite the development of climate resilient farming systems being seen as a key adaptation strategy, very little work on cropping or farming systems level.

In the field of adaptive research, there is a lack of capacity in term of human resource, infrastructures and strategic frameworks. Although understanding how it relates to drivers of change is a prerequisite for selecting the most appropriate adaptation strategies. Spatial integration to bridge the gap between national level vulnerability and impact assessments and the demonstration of adaptation options at the household and community level is lacking.


Generalised national scale studies
Generalities too non-specific for regional/ local action;
case studies too specific (or non-comparable) to transfer elsewhere
Complex sets of case studies without generalisation

Technical Report

Introduction

This section should include background information, scientific significance, objectives, and other relevant information leading to the development and justification of the current project.

The training-cum- symposium aims to improve the management of climate associated risks in agriculture, including modified risk profiles associated with climate change scenarios. The training-cum-symposium consists of two parts: 1) A three-day training activity in the area of climate, crop, disease and pest modeling, thus building on the outputs of the original APN project (16-18November) and 2) A four-day international symposium on "Climate Risk and Agricultural Management" which focus on information exchange and regional priority setting (19-22 November). A combination training-symposium is jointing supported from APN for global change research (CBA2009-04NSY-Visarto), AusAID International Seminar Support Scheme and Crawford Fund. Workshop and Symposium on Climate and Agricultural Risk Management project involves 11 participating countries and two organizations; WMO and ICRISAD. The main objectives of the project were: 1)-Capacity building for promising young agricultural researchers in the Asia-Pacific region in the area of decision making based on weather and climate information, 2)- Interactive discussions among CARM Network members for planning and implementing collaborative research programs, 3)- Establishing regional research, development priorities, developing research concept notes, 4)- Producing material suitable for Climate Field Classes and 5)- Development of baseline study guidelines for Cambodia.

Methodology

The project namely "Workshop on Climate and Agricultural Risk Management" was undertaken by conducting CARM workshop and International Symposium in Phnom Penh Capital of Kingdom of Cambodia from 16 to 22 November 2009, which the workshop on Climate Risk Management took place from 16 to 18th November and continued in the following day of 19 to 22 November 2009 under the activity of International Symposium on Climate Risk Management in Rural Communities in Developing Countries of the Asia-Pacific Region.

Technical report

Dr. Yaya Abavi from the National Climate Centre Bureau of Meteorology & University of Southern Queensland had presented on Developing Climate Resilient Systems in the Asia Pacific Region. He addressed on three approaches: *1) Renewable Energy –2) Water Management (Kiribati, Fiji, Tonga, Tuvalu, Cook Islands, and Vanuatu and 3) Climate Prediction Project- Prediction of Vector-born diseases (Malaria);* they are:

1) Renewable Energy: When the environment around us changes (either temporarily or permanently) we must adjust in order to survive. The more gradual the change, the easier it is to adjust. The more rapid the change the higher the exposure to risk and the more urgent the need for adaptation. Vulnerability is the combined effect of exposure to risk and the capacity to adapt to it.

Building resilient systems or the ability to respond and adapt to change (Risk Management) will reduce vulnerability now and in the future in the Pacific Islands (Samoa Case Study); the hydropower management will develop in aim of determine the utility of SCF in the management of hydro-power generation for the Afulilo Dam and identify management strategies to maximize the use of hydropower generation relative to thermal production. The outcome of this project is energy demand increasing 4-5% p.a. In 1992, Hydropower supplied 80% of demand; currently 50% of energy demand is sourced from thermal (diesel).

2) Water Management (Kiribati, Fiji, Tonga, Tuvalu, Cook Islands, and Vanuatu): Assessing the potential of seasonal climate forecasting to better manage groundwater resources in Kiribati (and Tonga): Collect, collate and digitize historical groundwater test data. Develop software to transform historical groundwater EC measurements into time-series of freshwater lens volume. Assess the forecasting potential of seasonal rainfall and seasonal average freshwater lens volume. Develop guidelines for freshwater lens management based on different ENSO conditions using SCOPIC method.

3) Climate Prediction Project- Prediction of Vector-born diseases (Malaria)- Determine whether malaria epidemics in the Solomon Islands are (SI) related to the ENSO, rainfall and other hydro-climatic variables; and determine if such relationship can be used as an early warning system for predicting heightened risk of a malarial epidemic and therefore in assisting targeted control strategies. Malaria Snapshot 100 countries, 40% of world population live in areas where malaria transmission occurs. We observed around 300 – 500 million cases each year worldwide and about 750,000 – 2 million deaths each year, *Plasmodium falciparum* accounts for 60-70% of all cases in SI. The disease is transmitted by Anopheles Mosquitoes with an ideal breeding condition of 25-30 C with RH 60%. Rainfall prediction based on SST1 and 9 have good skill during the wet season for most of the provinces except Western and Choiseul. It is therefore possible to forecast malaria epidemic well ahead of time and take preventative measure to reduce its impact on the population.

Sharing information related to the climate issue is an important tool for climate change research and taking part on climate resilience and adaptation, even that information from the least developing countries. Dr. Khanmany KhounPhonh, Head of Technical management Division, Department of Meteorology and Hydrology of Lao P.D.R, has presented to the workshop on general climate in his country.

The Climate in Lao PDR is tropical with wet and dry seasons. Generally, Lao PDR has two monsoons: 1) the Northeast monsoon, which occurs from November to mid of March and 2) the Southwest monsoon, occurs from mid of May to mid of October; latter being characterized by frequent and heavy rainfall and high humidity. A short drought about two weeks is normally experienced between of the end June and the beginning of July. Cyclone disturbances or the passage of tropical cyclone often causes heavy rain. The annual rainfall ranges from 1,400 mm to 3,500 mm. The temperature is highest in April (35^{o}C-38^{o}C) and lowest from December to January (13^{o}C –17^{o}C) with an annual average of 26^{o}C.

The data of meteorological and rainfall are collected from a network of main and secondary synoptic stations, in which due to power man resources, Lao PDR can only monthly recording. The data processing, analysis and archiving system is conducted in head quarter of Department of Meteorology and Hydrology (DMH). The data storage and processing is taking place at the center, where the activity is to process all climatic data in accordance to Clicom and spreadsheet excel (climate computing) and for the hydrological data use HYMOS modeling for processing and analysis

the stream flow data. For the weather situation, Lao PDR use synergies software for analyzing the surface, upper air chart and the tropical cyclone track forecast from TC web site project under WMO. Rainfall forecast 1-7 days from NOAA, and every 3hours from USA's Fnoc Navy.

As Lao PDR is a tropical country with a heavy rain, flood occurs almost every year. In average, they recorded two to three tropical storms passed over Lao P.D.R, except El Niño's year. In Lao PDR, the tropical cyclone is not a direct threat. Flooding along the Mekong river result from heavy monsoon rainfall and tropical cyclone originating in the south of China Sea is during the period of August to September. Lao P.D.R has experienced 25 floods on the Mekong River in the last 33 years (From 1996-1997, 2002 and 2008) and the 25 historic floods only five years were large, covering whole the country (1996, 1971, 1978 and 1995 & 2008). In August 2008, the tropical storm KUMMURI (0809) passed through Southern area of China, the spiral band of the tropical storm covered the northern and middle parts of Lao PDR. As a result, the monsoonal heavy rains can be observed over the upstream of Mekong River in Lao PDR, the rainfall was estimated to exceed more than 100 - 150 millimeters in 24 hours.

