



RESEARCH PROGRAM ON
**Climate Change,
Agriculture and
Food Security**



Workshop Report

Workshop on the impact of climate change on crop pests and diseases, and adaptation strategies for the Greater Mekong Sub - Region (GMS)

Hotel Continental Saigon,
Ho Chi Minh City, Vietnam
30 July - 1 August 2014

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- Last but not least all the participants for taking the time to attend the workshop and contributing their valuable thoughts.

acronyms and abbreviations

ADB	Asian Development Bank
BAR	Bureau of Agricultural Research
BPH	Brown planthopper
CABI	Centre for Agricultural Bioscience International
CABI - CDF	Centre for Agricultural Bioscience International Development Funds
CC	Climate change
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food
CGIAR	Consultative Group of International Agricultural Research
CLUES	Climate change affecting land use in the Mekong Delta: Adaptation of rice-based cropping systems
CO ₂	Carbon dioxide
CSA	Climate Smart Agriculture
CSV	Climate Smart Villages
EE	Entertainment Education
EFA	Environment - friendly agriculture promotion activities of South Korea
EPIC	Economics and Policy Innovations for CSA

GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIS	Geographical Information Systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GMS	Greater Mekong Sub - region
GSP	Generalised Scheme of Preferences
FAO	Food and Agricultural Organisation
ICON	Introducing non - flooded crops in rice - dominated landscapes: Impact on carbon, nitrogen and water cycles
ILYCM	Insect life cycle modeling software
IPCC	Inter - governmental Panel on Climate Change
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
M & E	Monitoring and Evaluation
MARD	Ministry of Agriculture and Rural Development, Vietnam

MDG	Millennium Development Goals
MICORDEA	Mitigating the impact of CC on rice disease resistance in East Africa
NAPA	National Adaptation Plans and Actions
P & D	Pests and Diseases
PRA	Pest Risk Assessment
PW	Plantwise
RFC	Regions for Concern
SLM	Sustainable Land Management
UN	United Nations
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WBPH	White Backed Planthopper

executive summary

The Center for Agricultural Biosciences International (CABI) and the CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS), convened a three-day regional workshop on the 'Impact of Climate Change on Crop Pests and Diseases, and Adaptation Strategies for the Greater Mekong Sub-region (GMS)' in Ho Chi Minh City, Vietnam from 30th July to 1st August, 2014.

This event brought together leading experts on pests and disease management, including national partners to discuss how agriculture, farmers in particular, can cope with the challenges brought about by climate change. Amongst the primary concerns were to identify and address the most important interactions, synergies and trade-offs among climate change, agriculture and food security. Over 20 participants from countries mainly in the GMS region, took part in the workshop. Participants included experts in climate change from key CGIAR Centers such as IRRI and CIP, FAO- United Nations, GMS-based National Research Organizations, Universities and CABI.



Fig. 1. Workshop in progress



Fig 2. Remarks by Dr. Nguyen Xuan Hong

The objectives of the workshop were: (i) To assess climate change scenarios and their potential in inducing pest and disease developments in the Greater Mekong Sub-region (GMS), (ii) To develop a process to assess the impact of Climate Change (CC) induced pests and diseases (P & D) on major food crops in the GMS, and (iii) To establish a process for developing adaptation strategies that will reduce the vulnerability of major food crop systems to losses due to CC-induced pests and diseases in the GMS.

To meet the objectives, the workshop was divided into four technical presentation sessions followed by group and plenary discussions. The four technical sessions were: i) Climate change and pest scenarios in food crops, ii) Frameworks for sustainable agricultural programs, iii) Climate change adaptation strategies focusing on crop pests and diseases, and iv) Communications and funding in developing and implementing adaptation strategies. A field trip to observe the practice of ecological engineering in a rice ecosystem pioneered by the Vietnamese was also organised.



Fig. 3 Presentation by Dr. Heong Kong Luen



Fig. 4. Introduction by Dr. Payom Cobelli

The following outputs and recommendations emerged from the workshop:

- Participants agreed that crop pests and diseases (P&D) were affected by the vagaries of climate change i.e. temperature, rainfall, wind patterns, and the innate ability of crop P&D to adapt to these changing environmental conditions. Many single factorial laboratory studies were presented to underpin this hypothesis. Numerous studies and modeling exercises also showed evidence that organisms respond in different ways to various ecosystem templates thus lending credence to the fundamental need to be cognitive of organisms' ecology and that of the nexus with ecosystem services.
- The workshop recognizes that there were conflicting messages on impacts of climate change on crop P&D that were sent out to policy makers and farmers. Several key issues were identified and the following need for refinement were recognised: (i) Research designs that span across spatial and temporal landscapes; (ii) Effective modalities of communicating impacts to influence policies and changes and (iii) re-designing policies and national agricultural frameworks to enhance resilience to climate changes (e.g. ecological engineering).

- The workshop also brainstormed for answers to several key issues (and questions) of climate change and adaptation strategies focusing on crop pests and diseases. The cross-cutting nature of the issues discussed focused on the following questions: (i) The specific needs (viz. ecological and implementation) in the development of climate change adaptation strategies for P&D management, (ii) New policies or infrastructure that need to be designed to enhance sustainable agriculture, (iii) policy change activities that could be initiated, and (iv) the key issues that need to be addressed to improve farmer livelihoods, learning and motivation.

The following next steps or recommendations were proposed:

- CABI will draft a quick concept note (CN) on 'Pest Smart' to complement the 6 'Smart' strands already being implemented for CCAFS in the Climate Smart Villages (CSVs). The suggested activities for 'Pest Smart', which would be funded by some seed funds from CCAFS, would include early warning systems (including use of mobile platforms), low energy intervention technologies (green, bio-based pest control options); and adaptation strategies (e.g. ecological engineering) which could be pilot-tested in the existing CCAFS-funded CSVs;
- CABI, over the next 3 months, in collaboration with CCAFS, will embark on: (i) a situational analysis using a focused questionnaire to gather and assess information on CC and its impact on pests and diseases in the GMS - which in turn will influence agricultural production and food security, (ii) develop a comprehensive proceedings of the workshop as a framework/reference for future project development, (iii) gather intelligence, conduct groundwork and sound out a GEF implementing agency (IA) like ADB or UNEP to develop a large GEF project for CABI together with CG centers to act as Executing Agencies (EA). Seed funding will be sought through CABI-CDF to progress this work.



Fig 5. Dr. Sivapragasam during Q & A



Fig. 6 Participants listening to the technical sessions

- Dr. Jurgen Kroschel from the International Potato Center / Global Crop Diversity Trust, Peru will help to coordinate with the following: (i) Develop frameworks, viz., on how to collect data, on pilot sites selection and assessments etc., and collate information on experiences with other regions on work done on CC; and (ii) Formulate a proposal to GIZ, anticipated call in March 2015 and follow-up with a GEF proposal in 2016.



Fig. 7 Dr. Buyong Hadi presenting his views



Fig. 8 Dr. Ho Van Chien during the Q & A session

Overall, the workshop provided a valuable opportunity to take stock of the current state of affairs pertaining to the impact of climate change on crop pests and diseases and the adaptation strategies needed to help us plan and prepare the best set of collective actions in the face of climate change.

Recommendations and next steps from the workshop will enable us to forge ahead with the directions and plans to diagnose and identify optimum efforts that will benefit the rural poor who are chronically vulnerable to the threats of climate change.

group photograph



Fig. 9 Participants of the 'Workshop on the Impact of Climate Change on Crop Pests & Diseases and Adaptation Strategies for the Greater Mekong Sub-region

introduction

Climate change can induce elevated temperatures, droughts, rising sea levels, floods, changes in wind patterns and abnormal weather. These events can cause changes in ecosystem balance that can disrupt ecosystem services and favor crop pest development resulting in heavy crop losses, heavy / injudicious pesticide use and in extreme cases, poverty, due to severe disruption of livelihoods.