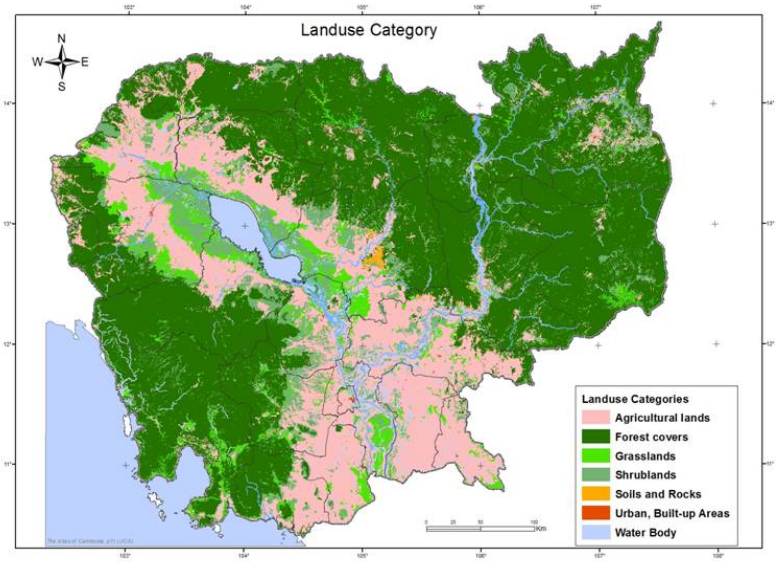
In Lao PDR, the heavy rainfall associated with tropical disturbance caused frequently severe flooding and the flood occurred over low-lying areas along the Mekong River. Rice production occupies over 80% of cultivated. The extreme weather monitoring and accurate of forecasts and warnings at DMH of Laos is a great importance to assist the government and public users to take prevention activities, especially the Agriculture and hydropower sector . Sharing of Meteorological and Hydrological information with mass-media and concerned line agencies is very important. DMH will keep going on strengthening with regional and international organization in term of disaster prevention and mitigation.

Cambodia is other tropical climate and least developing country. Representative from this country Dr. Ouk Makara, Director of Cambodian Agricultural Research and Development Institute, CARDI, from the Ministry of agriculture forestry and Fisheries (MAFF) presented general information on climate and it's relevant: Cambodia is located at 102^{o} to 108^{o}E and 10^{o}to 15^{o} N, which influence two monsoons; wet and dry. The dry monsoon started from November to April while wet monsoon is occurs from May to October. Cambodia is worm and wet climate; annual rainfall is fluctuated in the average of 1250 – 2500 mm. The lowest rainfall occurs in January and in October we record with a high rainfall. The air humidity in Cambodia is varied from 69 - 80%, in which the lowest is in March and the highest is in September.

The majority of traditional crop cultivars are fruiting depending on the variation of day length. The shortest of day length occurs in December (11hours) and longest is in June (13 hours). The temperature varies from 23 to 33^{o}C, the lowest occurs in December and highest is in April; with an evaporation of 2230mm/year, which the lowest and highest evaporation occurs in September and March respectively.

Land use categories

In total of 18 million hectares of land use, agriculture land is occupied 24 percent (4,370,027ha) after land covered by Forrest (56%). We expected that the land covered by forest would be decreased as the agricultural and urban lands will be increased. However, the development of the country related to the land use should be under the legal frame work.



Land use	Area (ha)	Area (%)
Total	**18,133,656**	**100**
Agriculture	**4,370,027**	**24**
Forest cover*	**10,215,094**	**56**
Grassland	**1,078,243**	**6**
Shrub land	**1,883,882**	**10**
Soil-Rock	**36,254**	**0.2**
Urban	**18,022**	**0.1**
Water	**532,133**	**3**

Under the Natural resources and environmental management law, in article 59 of the constitution stated that the state shall protect the environment and balance of abundant natural resources and establish a precise plan of management of land, water, air, wind, geology, ecology, ecologic system, mines, energy, petrol and gas, rocks and sand, germs, forests and forest products, wildlife, fish and aquatic resources".

Ministry of Agriculture, Forestry and Fisheries (MAFF) is a main government institution for management of natural resources while the Ministry of Environment (MoE), it duty is to protect the natural resources and prevent environmental degradation, advising relevant ministries on the conservation, development and management of natural resources. Promoting agricultural sector, the participation of private sector is indispensable, in which the Royal Government of Cambodia attempts to provide the assurance of land ownership and also promoting the development of irrigation facilities. The expanding support services on agricultural research and extension including

marketing for agricultural product, distribution of inputs, seeds, fertilizer, increased supply of rural credit and encouraging private investment is essential of Government Policy on Agriculture.

Dr. Ouk Makara, highlight that the constraints in agriculture in Cambodia are mainly water and soil fertility, which they are directly influenced to the crop productivity; farmers are facing to land degradation by flood and often following by prolonging draught associated with pests and diseases.

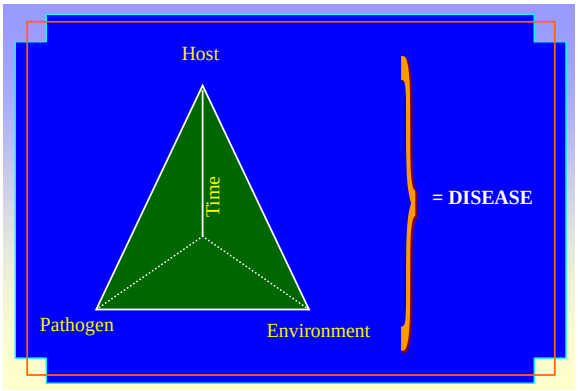
Response to the above constrains, Royal Government of Cambodia's Policies on Agriculture is to improve agricultural productivity and diversification. Agricultural sector is to serve as the driving force for economic growth and poverty reduction such as promoting agricultural intensification and diversification, creating employment and generating income in the rural areas, ensuring nutritional improvement and food security, increasing production while ensuring quality for international standard of agricultural products, and increasing agricultural exports.

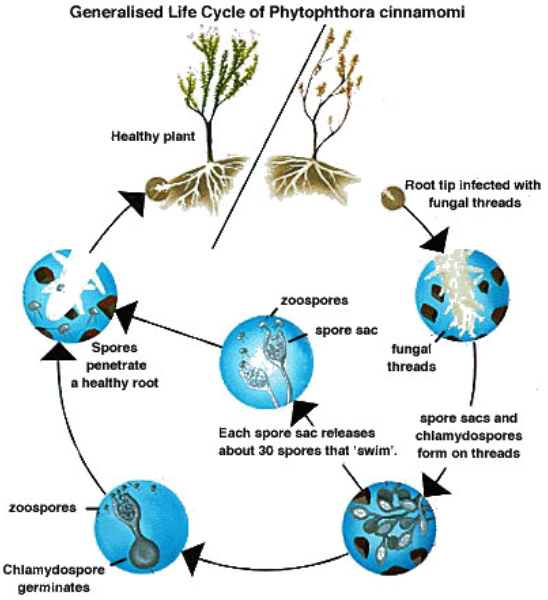
Cambodia's research system in the field of agriculture is very young compare to other member in this project. Providing an experience on agriculture research to the young scientist, a senior researcher from India, Dr Chattopadhyay, has presented a research paper on the models to forecast *Alternaria* blight and *Sclerotinia* rot in Mustard. Results indicated that the disease of Alternaria brassicae causes about 35% loss to oilseed of Brassicas (Kolte, 1985), on diseased seed/ affected plant debris in tropical or sub-tropical India ruled out (Naresh Mehta et al., 2002), oilseed of Brassicas sown late August to November (crop species, prevailing temperature, soil moisture), harvest - February to May, off-season crops - May to September, harbouring by vegetable Brassica crops and alternative hosts (*Anagallis arvensis, Convolvulus arvensis*) - reason for carryover one crop-season to another (Naresh Mehta *et al.,* 2002). Air-borne spores form primary inoculums (Kolte, 1985).

The field experiment were conducted in Bharatpu (27'12°N, 77°27'E), Dholi (25°59´N, 85°75´E), and Berhampur (24°6´N, 88°19´E) in the post rainy seasons of the year 2001-02-03-04-05...08-09. Results indicated that the initial date of AB appearance in each plot, disease progress recorded from 10-tagged randomly plants in experimental plot for percent disease severity (PDS) twice a week (Tuesday, Friday) till harvest on leaves, pods following scale of Conn *et al.* (1990).

Sclerotinia rot of mustard is a major soil borne disease in mustard causing premature drying of crops, which cause yield losses up to 40%. Chattopadhyay *et al.,* 2005, found to cause severe losses in Sriganganagar, Bharatpur, Alwar, Jaipur, Hanumangarh, Dausa, Bhilwara, Ajmer and other districts in Rajasthan, States of WB, Bihar and Haryana. Pathogen has a wide host range, known to infect more than 408 broadleaf species with no proven source of resistance against the disease reported till date in any of the hosts. The incidence of Sclerotinia rot was positively correlated with increase in soil moisture content (R2: 0.84), particularly during the flowering period and more specifically between 50 and 60 days after sowing. A combination of clear sky with cool weather and high soil moisture during the critical stage of 50-60 day age of crop seems to have favoured higher Sclerotinia rot incidence on Indian mustard at the site of experimentation.

Key factors influencing insect and pathogen introduction, survival and establishment was presented by Dr Suseendra, Indian pathologist. The results of his research showed that the biometeorology is the study of interactions between the physical environment and all of life's forms such fungi, bacteria, viruses, nematodes, phytoplasma. Pathogens are considered as part of the biotic environment that exert a strong selective force on populations of plants and animals; in example, *Phytophthora infestans* is famous because it was responsible for the great potato famines in Ireland in which over a million people died due to starvation. Virtually the entire potato crop was wiped out in a single warm, wet week in the summer of 1846. This event initiated large-scale emigration. Within the decade that followed the population of Ireland dropped from 8 million to 4 million people. Genetic systems determining virulence in the pathogen will be paralleled by genes conferring resistance in the host. This is because any mutation to virulence in a pathogen population will be countered by the selection of hosts able to resist this more aggressive pathogen. Thus, in a ideal world, we might expect a perpetual stalemate, with host and pathogen populations being closely matched in resistance and virulence. Hence, over time disease would be neither completely absent nor epidemic. So what happened in Ireland in 1846? Why did *P. infestans* wipe out virtually all of the potatoes? Disease epidemics often occur when genetic diversity of plant populations is eliminated by human intervention.





Many foliar pathogens like *Botrytis, Alternaria, Cercospora* require a thin water film to germinate and infect plant surfaces. Keeping leaf surfaces dry by controlling condensation can effectively prevent and suppress fungal diseases. The environment factors such as temperature (most plant pathogens prefer 5 - 30 C), moisture as free water, Relative Humidity, & over a period oxygen is required by most plant pathogens air movement (ventilation) Light - Intensity, Quality, Soil pH, Soil Fertility - Deficiencies, Toxicities, Salinity are influenced the disease development. The impact of plant disease and the losses that it causes are a function of disease progress. To reduce this impact, we must understand in quantitative terms of the progress of disease and the factors that influence disease progress. For example in a simple interest disease such as a soil borne pathogens (Phytophthora blight of pepper seedlings) where disease progress is roughly linear (allowing for some minor deviations that we can consider random error). From the influence of environment on disease development we can use a warning information module; for example Botrytis mold on grapes. Data for forewarning should collect from the sensor, which mounted in the canopy of the crop. The date using for this module are hourly average temp (°C) and leaf wetness duration (h).

This module is a multiple regression model best described (R^2=0.75) the logit of berry infection as a function of the interaction of wetness duration and temperature.

The Infection Index should be calculated followed by:

$$\ln (Y/1-Y) = -2.647866 - 0.374927W + 0.061601WT - 0.001511WT^2$$

Where: W= leaf wetness duration in hours;

T = temperature in Celsius; and

ln (Y/1-Y) = the logit of disease incidence where Y = the proportion of infected berries.

There is an additional model assumptions/implementation considerations:

Split wetness periods: If the wetness sensor registers more than 4 h dry, then model restarts wetness accumulation at next wetness event, otherwise, it combines wetness periods and notes that a split period has occurred;

If the temperature is less than 12 C then run the model as if T = 12 C (minimum temperature tested in experiments);

If T > 32 < 40 then run model as if T = 32 C (maximum temperature tested in experiments);

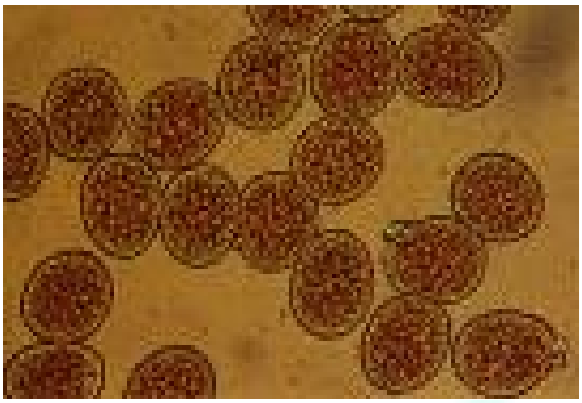
If T > 40 C then time interval is not conducive to infection;

If RH is greater than or equal to 95% then assume a wetness period is occurring due to limitations of wetness sensors;

If more than 16 hours of wetness occur, regardless of temperature, then consider wetness event severe. The disease index is calculated whenever leaf wetness is detected.

There are key factors that influence on:

Plant bacteria and phytoplasma: Rain splash, temperature, humidity, phenology of host, cell nutrients e.g. xylem a composition, availability of alternate hosts, ssurface area, mechanical, wind /hail damage, frost injury, presence of vector, vector acquisition and transmission.



Viruses: Insects/mechanical transmission-all factors influencing insect presence, replication in insect vector and its ability to acquire and transmit pathogen, factors affecting movement and titre throughout plant e.g. Phloem nutrient composition, and age of plant tissue.

Fungal pathogens (foliar): Over-wintering (life cycle) and inoculums load, cropping practices e.g. low till, machine harvest, host phenology, available alternate hosts, leaf area and wetness, humidity, wind, rain splash, and injury (mechanical, wind, pruning). A serious pathogen in wheat growing regions worldwide is wheat stripe rust (*Puccinia striiformis)*; when the iincreasing of temperature may limit spore survival and increased winds associated with severe weather events may result in more widespread dispersal of spores; also the increasing of CO_2 may increase biomass of wheat and infection surface area.

Fungal pathogens ***(soil-borne):*** Moisture, flooding, root-distribution, vector e.g. nematodes.

Insect: Humidity, temperature, wind and air currents, phenology of host/age of tissue, presence of alternate hosts, plant chemical and visual cues, presence of virus and other pathogens can attract insect, insect chemical cues e.g. pheromones LBAM, crowding and competition triggers flight (e.g. aphids), day length (e.g. aphids), and presence of predators. One of the most important pests in subtropical and tropical agriculture and greenhouse production systems worldwide is Silver leaf Whitefly (*Bemisia tabaci* biotype B), it is a ffeeding damage and virus vector insect; when increased winter temperatures-increase over-wintering and survival of insect then they shift in geographic range. Winds may speed up it dispersal. However, drought or intense rainfall could disrupt whitefly development and limit its population size and distribution in some regions; increased winds, driving rains and damaged plants will enable widespread dispersal of spores, cells and insects.

Rising CO2 and plants*:* Higher crop yield under elevated CO_2 in chambers (C fertilisation), greater water-use efficiency due to partial closing of stomata under high CO_2, changes to C:N ratio, increased waxes and terpenoids - physical and chemical resistance, increased surface area

Elevated CO2 and plant pathogens: May modify pathogen aggressiveness and host susceptibility, increased fecundity and growth of some fungal pathogens (Chakraborty *et al.*, 2000, Coakley *et al.* 1999, Hibberd *et al.* 1996). Predisposed rice to blast (*Magnaporthe oryzae*) and sheath blight (*Rhizoctonia solani*) and predisposed *Populus* to rust by 3 to 5-fold (Kobayshi *et al*. 2006).

Elevated CO2 and aphids: Reproductive rate increases in pea aphid, *Aulacorthum solani* and the peach potato aphid, *Myzus persicae* under elevated CO_2. Feeding and oviposition preferences may change, Insect development/life cycle changes, altered population size, altered genotypic and phenotypic frequencies in aphids on broad bean (Mondor, *et al* 2005). Feeding behaviour with C:N ratio changing (compensatory feeding effect), acquisition and transmission on virus and bacteria will change.