At the moment, farmers' pest management practices and pesticide use are causing environmental and human health concerns in food crop agro-ecosystems. Climate change is adding new dimensions to the multiple challenges agricultural policy makers and farmers are facing. However, links between climate change and pest scenarios are not well known, and much less known are adaptation options that may be adopted by agricultural policy makers and farmers to reduce vulnerability of crops to abnormal pest infestations and to build resilience against climate change induced pests and diseases.



Fig. 10. Heavy hopper burn in Sam Chuk district
(Source: Ricehoppers)

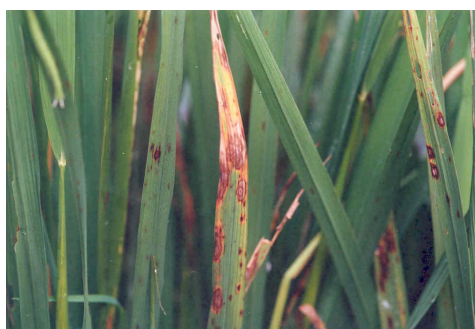


Fig. 11. Leaf blast symptoms (Source: IRRI)

Recent expansions and advances of insect infestations and disease epidemics may be associated with regional increases in mean or minimum temperatures, like pests in Japan and rice blast. Crop pests and diseases have made significant pole-ward shifts of 2.7 ± 0.8 km per year since 1960 threatening global food security by the CC-aided emergence and spread of crop pests and pathogens. Spread is facilitated primarily by human transportation, but climate change allows establishment. For instance, *Nezara viridula*, a rice pest, shifted its distribution range about 70 km north from 1960 to 2000.

Climate change also affects natural enemies and their interactions with pests in terms of predation behavior, mobility, tolerances and adaptive responses to temperature changes and wind patterns. However, there is a dearth of comprehensive information about how climate change will actually affect predator-prey interactions and the biological control services provided.

Many pests and pathogens exhibit considerable capacity for generation, recombination, and selection capacity and thus, there is little doubt that any new opportunities resulting from climate change will be exploited by them. The extent to which crop pests, their natural enemies and pathogens adapt in response to global warming and the impact of this on food production, especially in the Greater Mekong Sub-region (GMS), is still largely unknown. Better understanding of such mechanistic effects on crops will be needed to develop realistic predictions on crop production deviations on a regional scale and thereby, assist in the development of more robust regional food security policies and adaptation strategies.

Changes in intensity and wind patterns may have contributed to China's recent pest outbreaks in rice production. Increase in drought frequencies and intensities can also cause pests, such as armyworms and locusts, to outbreak. Failure to take into account climate change induced pest scenarios in land use planning and farm management can exacerbate their impacts.

The objectives of the workshop are as follows:

- To assess climate change scenarios and their potential in inducing pest and disease developments in the Greater Mekong Sub-region (GMS);
- To develop a process to assess the impact of Climate Change (CC) induced pests and diseases (P & D) on major food crops in the GMS; and
- To establish a process for developing adaptation strategies that will reduce the vulnerability of major food crop systems to losses due to CC-induced pests and diseases in the GMS.

The workshop was divided into four technical presentation sessions followed by group and plenary discussions. The four technical sessions were: i) Climate change and pest scenarios in food crops, ii) Frameworks for sustainable agricultural programs, iii) Climate change adaptation strategies focusing on crop pests and diseases, and iv) Communications and funding in developing and implementing adaptation strategies.

This report provides the summary points of the presentations of the speakers, the outcomes of the discussions and the key actions for further development based on the edited transcripts.

technical sessions / presentations



Welcome address

Dr. Leocadio S. Sebastian

Regional Program Leader (Southeast Asia)
CGIAR-CCAFS, Vietnam

In his welcome address, Dr. Leocadio Sebastian gave a brief introduction to CCAFS (CGIAR Research Programme on Climate Change, Agriculture and Food Security). CCAFS is a 10-year strategic research partnership between CGIAR (Consultative Group of International Agricultural Research) and Future Earth. It brings together the world's best researchers in agricultural science, climate science, environmental and social sciences to identify and address the most important interactions, synergies and trade-offs between CC, agriculture and food security.

CCAFS has three focus countries in Southeast Asia (SEA) – Vietnam (VN), Cambodia (CMB) and Laos. Most of CCAFS Research for Development (R4D) activities will be implemented in these countries. Indonesia will be the focus of the work on mitigating the impact of oil palm as the driver of deforestation. CCAFS will also work with the Philippines to mitigate the effect of sea level rise i.e. risk mitigation and coping with tidal surges to coastal areas. Myanmar, a high heat vulnerable area, will be targeted for future expansions.

Dr. Sebastian hoped that the workshop will collectively help to draw a roadmap for the best set of R4D actions that can be pursued to address the impact of climate change on crop pests and diseases and also help develop new pathways of generating science based innovations for pest management.

He stressed that the discussions of the workshop will enable the participants to diagnose and deliberate on the impact of CC on P & D so as to identify optimum adaptation efforts that will benefit the rural poor. He indicated that CC will disrupt natural cycles and ecosystem services. CC will also affect all trophic levels (e.g. plants, pathogens, insects, natural enemies) and ecosystems. He provided the following guidelines on the deliberations on the CC effects. They are: (i) the need to go beyond single species and single factor levels and (ii) CCAFS would be interested to know what IPM strategies and tactics can be jointly pursued to secure the livelihoods of millions of Asian farmers and to maintain global food security under CC.



Opening remarks

Dr. Loke Wai Hong

Regional Director Southeast Asia
CABI Malaysia

Dr. Loke gave a brief introduction to CABI. CABI used to be known as the Commonwealth Agriculture Bureau, and became CABI in 1985. It is now known as the Centre for Agricultural Bioscience International. The focus of CABI over more than 100 years has been on P&D management. However, he emphasized that the future direction of the work in CABI will also include impact of CC on P&D.

With respect to CC, Dr. Loke highlighted the overwhelming evidence of the various effects of CC and noted that the poorest people, smallholder farms and vulnerable countries will suffer most from the negative impacts of CC. Maintaining food security is critical for smallholders' farms and minimizing vulnerability is becoming a major challenge. A lot of money is already being spent trying to eradicate pests and diseases. He pointed out that CC is changing the distribution of crop P&D and that CC creates favorable conditions for P & D to move out to new areas.

Dr. Loke emphasised that CABI is delighted to partner with CCAFS to organize this workshop, and welcomed the presence of collaborating experts and country partners. However, he was concerned that there were no participants from two key CC afflicted countries, viz., Laos and Myanmar, and noted that it is always a challenge to get people from these two countries but their presence would have been most relevant and welcome.

In conclusion, he wished participants a fruitful three days of meeting and a pleasant stay in Ho Chi Minh City. He hoped that the programme put together for the workshop will help stimulate good discussions, thoughts and ideas for future work.



Official address and opening
Dr. Nguyen Xuan Hong
Director General
PPD, MARD, Vietnam

Dr. Nguyen Xuan Hong noted that CC is one of the biggest challenges of this century, and has serious implications on production, life and environment on a global scale. Vietnam is considered as one of the most vulnerable countries to CC, and the Mekong Delta of Vietnam is one of the world's three most vulnerable deltas to sea level rise.

According to widely known CC scenario, in the 21st century, temperatures in Vietnam will increase by 2 – 3°C and sea level can rise up to 75 - 100 cm compared to the 1980 and 1990 levels. If the sea level rises by 1 m, about 40% of the Mekong Delta area, 11% of the Red River delta and 3% of coastal provinces in Vietnam will be inundated, and over 20% of HCMC will be flooded. About 10-12 % of Vietnam's population will be directly affected and the country will lose about 10% in GDP. In the Vietnamese context, CC poses a serious threat to poverty reduction, an important MDG goal for sustainable development.