Integrated approach to understanding the risks of climate change to plant bio-security

The speaker (Jo Luck) highlighted the data collection for use in enhanced modeling tools to predict effect of climate change on pests and diseases. In the process, the crops were exposed to elevated (550 ppm) CO2 to understand the effect on diseases / pests.

In case of wheat stripe rust, no significant effect was found for symptom progress on the resistant variety. However, there was significant increase in disease progress and pathogen fecundity in susceptible variety with increased water availability. For crown rot, length of stem browning was higher in one of the years (2007) while it was not significant in 2008. For white head severity, there was no significant difference with elevated CO2. It was also noted that fungal biomass was significantly higher under elevated CO2 as understood by QRT PCR. For barley dwarf virus and its aphid vector (*Rophalosiphum padi*) were studied and found that the virus did not establish well in 2008 although it was widespread and abundant in 2007. *Psyllids* were found to have shortened life cycle. Adult *Psyllid* population was found to shift southwards, population reduced in the inland, north and population diminishes over time. The team of researchers tried to model the migration. The speaker clarified that factor using in this model was temperature. However, the model was not validated and this model was not included moisture observation for modeling *Psyllids.*

Downy mildew on oilseed Brassicas was presented by plant pathologist from West Bengal of India, Dr Soan indicated that a high infestation of disease was observed on all sowing dates on all test cultivars at a particular time. Downy mildew incidence was related to minimum temperature (~10^{o}C) and morning relative humidity (RH) > 90%. They found that alternaria blight on oilseed brassicas was higher under warm humid conditions. In case of potato late blight, percent disease incidence was inversely proportional to temperature at tuberisation stage or in February and is related to RH (r2: 85). They established that if RH: Thermal ratio is >3, late blight is more. Thus, such thumb rules are used to provide agro-advisories to farmers. However, there was no general conclusion regarding to the severity of alternaria blight; it should be higher in *Brassica rapa* or lower in *B. juncea.* At the Soan concluded that the forecasting of late blight of potato is quantify by using the Relative Humidity ration and indicated that if it is higher than 3 thus late blight would be observed more. Furthermore, researcher from also India, Dr. Bhattacharya indicated that downy mildew in cucurbits are high in the Gangetic West Bengal was due to improper disease management and year-round crop and weed hosts. Climate factors were responsible for incidence of the disease with lack of enough information on pathogen survival. He presented the epidemiology and disease cycle of the disease in brief. He demonstrated the way of risk prediction using relation of pathogen *Pseudoperonospora cubensis* sporulation being negatively related to temperature. Using the Burkard 7-day recording volumetric spore-trap, he showed that the sporulation was high in Jan-Mar period, particularly around 0800 hrs (morning) in the 2nd fortnight of January. Further, he concluded that the degree night hours were also related to spore production.

Speaker from Vietnam (Tran Van Hai) indicated that 3-7 crops of rice were taken in the study area every two-year period. Distribution of viral diseases on rice in Mekong delta was observed apart from high density of BPH in rice hills. Viral disease symptoms were visible at 7-21 days after sowing (DAS) and 7-35 days after release (DAR) of BPHs. Keeping in view the need to reduce application of pesticide to manage BPH and the fact that use of pesticide does not help manage viral diseases, the speaker demonstrated how sowing was delayed beyond first week of April after the BPH population lowers. This helps escape viral diseases on rice in the delta under study. The farmers are helped by providing agro-advisories with help of monitoring of BPH population and links with local meteorological experts. Instead of this strategy, there no other management such as cultural practices has been used for BPH management. However, based on data on BPH population migration and meteorological data, advisories are decided. Speaker ended his presentation with unsure BPH situation in the future in the course of climate change.

IPM approach in Cambodia

Integrated Pest Management (IPM) in Cambodia started from rice crop and now expanded to vegetable crops. This practice that can be mitigated the climate change as this approach is concerned on proper use of agricultural production inputs especially chemical. Kean Sophea from the General Directorate of Agriculture of the Ministry of Agriculture, Forestry and Fisheries has presented to the workshop that Cambodia was rebuilding itself after decades of civil war. About 36% of the population was below poverty line and hence in the cultivation of rice, IPM was a major approach. They considered 14 target areas for 2464 Farmers' Field Schools (FFSs) with participation of 76759 farmers. Apart from rice, they had maize, watermelon, rice-fish system, etc. as crops for IPM in the FFSs. They moved to 199 student field schools with participation of 5365 students. However, they got better results with 79 Farmers' Field Schools, wherein they had participation of 1657 farmers. They were successful in reducing use of pesticide by introducing the rice-fish-vegetable system.

The Impacts of the Climate Change and Disasters on Crop Yields and Some Measures to cope with them for the Food Security in Vietnam has presented by Nguyen Van Viet, researcher from Agrometeorological Research Center of Vietnam. The speaker was highlighted that disasters occurred in Vietnam in term of frequency and intensively it can be accounted with typhoons, heavy rain, floods, high temperature and drought. These phenomenons are increasing in many regions of the country.

In Vietnam the annual average temperature increases about 0.10 ^{o}C per decade. In summer months, temperature increases about 0.1- 0.30 ^{o}C per decade.

Heavy rain happen more frequently and Seasonal rainfall amount decreases in July and August and increases in September, October and November. The change of average annual temperature in mountain and Midland in the North of the country has been increasing and recorded as follows: In the Red river delta increased about 0.2 – 0.40 ^{o}C, while in the North West increased about 0.2 – 0.30 ^{o}C. Noted that in the south central of Vietnam the annual average temperature has increased up to about 0.50 ^{o}C. However, in the central of highland of Vietnam, the average temperature is annually increased only 0.10 ^{o}C and follows by the North East South, which it was increased about 0.20 ^{o}C. In the Mekong river delta, the increasing of average temperature is the same as in south central of Vietnam, they recorded about 0.50 ^{o}C increase annually. The temperature of the day was observed varied according to the location and time of the day: The day pass through 20 ^{o}C was

observed in one day in mountain and Midland of the North, five days in the south central, six days in Red river delta, seven days in the North central and eight days in the central highland. The day pass through 25 ^{o}C was observed two days in mountain and midland of the North. In Red river delta the temperature pass through 25 ^{o}C started at early day and ending at late of the day, while in the North central this temperature level prolonging till 12 days.

Methods of the predict food crop yields before harvest time for food security information as following:

$$Y_{t+1} = Y_t + \Delta Y$$

Where are: Y_{t+1} prediction of crop yield in present year

Y_t crop year in the year before

ΔY difference food crop yield can be found in the following equations:

a) For winter-spring rice:

a1) in midland Bacbo: $\Delta Y = 0.451 - 1.156\Delta T_3 + 0.095\Delta R_2 + 0.095\Delta S_4$

a2) in red river delta: $\Delta Y = 0.714 - 2.2422\Delta T_3 + 0.024\Delta R_2 + 0.02\Delta S_{11}$

a3) the Mekong river delta: $\Delta Y = 0.708 + 1.095\Delta T_2 + 0.0296\Delta R_2 + 0.042\Delta S_{12}$

Where are: ΔT_2 , ΔT_3, ΔR_2, ΔS_4 , ΔS_{11} and ΔS_{12} are the differences of temperature, rainfall and sunshine duration in February, May, April, November and December.

b) For summer rice:

b1) in midland Bacbo: $\Delta Y = 0.397 - 2.034\Delta T_8 + 0.01\Delta R_{10} + 0.008\Delta S_7$

b2) in red river delta: $\Delta Y = 0.159 - 3.406\Delta T_7 + 0.002\Delta R_7 + 0.02\Delta S_5$

b3) the Mekong river delta: $\Delta Y = 0.851 + 0.613\Delta T_7 + 0.011\Delta R_7 + 0.106\Delta S_6$

Where: ΔT_7, ΔT_8, ΔR_{10}, ΔS_5, ΔS_6 and ΔS_7 are the differences of temperature, rainfall and sunshine duration in May, June, July, August and October.

History of Agriculture losses by disasters in Vietnam

According to recent scientific studies from 1951 to 1998 there were 13 *Elniño* years, 11 *Laniña* years and 24 non ENSO years. The thirteen *Elniño years* were recorded in 1951, 1953, 1957, 1963, 1965, 1969, 1972, 1976, 1982, 1987, 1991, 1994, 1997 and 11 *Laniña* years were occurred in 1955, 1956, 1964, 1970, 1971, 1973, 1975, 1988, 1995 &1998. The average losses due to those phenomenons are US$ 134 million per year. To cope with climate change and disasters for food security and sustainable development the Government of Vietnam is taken two principal measures approaches: 1) adaptation strategies for agriculture and 2) application of ENSO forecast for changing crop calendar in winter - spring, summer rice such as in *Laniña years*.

The first approach of adaptation strategies for agriculture is grouping into two: short term and long term adaptation. The short term adaptation are included insurance in agriculture to cope with weather variation, diversification on crop and livestock for changing crop types requires sufficient, farmers' knowledge related to the climate change impact, production intensification, improving

nutrient and pest control management, changes in tillage practices and farm systems and temporary migration.

The long term adaptation strategies for agriculture are include the development of new technologies and modernization, changing crop mix, improving water management and permanent migration of labor. However, there are several strategies that can be short and/or long term; they are include of the investment and accumulation of capital, reform of pricing schemes development of open markets and other reforms, adaptation of new technologies, promotion of trade, this is likely to enhance economic adaptations under climate, extension services, diversification if income earning and employment opportunities, dissemination of climate data, institutional planning and implementation.

The second approach of adaptation measures is the application of ENSO forecast for changing crop calendar in winter - spring, summer rice such as in *Laniña* years. In *Laniña* years, rice crops should be change in winter-spring and such rice production system should consider with some necessary measures. In the following there are some measures that need to be considered according to the region for example, in the North Vietnam should pay attention to having measure for preventing chilling for seeding, using late maturity and chilling tolerant varieties and having priority to early and leading crops in designing rice cropping pattern in delta region. For Vietnam country, workshop would summarize in the following aspects:

a. The effect of climate change, variability, and disasters on agriculture is not similar in different agro-ecological regions in Vietnam.

b. For serving on food security and sustainable development on agriculture to cope with climate change and disasters, it is obligatory to change the cropping calendar, cropping pattern, cropping rotation for every agro-ecological regions.

c. At present and near future it is important to use climate index and ENSO index in early agro-meteorological monitoring and forecasting food crop yield especially for rice, for conserving with food security in Vietnam.

d. For region with unsustainable soil moistures it is necessary to keep water in the soil as first response, and then choose new varieties of crop, which can adapt to drought.

e. Building a good irrigating system such as in the Red River Delta and Mekong River Delta.

f. Building more reservoirs of all kinds in the midland and highland regions.

Impact of Climate Change on India Agriculture: Adaptation and Mitigation Strategies

The adaptation and mitigation strategies were raised by Dr Wani, research scientist in the International Crops Research Institute for the Semi-Arid Tropics of India. The main objectives of these strategies are to reduce poverty, increase agricultural productivity, enhance food and nutritional security and protect the environment of the semi-arid tropics by helping empower the poor through science with a human face and partnership-based research. Related to the climate change India identified several threats; those threats are included climate crisis, water crisis,

desertification, food crisis, energy crisis, population crisis, and biodiversity crisis. In his presentation, Dr Wani raised up several scenarios related to the climate change such as global project should mean to the global warming, very cold days become very likely, southwest monsoon tend to be stronger, increasing of the rainfall variability as well as summer rainfall including frequency. The increasing variability of rainfall provoked India facing to flood and drought disasters. In year 2002, drought occurred in India during July was unique with reference to its climate anomalies, their impacts as well as the institutional responses. The month of July, normally expected to be wettest month turned out to be the driest in the recorded history since 1877 causing a loss of around 24 million tonnes of food grain reported across the country. The impact of climate change cause on ecological stress, further land degradation and soil erosion, loss of soil nutrients, shrinking farm size, reduced access to technology and reduced credit leverage, undependable water availability, and economic vulnerability. To meet such challenge India set three strategies: 1) Business as usual will enhance the nation's vulnerability, 2) Develop strong and winning strategy in India and 3) Change in their mind-set is must and new paradigm is needed.

Conclusions

It is a starter driven force that the development of multi-scale adaptation strategies and demonstration of processes that enable policy makers to deliver more effective climate adaptation programs. Furthermore it can determine the limitations to adaptation, i.e. test adaptation options with respect to their appropriateness under future, locally calibrated climate change scenarios or determining whether thresholds exist beyond which incremental adaptation will necessarily be replaced by more transformational adaptation.

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Appendix

Conferences/Symposia/Workshops

Agenda/Programme (including title, date and venue)
Participants list (comprising contact details of each participant, including organization, address, phone number, fax number, and email address).

Appendix1: Programmes:

1.1- Programme, Climate and Agricultural Risk Management Workshop, Phnom Penh, 15-18 November 2009.

DATE	ACTIVITIES
Sunday 15	5pm: Registration at Goldiana Hotel 6pm: Pre-dinner reception at Goldiana Hotel
Mon 16	CARM Workshop: • Pick up by CARDI bus at 7.45 am each day • Opening Ceremony: Monks' blessing; speech by APN representative, CARDI Director • Introduction: Purpose of the workshop • Country papers: Progress arising from previous APN project on decision making on disease and pest management (India, Bangladesh, Cambodia, Australia, USA, the Netherlands). Other inputs invited if participants have any experience in this field • Evenings free apart from Workshop Dinner Friday
Tues 17	CARM Workshop Interactive workshop on improving decision making using crop growth, disease epidemiology and weather/climate data (could be expanded to include other agronomic decisions, such as planting, fertilizer application) • Presentations from crop, plant pathology and climate experts- what information can we supply? • Group discussions - Field research and extension specialists- What information do we need to make better decisions?
Wed 18	CARM Workshop • What are the gaps in information? What policy, research and extension strategies are required to improve decision making and

	economic and environmental outcomes? • Workshop Recommendations • Closing Ceremony • Possible short field trip in afternoon, returning to Phnom Penh *via Choeung Ek* Memorial (Killing Fields)

1.2- International Seminar: Climate Risk Management in Rural Communities in Developing Countries of the Asia-Pacific Region

19-22 November, Phnom Penh

Agricultural experts from India, Bangladesh, Thailand, Viet Nam, Cambodia, Indonesia, Papua New Guinea, Tonga, Australia, the USA, and the Netherlands are participants. This is sponsored by the Asia-Pacific Network for Global Change Research (APN), AusAID - the Australian government's overseas aid program, the Australian Centre for International Agricultural Research (ACIAR) and the Crawford Fund. The University of Western Sydney, Australia, the General Directorate of Agriculture (GDA)/Plant Protection Sanitary and Phytosanitary Department, MAFF, Cambodia, and the Cambodian Agricultural Research and Development Institute are hosts.

Expected Outcomes:

- Increased knowledge on how access to improved medium-term weather and seasonal climate forecasting can enhance the capacity of both farmers and rural communities to adapt to climate variability, including climate change. For Climate Change, our concentration is on adaptation rather than mitigation.
- Concept notes for collaborative research projects for major agricultural areas in South Asia and South-East Asia on managing climate risk and adapting to climate change
- Recommendations for policies and strategies that will increase the uptake of research findings and decision-making tools by stakeholders in rural communities

Some notes on the Program:

1. Session Times: On Thursday finish opening ceremony and have (late) Morning Tea. Then:
    - 11.30-12.30-Papers
    - 12.30-1.30 lunch
    - 1.30-3.00-Papers
    - 3.00-3.30 Afternoon Tea
    - 3.30-5.00 Papers
    - Friday- pm the same as for Thursday, but in morning there will be two paper sessions 9.00-10.30 and 11.00-12.30
    - Sat 9.00-10.30 am Papers; 11.00-12.30 and 1.30-3.30 pm-The Way Forward, 4.00-5.00 pm Closing Ceremony

2. At this stage we are planning a 20 minute presentation time, including questions

3. A List of papers is given below, but they are not yet placed in order or in themes. Note that we do not yet have paper titles from the following: Wani, Khounponh, Inthravong , Nguyen Van Viet, Surana, Charlesworth-Vannareth.