Vietnam is a party to both the UFCCC and the Kyoto Protocol. The National Programme on CC was approved by the Prime Minister (PM) in December 2008. This marks the country's effort in supporting international donors in responding to CC. The international community has given recognition to Vietnam for some of its initiatives to cope with CC. Stronger cooperation with other countries and international organizations is needed to realize the Vietnam framework on the prevention of CC, and to improve Vietnam's role and status in the region and in the world.

In Vietnam, IPM plays an important role in sustainable agriculture development and Vietnam exports a lot of agricultural commodities to other countries. Thus, since crop P&D are weather dependent, warmer weather conditions and higher humidity will help P&D spread and affect crops more seriously. He informed that in recent years, new pests have invaded Vietnam and are emerging as serious threats. He therefore felt that the workshop was timely to elucidate the impacts of CC on crop P&D and make the necessary changes to IPM strategies to improve plant protection.



Introduction to workshop objectives

Dr. Heong Kong Luen

Associate Principal Scientist & Senior Advisor
CABI Malaysia

Dr. Heong delivered the rationale behind the objectives of the workshop against the scenario pertaining to the vagaries of CC – that CC will cause temperature increase; changes to annual precipitation; increase in dryer seasons and decrease in precipitation over water catchment areas particularly in the Mekong. There will be excessive water availability resulting in floods in certain areas but there will also be pockets of water stress. He pointed out the increase in flooding already occurring in some areas and this has caused overall increase in food scarcity.

UNDP has helped many countries prepare NAPAs (National Adaptation Plans and Actions) to address CC. However in most cases, the NAPAs had not dealt adequately with the impacts of CC on P&D. General statements that CC is likely to increase P&D without providing details were written in the NAPAs but without sufficient details / recommendations. However in reality the impact of CC on pest species and diseases as well as ecosystem services is likely to be more complex than is currently known.

Dr. Heong gave several key points/questions for the participants to consider:

- Implications of multifactorial effects of CC on crop P&D. Many studies on CC quantify single effects in response to a single factor (usually in a laboratory or a greenhouse). These single factor driven models can sometimes give inaccurate information because they are done in isolation in an artificial environment.
- Range shifts - Wind patterns may change due to CC and may bring non-native pests and diseases to new areas.
- Phenotypic plasticity of species. The effects of CC are gradual, and pests may evolve in response to the changing environmental conditions. A study conducted in IRRI indicated that brown plant hoppers (BPH) in Philippines had lower tolerance to high temperatures while those in northeast Thailand, where high temperatures occur more frequently, had higher tolerance indicating that BPH have the genetic capacity and elasticity to adapt to temperature increases

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- Behavioral and physiological adaptation of species over time. What dimorphism / trophic changes would be induced by CC? Non-pest insects may become pests due to alteration of resource utilization.
 - Interspecies relationships - How would CC affect prey-predator relationships, and affect adaptations?
 - Ecosystem level responses
 - Other non-ecological and non-biological effects of CC.
 - What social policies have to be implemented to complement CC adaptation strategies?
 - Communication strategies - What incentives can we build to motivate farmers and influence policy intervention? How can policies be adjusted to favour CC adaptation / resilience and what new policies do we need to generate?

Dr. Heong further cautioned that: (i) Many pesticide companies have used CC and single factor statements as selling points or scare factors to get farmers to use more pesticides to avert P&D outbreaks and (ii) New and chemicals more toxic to natural enemies will be marketed. For example, the neonicotinoids which are a new group of insecticides has been reported to be toxic to bees and parasitoids. It has also been banned in Europe, and China has reduced their use as the pests have developed resistance very rapidly.

Session 1

Climate Change and Pest Scenarios in Food Crops

This session had five key papers delivered on CC impacting a range of targets from food security to P&D, with greater focus on rice, a critical crop in the GMS Region. Excerpts from the papers are presented.



Climate change impact on food security

Dr. Oliver Schweiger
Senior Research Scientist
UFZ, Germany

Dr. Oliver gave insights into the concerns with regards to food security over the past few years due to population growth. Essentially, he raised concerns, particularly, on food sufficiency and increasing affluence. The key question is whether there would be enough food for everyone? He also touched upon factors that affect food security and human influence on CC such as world trade, policies, land utilization and intensification, increasing high emissions. Examples were referred to the effects of CC on food production directly, and indirectly on land use, land use intensity, biodiversity and ecosystem services.

Risks of food insecurity and the breakdown of food systems linked to warming, drought, flooding and precipitation variability and extremes, particularly for poorer populations in urban and rural settings are very high – which also implied that impact and yield change are different for tropical and temperate regions and for the main crop types.

Projection models and mapping tools showed that areas already suffering from hunger will be much more at risk from changes in yield caused by CC. A large majority of the people who would be most affected are the rural poor and those from non-farming households.

Dr. Schweiger also alluded to the fact that when temperature rises, pesticide use pressure increases dramatically. He suggested ways to improve food production, viz., through change of cultivars, change in planting dates, optimising irrigation schemes, use of fertilizers. Adaptation strategies to conserve biodiversity and ecosystem services should focus on species interactions, and functional structure between communities. In terms of land use and to increase arable area at the biodiversity neutral level, arable land intensification can be conducted between 20-60%.



Impact of CC on rice diseases

Dr. Adam Sparks
Plant Disease Management Specialist
IRRI Philippines

Rice production will be affected by drought, changing rainfall patterns and more intense flooding. Irrigation will pose a problem to production areas as more water is being used for urban areas. IRRI is currently working on submergence tolerance rice and drought tolerance rice because farmers never know when they are going to experience flooding and drought, or maybe both in the same season. There is evidence that rice yield will be affected by rising temperature. The analyses conducted on global heat stress events from 1983 – 2011 showed that rice yields decreased as night time temperatures increased. The specific CC effects on rice diseases were:

- Plant diseases arise from a combination of pathogen, susceptible host and environment that is conducive to disease development.
- The environmental changes effected by CC may cause pathogens to move out of its current range (e.g. less rainfall).
- Some diseases have been observed to adapt to increasing temperature e.g. yellow rust in Australia. Yellow rust has also become a major problem in Kansas and the Great Plains. The disease typically occurs in the cooler and rainier conditions of the Pacific Northwest.

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- Already observing rice diseases moving further north, and moving to highland area
 - Already observing shifts in bacterial and fungal diseases due to increase in precipitation especially during intense events e.g. typhoon Haiyan in the Philippines.

However, he cautioned that it is difficult to tease out whether the incidence of diseases is caused by CC or human factors. For example, farmers are also changing farming methods. The change in production systems alters occurrences of diseases and so does the use of different cultivars that affect the micro-environment of the rice crop canopy. Emergent diseases e.g. false smut, bacterial leaf blight, and sheath blight are caused by plant pathogens that cannot be used as a robust indicator of CC. Dr. Adam described two key projects on modeling CC effects on agriculture. They were:

- MICORDEA – Mitigating the impact of CC on rice disease resistance in East Africa (funded by BMZ). The project simulated climate data (baseline and future IPCC), temperature, relative humidity and rainfall into the EPIRICE model to look at unmanaged epidemics and then use the information from this model to simulate predicted yield loss due to P&D using the RICEPEST model. This model was used for bacterial blight and leaf blast. Depending on the scenarios, bacterial blight caused different levels of yield loss, with the highest yield loss in the A2 scenario. The RICEPEST model showed that there are a lot of areas one should not be growing rice. The simulation for the yield loss due to leaf blast showed that there are fewer occurrences. This matches with the oral reports from farmers.
- ICON – Introducing non-flooded crops in rice-dominated landscapes: Impact on carbon, nitrogen and water cycles (funded by GIZ). The model tries to incorporate environmental factors in the field and simulate the effects of changing production systems. The model looked at the rice and maize rotation system, and the rice mono crop system. The results showed that diseases occurred on a lesser scale in the dryer season compared to wetter seasons.