4. The following Session Themes are suggested: crops, pests and diseases, water management, meteorological data management, and decision-making, including Farmer Field Schools.

19 Nov Thursday

Time	Activity
08:30-09:00 09:00-10:00	Registration National Anthem Welcome remark by Dr. Ouk Makara, Director of CARDI, Welcome remark by Mr. Pen Vuth, DDG, GDA, MAFF Associated Prof. Samsul S. Huda : Project aims/objectives Opening Ceremony with invited Dignitaries and opening speech by Australian Ambassador HE Ms Margaret Adamson Opening Ceremony with invited Dignitaries and opening speech by Acting Minister of Agriculture Forestry and Fisheries, HE Chan Tong IV
1000-1040	Group picture and Tea break
Session: 1 **Chair: Kep Coughlan** **Rapporteur: Jo Luck**	
1040-1100	Samsul Huda: Leadership Building Capacity towards Developing Climate and Agricultural Risk Management Strategies.
1100-1120	Christian Roth: Bridging Building the gap between national climate change vulnerability and impact assessments and farm level demonstration of adaptation interventions.
1120-1140	Brian Lund- OXFAMUS: Bottom up adaptation in crop husbandry with implication for Climate Change adaptation and mitigation
1140-1200	Ouk Makara- Agricultural Research and Development in Cambodia
1200-1230	Discussion
1230-1330	Lunch

Session 2: **Chair: Dr. Ouk Makara** **Rapporteur: Chirantan Chattopdhyay**	
1330-1350	Jo Luck: An integrated approach to understanding the risks of climate change to plant bio-security".
1350-1410	Tran Van Hai : Management of Brown Plant Hopper transmitting virus diseases at community level: Synchronized cropping season combined with Brown Plant Hopper escape strategy on rice in the Mekong River Delta of Vietnam
1410-1430	Saon Banerjee, Indrabrata Bhattacharya, S. A. Khan, and A.K.S. Huda: Weather sensitivity of downy mildew and Alternaria blight of mustard in the Gangetic West Bengal, India.
1500-1530	Saon Banerjee, Indrabrata Bhattacharya, S. A. Khan, and A.K.S. Huda Weather sensitivity of downy mildew and Alternaria blight of mustard in the Gangetic West Bengal, India
1430-1450	I. Bhattacharya and Khan: Weather-base risk assessment of downy mildew disease of Cucurbits.
1450-1510	K. Sophea: IPM approach in cambodia
1510-1540	Report back in plenary with summary-rapporteurs.
1540-1600	Tea and bus leaves for hotel 1600
1800	Bus depart from hotel
1830	Conference Dinner- Boeung Meas Restaurant

20 November 2009 Friday

Session 3:

Chair : Kees Stigter

Rapporteurs: Saon Banerjee,

Time	Activity
0900-0920	LS Rathore and N. Chattopadhyay : weather-based risk management in agriculture.
0920-0940	GGSN Rao : Weather based agro-advisories for enhancing agricultural productivity.
0940-1000	N. Chattopadhyay and LS Rathore: Integrated Agromet Advisory Services in India.

1000-1020	Guillaume Lacombe: Analysis of possible impacts of climate change on rainfall and temperature in the greater Mekong region.
1020-1030	Discussion
1030-1100	Tea
1100-1120	Robert Spooner-Hart: UWS & Climate Change: specifically elevated CO2 and insects.
1120-1140	S Desai: Decision support systems for disease forewarning in field crops.
1140-1200	Md. Delowar Hossain : Impact of climate change on plant diseases And Major disease status of important crops in Bangladesh
1200-1220	Chirantan Chattopadhyay: *Sclerotina* rot and *Altenaria* blight forewarning models-new proposals in mustard.
1220-1230	Discussion
1230-1330	Lunch
Session 4 **Chair: Giashuddin Miah** **Rapporteur: Peter Hayman**	
1330-1350	Yahya Abawi: Developing climate resilient systems in the Asia-Pacific region.
1350-1410	Thavone Inthavone: Spatial variation in field water availability and water stress development during crop growing season in Loas.
14101430	Kasis Inape- Impact of climate variability in agriculture and human health in PNG.
1430-1450	Surana- Strategic measures to adapt the variability of climate change related to water resources management in Lombok.
1450-1510	Discussion
1510-1530	Tea
1530-1550	Ken Boote: Crop Modeling Approaches for Predicting Climatic Risk on Crop Production.
1550-1610	Kees Stigter: Coping with climate risk in rural communities in developing countries of the Asia-Pacific region: Policies for preparedness.
1610-1630	Discussion

21 November 2009, Saturday

Time	Activity
Session 5 **Chair: Suhas Wani** **Rapporteur: N. Chattopadhyay**	
0900-0920	Giashuddin Miah- Climate change and anthropogenic activities: Impacts on natural resources and food security particularly in coastal region of Bangladesh.
0920-0940	N. Van Viet- The impact of climate change and disaster on food crop yields and some measures to cope with them for food security in Vietnam.
0940-1000	Peter Hayman- Communicating climate information for decision-making: Examples from Australia and the Philippines.
1000-1020	Suhas Wani- Impact of climate change on Indian agriculture: Adaptation and mitigation strategies.
1020-1030	Discussion
1030-1100	Tea
1100-1230	The way ahead-Time line for current program and development of new project proposal: - Role and responsibilities (crop-wise and country-wise) - Model selection, generation, testing and validation - Funding and other resource needs Inputs for final workshop - Plenary and small group discussions to determine collaborative research groups and priority activities for different geographic/river basin areas in the Asia Pacific Region. - Development of concept notes for activities, and suggestions for possible funding sources - Draft Seminar recommendations, including in the policy and strategy areas.
1230-1330	Lunch
1330-1500	The way ahead discussion and draft recommendations.
1500-1530	Tea
1530-16	Closing Ceremony- Mr. So Khan Rithykun, Acting Director General, GDA. Recommendation

22 November 2009 Sunday: Field trip Phnom Penh- Siem Reap

Appendix2:

Welcome Remarks by Dr. OUK Makara, Director of CARDI on 19 November 2009.

International Symposium: climate Risk Management in Rural communities in Developing countries of the Asia-pacific Region, 19-22 November, 2009' CARDI

His Excellency Chan Tong Yves, Secretary of State, Ministry of Agriculture, Forestry and Fisheries.

Her Excellency Margaret Adamson, Australian Ambassador to the Kingdom of Cambodia.

His Excellency Kith Seng, Undersecretary of State, Ministry of Agriculture, Forestry and Fisheries.

Associate Prof. Samsul Huda, Representative of the University of Sydney.

Mr. Pen Vuth, Deputy Director General of General Directorate of Agriculture

Excellencies, Distinguished Guests and Participants, ladies and Gentlemen
It is a great honor" for the Cambodian Agricultural Research and Development Institute to holding this important international symposium on climate and risk management in rural communities in developing countries of the Asia-Pacific region.
On behalf of the Cambodian Agricultural Research and Development Institute, I have a great pleasure to welcome yours presided Excellencies, resource persons' participants and all distinguished guests.

To take this solemn opportunity, I would like to express my great appreciation to the Asia-Pacific Network for Global Change Research, AusAID, ACIAR and the Crawford Fund for the financial support; and to the University of Western Australia and the Plant Protection, Sanitary and Phyosanitary of the General Directorate of Agriculture for organizing this valuable workshop with CARDI.