The main diseases to look at in terms of CC impact include rice brown spot, a pathogen known to occur in dry areas with poor fertilization, including well irrigated areas (e.g. in central Thailand). He also suggested that some diseases are not captured because farmers are constantly adapting cultivars for planting. There is also a need for large datasets to tease out trends and produce more accurate model simulations.



Understanding the impacts of changing climates on insect pests on global, regional and local scales: A modeling and GIS mapping approach

Dr. Jurgen Kroschel
Science Leader Agroecology / IPM
International Potato Center / Global Crop Diversity Trust,
Peru

Dr. Kroschel's focus was on the impact of CC on insect pests. He described insects as exothermic organisms that cannot internally regulate their own temperature and depend on the temperature of their environment. Temperature increase is expected to magnify pest pressure on agricultural systems through:

- Range expansion of existing pests, and invasion by new pests
- Accelerated pest development leading to more pest cycles per season
- Disruption of the temporal and geographical synchronization of pests and beneficial insects that increases risk of pest outbreaks

- Promotion of minor pests to primary pests due to reduction in host tolerance and changes in landscape characteristics and land-use practices
- Increase in susceptibility to pests

As evidence of CC on insect pests, he presented the study conducted on pest infestation in potato/sweet potato in the Canete Valley of Peru before, during and after the El Nino year in 1997. It showed that the leaf miner fly, which is usually a major pest, did not occur as frequently in the El Nino year. Minor pests were elevated to more serious pest status instead.

The PRA framework can be used to evaluate the impact of CC on potential invasive pests to a new area and its impact on the environment and economy. Dr. Kroschel suggested that the PRA should include a framework to also assess the impact of CC on the pest concerned. The different management methods and options should be tested and documented. Documentation would enable the development of national and regional adaptation plans. The PRA evaluation will enable us to understand better the likelihood of entry, establishment, and the colonization, spread and the establishment potentials in addition to the economic, environmental and social consequences. A case example where a PRA could have prevented the infestation of a pest on potato crop was shown by the introduction of *Tuta absoluta* that is native to South America into Spain and Sudan. The pest changed its dietary preference and attacked potatoes and has spread throughout Europe and Africa.

Dr. Kroschel suggested the Insect Life Cycle Modeling software (ILYCM) to conduct PRA. The ILYCM is developed based on temperature-based phenology models for pest species and utilizes GIS to map put the distribution under various scenarios. The most important information is to use the insect life table data. The software aims to understand the full biology response to temperature increase. Dr. Kroschel also mentioned that:

- CLIMEX looks at existing presence data and evaluate areas of similar climatic conditions where the pest can spread.
- ILYCM has 50 biological functions, and statistical tools to select the best function and regression model to build your model.
- Case example: potato tuber moth. By 2050, the pest will move up to the northern hemisphere and also expand into tropical mountainous region. Pest problem occurs when more than 4 generations occur in a site.

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- More accurate site-specific models for different pest species can be generated using local weather station data

The ILYCM models can be used to generate global, regional and local risk maps to develop pest management adaptation. Future work on the software includes integrating other variables e.g. precipitation, humidity, and linking to crop models to generate results on yield loss.



Effects of global warming on rice pests

Dr. Jiranan Piyaphongkul
Kasetsart University, Thailand

Dr. Jiranan highlighted the effects of global warming on rice pests using the example of the brown planthopper (BPH), *Nilaparvata lugens* which is a significant rice pest throughout Asia across tropical, subtropical and temperate sub - regions. The pest has high metabolic activity and high reproductive capacity. She further described results of a project done under laboratory conditions designed to investigate the effect of climate warming on mobility, survival and feeding behavior. Results showed that BPH nymphs were unresponsive to temperature stimuli of 32°C, while adults were unresponsive at 42°C. She suggested that in nature however, insects may use various mechanisms to avoid heat stress such as flying to different locations.

The implication of the study is that when the environmental temperature surpasses the optimal temperature for the insects, it will limit the movement of insects to more suitable sites and escape from natural enemies. Different ages / stages of the insect will also determine its heat tolerance. Nymphs (larger surface area to body volume) have lower heat tolerance compared to adults (smaller surface area to body volume). The study suggested that nymphs are already living close to their upper thermal limit across parts of its distribution. Occasional peak temperatures (>45°C) are likely to become more detrimental to insects in a warmer climate.

It is noted that beneficial species have a narrower distribution range compared to pests and some of them only thrive in specific regions so they might be more susceptible to environmental changes. Actual thermal tolerance of BPH may differ due to acclimatisation. Acclimatisation would be a selective advantage and can modify thermal tolerance (beyond the upper temperature limit measured in laboratories). Mortality is then dependent on the duration and intensity of the stress. *N. lugens* can cope with higher temperatures and have higher heat tolerance.

The key challenge for future research is to continue similar investigations on other widely distributed tropical species and other rice pest species, comparing with other natural enemy species and designing field experiments to test the hypotheses derived from lab studies. Scientists should also look into fluctuating temperatures and other factors e.g. drought, rainfall, humidity, farm practices and behavior of natural enemies to get more accurate predictions about the survival and distribution of rice pests and other insect populations in various areas.



Climate change experiments: Limitation of research in laboratories and greenhouses

Dr. Lu Zhongxian

Deputy Director

Institute of Plant Protection and Microbiology, ZAAS China

In his introduction, Dr. Lu gave some statistics on CC in China. There are more than 2000 weather stations monitoring weather conditions in China. The temperature has increased by 1.1°C in the last 100 years, while rainfall has decreased in the last 50 years, and precipitation has decreased by 2-5% compared to the 1980 – 1999 data. There has been a 15-30% loss of crop production as a result of CC.

The temperature increase has also caused changes in the pest behavioral patterns, population dynamics and has moved the ranges of pests in China. He suggested that pests such as Leaf folders can increase by almost two generations / year. The Golden Apple Snail and BPH has moved from south to north. He indicated that BPH does not overwinter. In the case of the small BPH, when the temperature increases to 30°C, the nymph duration is extended, with lower survival rate (5%), shorter adult longevity and no eggs were laid. It was shown that rice planthopper population increased drastically in China since 2005 and so did leaf folders since 2000. Stem borers also increased but not dramatically.

There are 3 rice planthoppers in China – BPH, WBPH and small BPH but they have different heat tolerance capacities. The small BPH has the highest tolerance to heat increase in both the survival of higher instar nymph under 38°C and survival of female adults under 38°C.

The BPH can have increased nymph duration in higher temperature but nymphal survival rates were reduced at higher temperatures. Fecundity reduced very fast at higher temperatures, and rapidly declined with higher nitrogen fertilizer use and higher CO₂ environment.

Dr. Lu also presented results of the effects of temperature on host plants and pesticide activity using the standard seed box screening technique (SSST) to monitor the resistance of varieties to BPH. It was evident that IR36 variety was more sensitive to temperature increase. Its content of oxalic acid reduced but the content of soluble sugars increased. Therefore, it was less resistant to BPH attacks.

Higher temperatures also affected the activity of some pesticides. The LC₅₀ of chlorpyrifos was reduced when the temperature increased from 31 to 36°C and we can find that LC₅₀ of chlorpyrifos reduced rapidly. However, he cautioned that it is not possible to model all the interlinks in the laboratory studies alone as it is difficult to test multiple variable CC factors simultaneously due to the difficulty of replicating the exact environmental conditions, the complexity of factors that affect pest populations and the challenges of stimulating complex food chains in the laboratory.

Dr. Lu suggested building CC adaptation strategies for sustainable rice pest management through ecological engineering. He shared the following findings:

- In Jinhua, China, farmers planted sesame, *Zizania* and the trap plant, *Vetiver*, on the bunds in the rice fields and reduced their application of nitrogen fertilizer and pesticides.
- Resistant rice cultivars were used.
- Sesame can last only for 2 months but provides refuge for natural enemies and can extend longevity of egg parasitoid of BPH – *Anagrus* - and also increase the parasitisation capacity of *Anagrus*.
- Sesame flower can also extend the longevity and increase fecundity of the predator *Cyrtorhinus lividipennis*.
- *Zizania* is a type of vegetable. It attracts *Anagrus*.
- Sex pheromones were used to capture stem borers. It was found that larvae of stem borer cannot survive on *Vetiver*; most of the larvae died.
- Ecological engineering practices reduced more than 75% of the BPH.

Q & A Session 1

Climate Change and Pest Scenarios in Food Crops

The key question raised was: Considering that there are conflicting results and many models projected impacts over mountainous terrains and lakes where agriculture is not carried out. Countries generally make policies mostly based on exigencies. Also, research experiments cannot replicate actual field conditions. Thus, what is the clear message of impacts of CC on crop P&D that can be presented to policy makers and farmers? How do we communicate a simple yet effective message? The responses can be categorized under the following:

Research design

There is a consensus that crop P&D are affected by climate change i.e. temperature change, changes in the rainfall and wind patterns, and the innate ability of crop P&D to adapt to these changing environmental conditions. Many single factorial laboratory studies have produced evidence to support the aforementioned statement. The studies have also shown that different organisms in different regions are affected in different ways, and models based on the studies are based on ecology and understanding of ecosystem services.

Researchers must now look into:

1. Conducting field studies which would produce more realistic crop P&D scenarios.
2. Performing risk assessments on individual pests but the risks have to be adjusted on different scales.
3. Integrating socio-economic studies into scientific studies of crop pest management to capture influence of agro-chemical marketing and farmers' behavior / farming practices.
4. Potential of using "big data" if there are enough observations from communities, cellphones or via any means of technology. This will enable the understanding of benefits and losses, and integrate the information into policies.

Communicating impacts to influence policies and changes

Scientists and researchers have to interpret technical results into clear, impactful and tangible statements to enlighten policymakers, farmers and the public. These statements should be communicated in terms of food security, yield loss, % reduction/increase in pests, changes to the landscape, increased costs for coordination and surveillance. Case in point: The 2008 outbreak of BPH only elicited response from policymakers after they were told that the outbreak would cause famine (threat to food security).

Scientific results have to be interpreted in a cost-benefit framework to enable policymakers to make decisions on incentives and allocation of resources for research and extension work.

The research community must also come to a consensus on a clear message and support it with a certain level of confidence.

Redesigning policies and national agriculture framework

The ultimate goal from this workshop is to create policies focusing on healthy agro-ecosystems, which are resilient to changes in climatic conditions. Policies should also be redesigned to support IPM strategies, ecological engineering approaches to managing crop systems, and the use of resistant cultivars.

Session 2

Frameworks for Sustainable Agricultural Programs

This session had four papers that covered existing and potential frameworks and adaptation plans that could be used to leverage measures to mitigate the vagaries of CC to provide pathways towards sustainability. Excerpts from the papers are presented.



Climate change adaptation plans of FAO

Mr. Jong-Ha Bae
Deputy Director
FAO Representative, Vietnam

Agriculture must undergo significant transformations in order to meet the challenges of CC and food security in the future. Developing countries are more vulnerable - lower literacy rates, lower education levels, and less developed investment structure; hence, lower resilience to disasters. It is estimated that with population growth and increasing affluence, farmers in the developing world must double food production by 2050. Arable areas for expansion are already limited either due to poor soil quality or need to preserve for other uses. There is a clear need to intensify production on the same land area but it must be done sustainably.

Dr. Bae listed the FAO programmes that are responsive to food security:

- Climate Smart Agriculture (CSA)
- Save and Grow - sustainably intensify agriculture and development initiatives
- Economics and Policy Innovations for CSA - EPIC

- Global Soil Partnership - GSP
- Land Degradation Assessment in Dry Land Areas
- Global Agro-ecological Zoning Program

FAO programmes that focus on adaptation to CC:

- CSA - Introduced in 2010 and made up of 3 pillars: i) Sustainably increasing agricultural productivity and incomes, ii) adapting and building resilience to CC, and iii) reducing and removing GHG. The program is an approach that requires site-specific assessment of lifestyle, local conditions, policies and economic base (agriculture, forestry, etc.) to design site specific agricultural initiatives (e.g. best practices, cultivars, climate monitoring, water management). The program also supports technology, policies and financial approaches.
- EPIC -The program aimed at providing financial support to the poorest northern mountainous region of Vietnam including Son La, Dien Bien and Yen Bai province to establish sustainable land management of steep lands to counter soil erosion and landslides. Efforts include mini-terracing, legume-crop rotation, minimum soil disturbance and other measures of soil and land erosion. This intervention is aimed at reducing climate shocks.
- Minimum tillage potato - The initiative focused on reducing GHG in potato plantation by recycling rice straw as mulch. Mulching also reduces the use of irrigation water five-fold per hectare.

Risk assessment measures are used widely to assess pest spread within conditions of anticipated change in climate. In addition, capacity building in using these tools will be necessary to prevent and manage pests including potential invasive species.

Dr. Bae reiterated that management of crop P&D is urgently required at all levels to understand and develop systems for change. To enable that, the following were suggested as the key investments in managing risks:

- Capacity building
 - At farm level - Farmers, extension workers and educators should strengthen monitoring of changes so that appropriate cultivars and breeds used are suitable for new environmental conditions.

-
- At institutional level - Capacity has to be improved to disseminate information and create public awareness on food production systems. Information systems training to also be considered to complement CSA.
 - At policy level - Local and international policies should incorporate producer training, new management for crops, livestock and forestry and new investments
 - More effective regulations
 - Greater regulation of private sector and other organizations who will take advantage of the fear of change so as to not create any panic to the detriment of farmers and society. In the case of rice, the increased use of pesticides will likely lead to resurgence of pests.



Climate change affecting land use in the Mekong Delta: Adaptation of rice-based cropping systems (CLUES)

Dr. Ngo Dang Phong
IRRI post - Doctoral Fellow
Can Tho University, Vietnam

Dr Phong highlighted the threats faced in the Mekong Delta due to temperature increase, change in rainfall pattern, increased in rat infestation, invasion of golden apple snails, increased disease incidence, increased water demand, saline water intrusion and flooding. He then described the CLUES project which is based in the Mekong Delta in Vietnam. It has six (6) themes - hydrological modelling, plant breeding, natural resource management, socio-economy, land use planning and GHG.

The experimental sites are at Hau Giang (deep flood zone), An Giang (deep flood zone), Can Tho (intermediate flood with alluvial soil) and Bac Lieu (saline zone). The overall objective is to increase the adaptive capacity of rice production systems in the Mekong delta region. The project employed a multi-disciplinary approach (scientific and social). The activities included water management and water saving techniques, reduced phosphate use and changes to cropping rice systems + upland crops and use of appropriate cultivars.

The takeaway from this project are as follows:

- Change is possible if all stakeholders are involved right from the conception of the project - local universities, institutions, consultants, policy-making institutes and authorities
- The communication between local and national authorities is essential for long-term sustainability of initiatives.