Excellencies, Distinguished Guests and Valuable Participants; with scientific proof of the global warming, the immediate and prompt action is required to be taken to minimize or control the adverse impact of climate change. Simultaneously, there is a need for researchers to work for the sustainability of agricultural productivity by challenging against the climate risk. In this opportunity, I would like to inform you that this week is timely events wee for CARDI in relation to the climate change issues. There were two international events has been held in CARDI in the last three days.

First, all resource persons and participants in this symposium have been actively discussed during the last three-days training workshop on climate and agricultural risk management.

Second, an international group composes of about 50 scientists and researchers from Japan
China, Indonesia, Thailand, Vietnam, Korea, the Philippines and Cambodia met in last Tuesday to share and discuss the research results and experiences related to the Environmental Restoration and Sustainable use of Problem Soils' Today we are starting this important symposium that will be last for four days' As an organized institution, we will all the best for providing all necessary requirements including meals during the symposium.

At last but not least, I would like to wish this international symposium a very success with more creative reactions and to all international participants' a very pleasant continuous stay in Phnom Penh and enjoyed the field trip in Sunday.

Thank You,

Appendix3:

Opening Remarks by H.E. Margaret Adamson, Australian Ambassador to Cambodia

International Seminar: Climate Risk Management in Rural Communities in Developing Countries of the Asia-Pacific Region, 19-22 November 2009, Cambodian Agricultural Research and Development Institute (CARDI), Phnom Penh.

Excellency Chan Tong IVES, Secretary of State, Ministry of Agriculture, Forestry and Fisheries, Other Excellencies, Distinguished Guests, Ladies and Gentlemen;

I'm delighted to represent the Australian Government at the opening of this important international seminar which will contribute to improving the use of climate information to inform farmer decisions about' crops, water management and pest management in the face of a variable and changing climate.

I would like to thank the Ministry of Agriculture, Forestry and Fisheries (MAFF), the Cambodian Agricultural Research and Development Institute (CARDI) and the University of Western Sydney for hosting this event. I would also like to welcome the international agricultural experts here today from across the Asia Pacific region.

Climate risk is one of the major challenges to sustainability of farm productivity. Countries in the Asia Pacific region regularly experience economic, social and environmental impacts from floods and droughts. For example, between 1998 and 2002, 70 percent of all Cambodia's lost rice production was attributed to floods and a further 20 percent to droughts. This has been particularly apparent this year in Cambodia, where early droughts were followed by serious flooding due to Typhoon *Ketsana*.

Tackling the challenge of climate change is one of the Australian Government's highest priorities. The Australian Government is implementing a comprehensive response to climate change, including reducing carbon pollution, adapting to unavoidable climate change and helping to shape a global response.

Only truly global action can stop the worst impacts of climate change. All countries need to consider how they can contribute to an effective outcome. In December, the world will come together under the United Nations in Copenhagen to agree a path forward on a new climate change outcome. Three key issues are central to this deal: a long-term global goal for emissions reductions; credible commitments and actions by all major economies to reduce their emissions; and support to help the most vulnerable and least able adapt to the inevitable impacts of climate change. To ensure our long-term interests are upheld, these elements need to be captured in a robust and long-lasting legally-binding agreement.

Australia is seeking an ambitious global deal consistent with stabilising greenhouse gas levels at 450 parts per million (ppm) or lower. This will reduce the risks of severe climate change and will support our aim of limiting the rise in global temperature e to 2 degrees Celsius. If the world agrees to this deal, the Australian Government is committed to reducing Australia's carbon pollution by 25 per cent below 2000 levels by 2020. This is a credible and ambitious commitment, equivalent to almost halving the average emissions of every Australian over the period 1990 to 2020.

The Australian Government is also committed to assisting vulnerable countries in the Asia-Pacific region to increase resilience to the unavoidable impacts of climate change. The Australian Government is investing $150 million through the Australian aid program over three years from 2008 to 2011 to meet high priority climate adaptation needs in vulnerable countries in our region.

The primary geographic emphasis of the International Climate Change Adaptation Initiative is Pacific island countries and East Timor, but targeted policy and technical assistance is being made available for other countries in the Asia-pacific region.

The Initiative has the following objectives:

Firstly, increasing understanding in partner countries of the impacts of climate change on their natural and socioeconomic systems;

Secondly, enhancing partner country capacity to assess key climate risks, formulate appropriate adaptation strategies and plans, and mainstream adaptation into decision making; and

Thirdly, identifying and helping to finance priority adaptation measures to increase the resilience of partner countries to the impacts of climate change.

Activities funded to date which are particularly relevant to the countries represented here today include a 40 million Australian Dollar contribution to the World Bank-administered Pilot Program on Climate Resilience. This program will pilot and demonstrate ways to integrate climate risk and resilience into development planning, with a particular focus on highly vulnerable sectors such as agriculture and water. This initiative is developing nine country and two regional pilots, including in Cambodia, Bangladesh, Nepal, PNG, Samoa and Tonga.

Six million Australian Dollars has also been invested in the Mekong and Asia-Pacific Community-Based Adaptation Small Grants Program. This program is providing funds to implement priority adaptation measures at the local level in the Cambodia, Laos, Vietnam, Sri Lanka, East Timor and 15 Pacific island countries.

And finally, three million Australian Dollars has been contributed to the Mekong River Commission's Climate Change and Adaptation Initiative. This initiative aims to increase understanding of key climate change impacts in the lower Mekong Basin and pilot adaptation actions.

Excellencies, Distinguished Guests, Ladies and Gentlemen, as part of this comprehensive response to the challenges of climate change, the Australian Government, through the Australian Agency for International Development (AusAID) and the Australian Centre for International Agricultural Research (ACIAR) is very happy to sponsor this seminar. We also appreciate the support provided to participants by the Asia Pacific Network for Global Change and the Crawford Fund.

Although I have spoken today about the comprehensive global response required to address the challenges of climate change, this seminar has a specific focus on the better use of climate

information to help farmers adapt to existing climate risks and potential changes in the risk profile associated with climate change. Effective research and policy planning in this area will make a significant contribution to increased food security through improved crop yields. Food security challenges are likely to become more severe in this region due to the unavoidable impacts of climate change, with potential conflicts for water and land use.

And so, I wish you all the best of success in exchanging lessons and best practice identifying regional priorities for research and policy initiatives in the area of climate risk management.

Thank you for your attention.

Appedix4:

Opening Speech by H.E. Chan Tong Yves, Secretary of State, Ministry of Agriculture, Forestry and Fisheries (*Unofficial translation by CARDI*).

Speech

H.E. Chan Tong Yves, Secretary of State,

Ministry of Agriculture, Forestry and Fisheries

The Opening Ceremony of the International Workshop on Climate and Agricultural Risk Management, held at the Cambodian Agricultural Research and Development Institute

19-22 November, 2009

3

Her Excellency **Mergaret Adamson**, the Australian Ambassador to the Kingdom of Cambodia,

Associate Professor Samsul Hunda, Representative of the University of Western Sydney Excellencies, *Lok Chumteav*, Distinguished national and international guests, Ladies and Gentlemen!

1. Today I have a great honor to address the opening ceremony of the international symposium on '' Climate and Agricultural Risk Management'' which is organized by the General Directorate of Agriculture and the Cambodian Agricultural Research and Development Institute-CARDI under a closed cooperation with the University of Western Sydney. On behalf of the Ministry of Agriculture, Forestry and Fisheries, I would like to express my warmest welcome for the presence of Excellencies, *Lok Chumteav*, Ladies and Gentlemen who government ministries, institution, departments, and provincial departments of agriculture of the Ministry of Agriculture, Forestry and Fisheries. At the same time, I would like deeply thank to the Foundations of the Asia-Pacific Networks (APN), the Australian Centre for International Agricultural Research (ACIAR), the Australian Agency for

International Development (AusAID) and the Crawford Fund for funding supports for such an important International Symposium.