Plantwise: A framework for sustainable plant health in support of resilience to climate change

Dr. A. Sivapragasam
Deputy Regional Director Southeast Asia
CABI Malaysia

Changes in climate result in changes to ecosystems, which can lead to consequences that can cause crop losses, excessive chemical use and disruption of farmer livelihoods if not well managed. Temperature increase would favour the development of insects with soft bodies and short developmental stages (e.g. scales, mealybugs). Building resilience is about building systems to cope with uncertainties posed by changes in climatic conditions.

Plantwise (PW), a global programme led by CABI, aims to increase food security, strengthen plant health systems and improve rural livelihoods. PW establishes a formal network between farmers, extension workers and diagnostics labs through plant clinics, and provides farmers advice to help them respond to P & D and other shocks / impacts of CC.

Dr. Siva highlighted that in typical extension systems, farmers are expected to travel to extension offices to seek extension advice.

In PW, the plant clinics are held in the villages and are more accessible by many. Plant doctors collect information on crop P & D in a formal manner, provide practical recommendations on P&D and upload plant clinic and prescription information into an online database system.

A knowledge bank that contains global resources about P&D supports the plant clinics. The knowledge bank is an important component in the spatial and temporal analyses of P & D distribution. Training of plant doctors is also conducted to increase skills to provide fundamental diagnoses and advice to farmers in the GMS.

PW is now being implemented in Vietnam, Cambodia, Thailand and Myanmar. It is envisioned that the PW framework will be mainstreamed into national programmes and there are plans to conduct accreditation programmes for plant doctors.

The framework focuses on monitoring threats, identifying threats as early as possible, assessing risks and conducting research where necessary, making policy decisions, developing management options and delivering them with advice to farmers.



The Environment-Friendly Agriculture Promotion Act of South Korea

Dr. Yoo Han Song
Professor Emeritus
Gyeongsang University, South Korea

Dr. Yoo described the historical developments that led to the formulation of the Environment-Friendly Agriculture Act in South Korea. In the 1950s and 1960s, South Korea implemented agricultural policies that promoted heavy use of agro-chemicals in rice production areas. These policies were implemented to reduce the reliance of imported rice.

The main assumption was if rice was not protected by pesticides, farmers will suffer huge crop losses due to pests and diseases. However, only one variety of rice was cultivated - Tong-il rice. In 1981, the rice industry collapsed because it was affected by rice blast and cold weather.

In 1994, a new agricultural policy, the Environment-friendly Agriculture (EFA), was introduced to replace older policies, and the EFA Act was established in 1998. The objective of the EFA is to conserve the environment, to reduce environmental pollution while increasing productivity.

The key elements of the EFA were:

- It promotes crop diversification and planting of landscape crops designated to attract tourists and increase floral biodiversity.
- Rice production was discouraged as there was a surplus, and rice consumption in modern Korea has gradually decreased.
- Compensations were offered for EFA farming and landscape crop loss if they were affected by natural disasters or falling prices.
- Subsidies were offered for the use of natural enemies and eco-friendly materials, methods and machines for plant protection.
- Certification schemes were established for organic and pesticide-free products
- Local governments were responsible in establishing their own programmes and they promoted the certification, compensation and consumption of EFA products. Local governments and politicians started promoting EFA so as to earn political mileage.
- Crop production under EFA schemes increased steadily
- After the adoption of the EFA, the use of agro-chemicals dropped and there are only minor problems with pests such as small BPH (mainly displaced from China) and striped stem borer.
- High consumer demand (80%) for EFA products put pressure on producers to comply with the EFA.

Q & A Session 2

Frameworks for Sustainable Agricultural Programs

How do PW plant clinics differ from other plant clinics established through other agencies e.g. rice doctors from IRRI projects?

PW focuses on complementing existing systems and it introduces more orderly / structured systems and processes to ensure clarity and sustainability. PW also ensures that good record keeping is practised so that proper monitoring of P & D can be undertaken. It is envisioned that countries will internalize and build in these processes into their extension systems and CABI can then exit.

What is the background required of a plant doctor under PW?

PW has a set of criteria in selecting plant doctors. Countries then select their own plant doctors according to these criteria. These people usually have experience with extension work and are involved in agricultural-based systems.

How do PW plant doctors ensure the accuracy of their diagnoses?

Most plant doctors are agronomists and have the experience to differentiate between crop P&D and symptoms of nutrient deficiencies. Field visits would be undertaken to validate diagnoses. The training will enable them to perform basic diagnoses and the ability to screen symptoms at first instance before unknown samples are sent to the national diagnostics labs. The plant doctors operate in rural settings where they need to be able to provide basic and systematic plant clinic services. Monitoring and evaluation assessments are also conducted to ensure the quality of plant doctors. Plant clinic forms are reviewed and validated by national experts and CABI experts for accuracy. Feedback is given to improve the quality of plant doctors.

Session 3

Climate change adaptation strategies focusing on crop pests and diseases

Dr. Heong moderated this session and posed these questions to the participants:

- What are the key issues in the development of CC adaptation strategies for P&D management? Consider ecological needs and implementation needs.
- What new policies or infrastructure can be designed to enhance sustainable agriculture?
- What policy change activities can we think about?
- What are the key issues to be addressed to improve farmer livelihoods, learning and motivation?

The participants were divided up into groups to brainstorm on the responses. The table below summarised the responses.

Ecological		Policies / Infrastructure	Farmers
Research needs	Implementation needs	New ideas:	
<ul style="list-style-type: none"> • Integration of data obtained from laboratory and field observation with models • Framework for research: data collection, analyses, syntheses • 1GMS research • Evaluate gaps in existing data • Collect other data to get more accurate and realistic models <ul style="list-style-type: none"> - Life tables 	<ul style="list-style-type: none"> • Effective and targeted communication strategy to various stakeholders i.e. policymakers, NPPOs, farmers • Simplify technical data and transform into interesting and relevant messages easily understood by stakeholders • Technology transfer 	<ul style="list-style-type: none"> • Economic incentives / support: <ul style="list-style-type: none"> - Research programmes - Promotion of new green technologies and ideas • Market incentives: <ul style="list-style-type: none"> - Eco - friendly producers • Evaluation and redistribution of agri. areas • Regional platforms for P&D monitoring and mgmt. 	<ul style="list-style-type: none"> • Access to better / relevant information: <ul style="list-style-type: none"> - Market - Weather - Technology - Ecosystem services - Biodiversity management • Improve value chain of crop production: <ul style="list-style-type: none"> - Packaging - Marketing • Diversification of side products e.g. coconut husk processing • Farmer cooperatives: <ul style="list-style-type: none"> - Crop insurance

Ecological		Policies / Infrastructure	Farmers
Research needs	Implementation needs	<ul style="list-style-type: none"> Promote fair trade Regulation of pesticide use 	<ul style="list-style-type: none"> Areas for improvement: <ul style="list-style-type: none"> - Location specificity - Technical capability - Resource availability
<ul style="list-style-type: none"> Models / GIS: <ul style="list-style-type: none"> - Crop yield + pesticide action + biocontrol effects - Hydrological planning - Crop + pest systems Methods to dissect complex interaction <ul style="list-style-type: none"> - Resilience: elements Assessment studies of cultural practices Ecological and behaviour 		<p>Changes needed:</p> <ul style="list-style-type: none"> Agroecosystems: <ul style="list-style-type: none"> - Long - term resilience - Ecological balance Create enabling environment for environment - friendly agriculture Enhance consumer awareness to catalyse / create the environment for environment - friendly agriculture Policies to target consumers & producers Green policies <ul style="list-style-type: none"> - Reducing chemical subsidies Enhance food security, resource use efficiency and quarantine process 	

Session 4

Communications and Funding in Developing and Implementing Adaptation Strategies

This session had two key papers dealing with Communication and Funding. Excerpts from the papers are presented in the following pages.



Challenges in communicating CC adaptation strategies to manage pests and diseases

Dr. Monina Escalada
Communication Scientist
Visayas State University, Philippines

Dr. Monina highlighted that decision-making is often driven by heuristics or rules of thumb. Heuristics are often derived from simple logic reasoning which may or may not be accurate e.g. if skies are dark, then it is very likely to rain. Most people do not have time or the mental capacity to filter scientific data.

Understanding of terms used varies among individuals and activates different sets of beliefs, feelings, behaviours and different degrees of urgency among the farmers. The key challenge in disseminating technical messages is to distill them into simple language that the audience can understand and can make connections to, and to draw out the desired set of actions.

Dr. Monina cited the events during the occurrence of Typhoon Haiyan in the Philippines in November 2013 as a case example.

Steps to achieve effective communication of adaptation strategies:

- Assess people's knowledge, perspectives and expectations from adaptation strategies.

-
- Find ways to ensure farmers understand - like using associations.
 - Understand how farmers see the world and frame messages from their point of view.
 - Integrate local knowledge with scientific knowledge.
 - Involve community stakeholders in decision-making to ensure sustainability. Most projects have shelf lives and many values instilled get forgotten when new projects are implemented. It is desirable to develop community ownership of the initiative.
 - Build on existing communication systems.
 - Ensure equitable access to knowledge and information.
 - Promote local content.
 - Use appropriate communication technologies - combine conventional media with ICT e.g. Entertainment Education, folk theatre, rural radio, community TV and community newsletters.

Entertainment Education (EE) is a recent approach to communicate the importance of natural enemies and pollinators in crop systems and has been shown to be very cost effective. Surveys were conducted to assess farmers' knowledge about biodiversity conservation and expectations, and views about planting nectar-rich flowers on rice bunds.

Relationships about complex insect phenomena like egg parasitism were illustrated using bees as surrogate insects. Bees are easier to observe and well known to farmers (high visibility) and thus close association can be established.

Scientific messages were simplified and made into a three-part 15-min entertainment program, which were aired twice a week. Local comedians that were popular with the public were employed as actors in the programme.

Learning through entertainment (via TV or radio) can create favorable attitudes in social norms and change behavior. TV is also a wide-reaching communication tool. The post survey to quantify changes in farmers' belief systems must be conducted to assess the change and effectiveness of this communication strategy. EE is one possible method of communicating abstract concepts e.g. ecological concepts.



GEF-6: Assessing GEF country allocation funds

Presented by Dr. Heong
On behalf of Ms. Cristina M. Regunay
OIC Chief
Department of Environment and Natural Resources,
Philippines

NB: Ms. Regunay cancelled her trip because of a recent typhoon that caused significant damage to homes in Manila

Dr. Heong suggested that GEF is a possible avenue of funding for the activities subsequent to the workshop. Possible focal area of GEF funding is the land degradation (agriculture) area. Activities such as sustainable land management (SLM) and improving the flow of agro-ecosystem services can be pitched.

Q & A Session 4

Communications and Funding in Developing and Implementing Adaptation Strategies

What are the short term impacts (1-2 years) of EE?

In previous projects, there was an issue of discontinuance because there was active competition from chemical companies, especially in Vietnam where TV stations air pesticide advertisements all day. Now, the Vietnamese government has issued a new regulation where pesticide advertisements are better regulated. In Vietnam, agricultural initiatives can achieve sustainability as the national government has launched the 3 reductions, 3 gains programme and has allocated national budgets for the programme.

How many farmers that were reached through EE actually adopted the messages and changed their behavior?

Beliefs will only influence intention and does not necessarily influence practice. Intention is always hindered by other social factors e.g. the lack of resources available to carry out certain activities, the lack of motivation to perform extra physical tasks that has no monetary value attached. There is a need to collect information on these barriers so that efforts can be taken to address them. In our past experience using a radio soap opera, a substantial change in attitudes was recorded among the listeners.

How do you ensure that your programme is aired at prime time and reach a wider range of target audience? Farmers are usually too busy to listen to radio or watch TV at certain times (8 am and 4 pm).

TV stations will not usually give you prime time because it is in demand and expensive. To overcome this challenge, the outreach units of the Plant Protection Department can download the program and show it to farmers during their field visits using a laptop, projector and speakers. The equipment does not need to be high tech or expensive. A white bed sheet can be used as a projection screen. Furthermore, TV programmes can be played on repeat by the TV stations so that people who missed the original air time can catch the programme during the repeats.

How to do get buy in from policymakers?

The key is to ensure that the right policymaker is engaged from the start of the initiative right to the completion. He or she is given a key role as chair of the programme and the main person involved in conducting a high profile launch with lots of press coverage. It is also important that policymakers have frequent interactions with farmers and be involved in every step of the decision making process.

P & D in the country - context

Key P&D in the participating GMS countries highlighted at the Workshop were as follows:

- **Thailand (represented by the Rice Division)** – pests and diseases of rice; cassava mealybug; newly emergent pests in rubber, horticultural crops such as whiteflies, thrips and leaf miners.
- **Cambodia** – pests and diseases of rice; the cassava pink mealy bug
- **Philippines** – pests and diseases of rice and corn
- **Vietnam** - pests and diseases of rice, salt water intrusion

stakeholder views

- Dr. Sebastian suggested the need to consider landscape of crops e.g. rice-based system to make it community based; also look at other crops e.g. vegetable; fruits; root crops that are food security crops especially in bad weather like after typhoons e.g. sweet-potato, banana etc. In addition, he alluded to the process by which we exploit the experiences accrued from the other projects and adapt them to the GMS sub-region (e.g. the ILCYM model to fit the local scenario).
- Dr. Sparks (IRRI) indicated the need for long-term data to make sense of predictability for pests.
- Dr. Kroschel reiterated the need to set boundaries for future studies and ascertain ways to transform R&D outputs to adaptation strategies. There is also a need to promote risk assessment tools and systems to mitigate the vagaries of CC.
- Dr. Loke emphasized the need to understand the current status, gaps and needs of the GMS countries based on a focused situational analysis study targeting rice and other key crops (vegetables and root crops) in the GMS (Stage 1); Developing adaptation / resilience-enhancing strategies (Stage 2); and Communication (awareness and publicity), capacity building and policy change (Stage 3).

key outputs and recommendations

The following key outputs and recommendations emerged from the workshop:

- Participants agreed that crop pests and diseases (P&D) were affected by the vagaries of climate change i.e. temperature, rainfall, wind patterns, and the innate ability of crop P&D to adapt to these changing environmental conditions. Many single factorial laboratory studies were presented to underscore this hypothesis. Numerous studies and modeling exercises also showed evidence that organisms respond in different ways to various ecosystem templates thus lending credence to the fundamental need to be cognitive of the organism's ecology and that of the nexus with ecosystem services.
- The workshop recognized that there were conflicting messages on impacts of climate change on crop P&D to policy makers and farmers. Several key issues were identified and the following needs for refinement were recognised: (i) Research designs that span across spatial and temporal landscapes; (ii) Effective modalities of communicating impacts to influence policies and changes and (iii) re-designing policies and national agricultural frameworks to enhance resilience to climate changes (e.g. ecological engineering).
- The workshop also brainstormed for answers to several key issues (and questions) of climate change and adaptation strategies focusing on crop pests and diseases. The cross-cutting nature of the issues discussed focused on the following questions: (i) The specific needs (viz. ecological and implementation) in the development of climate change adaptation strategies for P&D management; (ii) New policies or infrastructure that need to be designed to enhance sustainable agriculture; (iii) policy change activities that could be initiated, and (iv) the key issues that need to be addressed to improve farmer livelihoods, learning and motivation.

next steps

The following were proposed:

- CABI will draft a quick concept note (CN) on 'Pest Smart' to complement the 6 'Smart' strands already being implemented for CCAFS' in the Climate Smart Villages (CSVs). The suggested activities for 'Pest Smart', which would be funded by some seed funds from CCAFS, would include early warning systems (including use of mobile platforms), low energy intervention technologies (green, bio-based pest control options) technologies; and adaptation strategies (e.g. ecological engineering) which could be pilot-tested in the existing CCAFS-funded CSVs;
- CABI, over the next 3 months, in collaboration with CCAFS, will embark on: (i) a situational analysis using a focused questionnaire to gather and assess information on CC and its impact on pests and diseases in the GMS - which in turn will influence agricultural production and food security, (ii) put together a comprehensive report of the workshop as a framework/reference for future project development, (iii) gather intelligence, conduct groundwork and sound out ADB to develop a large GEF project with possibly ADB as the Implementing Agency (IA) and CABI as the Executing Agency (EA). Seed funding will be sought through CABI-CDF to progress this work.
- Dr. Jurgen Kroschel from the International Potato Center / Global Crop Diversity Trust, Peru will help to coordinate with the following: (i) Develop frameworks, viz., on how to collect data, on pilot sites selection and assessments etc.; collate information on experiences with other regions on work done on CC; and (ii) Formulate a proposal to GIZ, call anticipated in March 2015 and follow-up with a GEF proposal in 2016.

field trip to tan hoi dong village

Participants were taken on a field trip to the Tan Hoi Dong village, Chau Thanh District in Tien Giang province on the third day of the workshop. The field site was about an hour by road from Ho Chi Minh City.

The aim of the field visit was to demonstrate the practice of ecological engineering pioneered in the Vietnamese province.

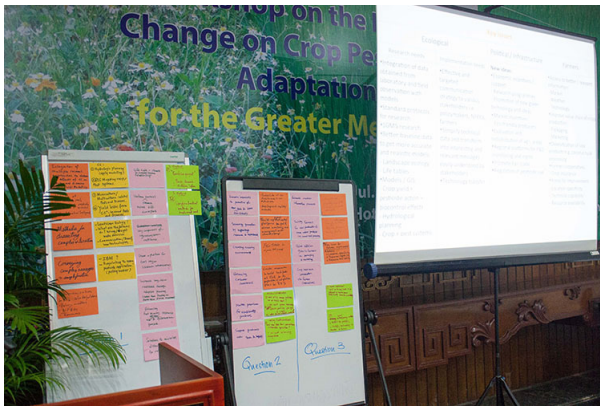
The farmers grow nectar-rich flowering plants on the bunds and abstain from insecticide use in early crop stages. The flowers will provide shelter, nectar and alternative hosts and pollen to conserve and augment natural biological control services.



Fig. 12. Field trip to Tan Hoi Dong village

photo gallery







appendix 1 - workshop programme

DAY ONE

Wednesday, 30 July 2014

- 8.30 a.m. Registration
- 9.00 a.m. Welcome address
Dr. Leocadio S. Sebastian
Regional Programme Leader (Southeast Asia)
CGIAR - CCAFS, Vietnam
- 9.15 a.m. Opening remarks
Dr. Loke Wai Hong
Regional Director Southeast Asia
CABI Malaysia
- 9.30 a.m. Official address and opening
Dr. Nguyen Xuan Hong
Director General
Plant Protection Department, MARD, Vietnam
- 9.45 a.m. Introduction to workshop objectives
Dr. Heong Kong Luen / Dr. Monina M. Escalada
Associate Principal Scientist / Senior Advisor, CABI
Malaysia / Communication Scientist, Visayas State
University, Philippines
- 10.00 a.m. Coffee break
- 10.15 a.m. Group photograph
- Session 1. Climate Change and Pest Scenarios in Food Crops**
- Chairperson: **Dr. Loke Wai Hong**
- 10.20 a.m. Climate change impact on food security
Dr. Oliver Schweiger
Senior Research Scientist
UFZ, Germany

-
- 10.40 a.m. Impact of climate change on rice diseases
Dr. Adam Sparks
Plant Disease Management Specialist
IRRI, Philippines
- 11.00 a.m. Understanding the impacts of changing climates on insect pests on global, regional and local scales: A modelling and GIS mapping approach
Dr. Jurgen Kroschel
Science Leader Agroecology / IPM International Potato Center / Global Crop Diversity Trust, Peru
CABI Malaysia
- 11.20 a.m. Effects of global warming on rice pests
Dr. Jiranan Piyaphongkul
Kasertsart University, Thailand
- 11.40 a.m. Climate change experiments: Limitations of research in laboratories and greenhouses
Dr. Lu Zhongxian
Deputy Director
Institute of Plant Protection and Microbiology
ZAAS China
- 12.00 p.m. Question and answer session
- 12.30 p.m. Lunch

Session 2. Frameworks for Sustainable Agricultural Programs

Chairperson: **Dr. Monina M. Escalada**

- 2.00 p.m. Climate change adaptation plans of FAO
Dr. Jong-Ha Bae
FAO Representative, Vietnam

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- 2.20 p.m. Climate Change Affecting Land Use in the Mekong Delta: Adaptation of Rice - based Cropping Systems (CLUES)
Dr. Ngo Dang Phong
IRRI Post Doctoral Fellow
Can Tho University, Vietnam
- 2.40 p.m. Plantwise: A framework for sustainable plant health in support of resilience to climate change
Dr. A. Sivapragasam
Deputy Regional Director
CABI Malaysia
- 3.00 p.m. The Environment - Friendly Agriculture Promotion Act of South Korea
Dr. Yoo Han Song / Dr. Heong Kong Luen
Professor Emeritus, Gyeongsang University, South Korea / Associate Principal Scientist
CABI Malaysia
- 3.20 p.m. Question and answer session
- 3.40 p.m. Coffee break
- Session 3. Climate Change Adaptation Strategies focusing on Crop Pests and Diseases**
- Facilitators: [Dr. Heong Kong Luen / Dr. A. Sivapragasam](#)
- 4.00 p.m. Key issues in adaptation strategies for pests and diseases
Group discussion
- 5.00 p.m. End
- 7.00 p.m. Dinner reception

DAY TWO

Thursday, 31 July 2014

8.30 a.m. Recap of Day One
Dr. Heong Kong Luen / Ms. Khing Su Li

Session 4. Communications and Funding in Developing and Implementing Adaptation Strategies

Chairperson: Dr. Jurgen Kroschel

9.00 a.m. Challenges in communicating climate change adaptation strategies to manage pests and diseases
Dr. Monina M. Escalada
Communication Scientist
Visayas State University, Philippines

9.20 a.m. GEF - 6: Assessing GEF country allocation funds
Ms. Cristina M. Regunay
OIC Chief
Department of Environment and Natural Resources
Philippines

9.40 a.m. Question and answer session

10.00 a.m. Coffee break

Session 5. Group Discussions

Facilitators: Dr. Heong Kong Luen /
Dr. Monina M. Escalada

10.30 a.m. **Workshop 1.** Research, development and policy issues on climate change and what it means for crop pests and diseases

12.30 p.m. Lunch

2.00 p.m.	Presentation on Workshop 1
2.30 p.m.	Workshop 2. Adaptation strategies and techniques to combat pests and diseases in a sustainable manner
4.30 p.m.	Coffee break
5.00 p.m.	Presentation on Workshop 2
5.30 p.m.	End

DAY THREE

Friday, 1 August 2014

8.00 a.m.	Recap of Day Two
8.15 a.m.	Workshop 3. Ideas on issues, topics, ways and action plans beyond the workshop
10.00 a.m.	Presentation on Workshop 3
10.30 a.m.	Coffee break
11.00 a.m.	Depart for My Tho
12.30 p.m.	Lunch at My Tho
2.00 p.m.	Depart for Long An
4.30 p.m.	Return to Ho Chi Minh City

appendix 2 - participant list

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