2. I would to take this opportunity to optimistically express the support to the Asia-Pacific Network (APN), the Australian Centre for International Agricultural Research(ACIAR), the Australian Agency for International Development (AusAID) and the Crawford Fund for their
initiative ideas to support the organizing of this international workshop related to agriculture with the aim to exchange experiences amongst countries in the globe, especially with use of this forum to constructively discuss and point out appropriate key measures for managing agricultural risk caused by climate change under to the Cambodian conditions in order to contribute to poverty reduction in parallel with the New Millennium Development Goals and the Royal Government of Cambodia's Strategy.

3. Excellencies, *Lok Chumteav*, Ladies and Gentlemen! As you know, in the world, many countries are facing food shortage which is caused by natural disasters and various forms of conflict; and food security becomes at risk with increasing food price caused by lowered food stock, increased fuel price, and demand of land for growing bio-fuel crops, drought and flood which are all related to climate change. The increased agricultural induced green house production, development of industrial sector, and the increased use of fossil fuel have emitted toxic gases to the atmosphere (Co_2, No_2, So_2) damaging the ozone layers, leading to the increased atmospheric temperature. The change from growing food to bio-fuel crops; and the change between cropland and desertification are the counter-action of nature, the change of its balance is caused by climate change induced by human activities. Climate change causes food insecurity, especially for the poor in the developing countries where they could not have food on demand through access to markets. Climate change badly impacts on crop and animal production, forestry and fisheries. In Cambodia, climate change has caused drought, flood, and insect-pest damage, etc. which we face almost every year. In 2009, as of 23 October, drought and flood damaged about 125,706 ha of cropped land, especially in *Svay Rieng, Takeo, Banteay Mean Chey, Battambang, Kampong Cham, Kampong Thom, Kandal, Kracheh, Mondul Kiri, Preah Vihea, Prey Veng, Rattanak Kiri, Siem Reab, Stung Treng,* and *Odor Mean Chey* provinces.

4. Facing with these problems, the Royal Government of Cambodia (RGC) with intelligent leadership of **Samdech Akka Moha Sena Padei Techo Hun Sen,** the Prime Minister of the Kingdom of Cambodia, has highly considered the livelihood of all Cambodian people by promoting the growth of national economy and development of all sectors in direction of improving food security, well-being, and reducing the poverty. Agriculture contributed about 34.4% to GDP and creates job for more than 60% of the country's population. The cultivated area for food production is ensured by balancing with projected area for agro-industrial crops. However, Cambodia remains seriously consider the demand for food production and sustainable development.

5. The RGC's vision is to ensure enough quantity and safety of foods for all Cambodian through increased GDP per capita, and to ensure sustainable management and conservation of natural resources. Cambodia, with this vision, has been strongly supporting and focusing on promoting the Cambodian people livelihood by taking necessary measures to strengthen agricultural productivity, and to facilitate market operations and food commercialization. In order to ensure national as well as food security, the RGC has been done its utmost to increase agricultural production through enhancing crop intensification, diversification, family livestock, fisheries and improving soil fertility for sustainable agriculture with the promotion of organic agriculture which is necessary for small land farmers and deduction of pesticide application etc. Cambodia has made great effort to produce surplus rice since 1996. Rice yield has increased 2.1 t/ha in 2003 to 2.74t/ha in 2008.

Yours Excellencies, ladies and gentlemen!

6. In order to control the impact on agriculture due to climate change, the Royal Government of Cambodia developed the policy and strategic management and maintained environmental sustainability and approved national planning for climate change on 20 October 2006 developed national strategic planning to minimize and control disaster etc. the Royal Government of Cambodia developed mechanism and planning to control natural disaster including draught, flood, insects and diseases etc. Committee for natural disaster control at national and local levels, other involved institutions and Cambodian Red Cross worked in collaboration with other development partners and funding agencies to urgent assistance to any unexpected natural disaster. MAFF has annually reserved many thousands tons of rice seed and other crops, fertilizers, pesticides, animal vaccine and treatment medicines and ten thousands liters of petrol to supply during and after natural disaster. IN 2008, with the support from FAO, MAFF provided 88.5 tons of rice seed and 140 tons of fertilizers to the draught victims in Kampong Speu, Takeo, Kampot and Kampong Chhnang, and also conducted a campaign against BPH by collecting more than 30 tons of this insect.

7. Regarding climate change control, MAFF implements relevant controlled regulations and natural conservations such as sustainable management and the use of forest resources for the poor through the priority of forest and fisheries reforms in order to conserve around 60% of forest land and forest conservation at 1.35 million ha in 2010, and also maintain flood forest. Every year, forest land rehabilitation and reforestation held on 09 July, we plant tens of thousands of new trees to cover bare land and contribute to climate change control. On the other hand, we have extended rubber plantation lands for both land cover and national economy improvement through rubber production with state, private and family rubber plantations which were significantly developed in 2008.

8. I hope that the symposium will use this good opportunity to share information and experiences to translate the title appropriately in order to improve the people's living standard and the outputs can be used for poverty deduction and national economic development, especially in response to the United Nation's goal and rural poverty reduction.

9. Taking this opportunity, once again I would like to thank H.E. Ms **Margaret Adamson**, Australian Ambassador to the Kingdom of Cambodia, and Associate Professor Samsul Huda, representative from the University of Western Sydney who spent their valuable time in the symposium and also thank to the organizers and sponsors of this useful symposium. I also thank Excellencies, ladies and gentlemen and all participants.

10. Finally, I am delighted to officially open this international symposium on '' Climate and Agricultural Risk Management'' from now onward and wish the workshop with success.

    In particular, I wish Excellencies, *Lok Chumteav*, distinguished national and international guests with good health, good luck, happiness, and success.

Thank you,

Appendix5: Participant list

	Name	E-mail	
1	M Asaduzzaman	masad@agni.com	BSF, Bangladesh
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Funding sources outside the APN

A list of agencies, institutions, organizations (governmental, inter-governmental and/or non-governmental), that provided any in-kind support and co-funding for the project and the amount(s) awarded. If possible, please provide an estimate amount.

1- *AusAID: co-funding with the amount of USD 12,209.78*
2- *CARDI: Staff and Facilities*
3- *GDA: Staff and Facilities*
4- *MAFF, Policy supporting*
5- *The CRAWFORD FUND: support fund for travelling of some participants*
6- *University of Western Sydney: Human resources*
7- *MoE: Policy supporting and staff participate in the workshop and symposium*

List of Young Scientists

Include brief detail (full name, involvement in the project activity) and contact detail (name of institution/country and email address) of your scientists involved in the project. Also include short message from the young scientists about his/her involvement in the project and how it helps develop/build his capacity and the knowledge he gained.

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Glossary 1of Terms

ACIAR- the Australian Centre for International Agricultural Research
APN- Asia Pacific Network
AusAiD- the Australian government's overseas aid
BARI-Bangladesh Rice Research Institute
BPH- Brown Planthopper
CARDI- Cambodian Agricultural Research and Development Institute
CARM- Climate and Agricultural Risk Management
CSIRO-
DAR- Day After Release
DMH- Department of Meteorology and Hydrology
ENSO- El Niño/Southern Oscillation
EU-European Union
FFSs- Farmers' Field Schools
Fnoc- Fleet Numerical Oceanography Center
GDA- the General Directorate of Agriculture
HYMOS modeling- a modeling using for processing and analysis the stream flow data
IPM- Integrated Pest Management
IRRI- International Rice Research Institute
MoWRAM- Ministry of Water Resources and Meteorology
MoE- Ministry of Environment
MAFF- Ministry of Agriculture, Forestry and Fisheries
NOAA- National Oceanic and Atmospheric Administration
OXFAM- the Oxford Committee for Famine Relief
RH- Relative Humidity
SI- Solomon Islands
Storm KUMMURI- a tropical storm
PDS- Percent Disease Severity
PPSPSD- Plant Protection Sanitary and Phytosanitary Department
WMO- World Meteorology Organization
ICRISAD-International Crops Research Institute for the Semi-Arid Tropics
USA-the United State of America
UWS- The University of Western Sydney