FORUM REPORT

Sixth Executive Forum on Natural Resources Management:

Water & Food in a Changing Environment

11-13 April 2012

Southeast Asian Regional Center for Graduate Study and Research in Agriculture

College, Los Baños, Laguna, Philippines

SEAMEO SEARCA

FSC Food Security Center

DAAD German Academic Exchange Service

RIHN

Contents

Separate Compilation

Executive Summary

Twenty-three government executives and planners, scientists, experts, and practitioners representing eight Asian countries convened in the Sixth Executive Forum on Natural Resource Management of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA). The executive forum was titled "Water and Food in a Changing Environment" and took place at SEARCA in Los Baños, Laguna on 11-13 April 2012.

The executive forum was organized by SEARCA together with the University of Hohenheim Food Security Center, Germany and the Research Institute for Humanity and Nature (RIHN), Japan. It aimed to promote greater awareness on current experiences and application of knowledge, with emphasis on the roles of science and scientific communities, in developing strategies to reduce climate-related risks on food availability in a changing environment.

Its emphases are on science and advocacy, knowledge transfer and mainstreaming, and science-to-policy convergence for environment, efficient water, and food production. As such, the resource persons focused their presentations on three sub-themes, namely: "Current Knowledge on Global Environment Change (GEC) Issues and Its Implications on Water Management for Food Production," "Climate Risk Management Strategies towards Water-efficient Food Production," and "Water-efficient Food Production in Climate-based Local Planning and Management."

The participating national and local executives from Cambodia, Indonesia, Japan, Lao PDR, Malaysia, the Philippines, Thailand, and Vietnam were sensitized on global environmental change (GEC) issues and challenges. This was so they would exert efforts in mainstreaming proactive policies that support green growth and adopt science-based programs and development strategies. The forum also engaged the participants—all of whom were actively involved in sustainable agriculture and rural development, NRM, and climate risk management—in reflection, dialogue, and exchange of knowledge and experiences on the impacts of change environment on water, food, and ecology as input to science-based policy formulation for climate-proof, safe, and water-efficient food production.

The roster of esteemed resource speakers during the seminar-workshop included Dr. Ryohei Kada, Professor, RIHN and Yokohama National University, Japan; Dr. Damasa B. Magcale-Macandog, Professor and Director, Institute of Biological Sciences, University of the Philippines Los Baños (UPLB); Dr. Rodel D. Lasco, Philippine Program Coordinator, World Agroforestry Centre (ICRAF); Dr. Ashutosh Sarker, Research Fellow, Monash University Sunway Campus, Malaysia; Engr. Samuel M. Contreras, Agricultural Engineer, Bureau of Soils and Water Management, Philippines; Dr. Bam H.N. Razafindrabe, Associate Professor, Faculty of Agriculture, Ryukyu University, Japan; Dr. Flaviana D. Hilario, Weather Services Chief of the Climatology and Agrometeorology Branch, Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA); Dr. Rex Victor O. Cruz, Professor and Chancellor, UPLB; Dr. Juan M. Pulhin, Professor and Dean, UPLB College of Forestry and Natural Resources; Mr. To Quang Toan, integrated land and water resources development and management expert; Hon. Ronaldo B. Golez, Municipal Mayor of Dumangas, Iloilo, Philippines; and Dr. Bessie M. Burgos, Manager for Project Development and Management, SEARCA.

Dr. Maria Celeste H. Cadiz, Manager for Knowledge Management, and Ms. Julienne V. Bariuan, Training Specialist, both of SEARCA, worked closely with Dr. Rogelio N. Concepcion, Adjunct Professor, UPLB School of Environmental Science and Management, and Dr. Gina P. Nilo, Chief of the Laboratory Services Division, Bureau of Soils and Water Management, Philippines, in organizing the executive forum.

Opening Message

Distinguished Guests, Partners, Participants, Colleagues, Ladies and Gentlemen ... Good morning!

We are very pleased to organize and host this executive forum on Water and Food in a Changing Environment. We especially welcome those of you who have travelled many miles from Cambodia, Vietnam, Indonesia, Malaysia, Thailand, Lao PDR and Japan. We are glad to have you in this forum and we hope you will enjoy our accommodation and facilities in this beautiful campus of our host institution, the University of the Philippines Los Baños.

To our participants who are SEARCA Alumni, allow me to welcome you home! I am more than pleased to note your contributions in your institutions and the Southeast Asian region after you've completed your scholarship; and that many of you are involved in finding solutions to the global issues such as this event's theme on food security in a changing environment.

To our partners, the University of Hohenheim Food Security Center in Stuttgart, Germany and the Research Institute for Humanity and Nature in Kyoto, Japan as represented by Dr. Ryohei Kada who leads the Food-Health Risk Research Project, along with his colleagues – we acknowledge your valuable contributions to this event.

This forum is the sixth under SEARCA's Executive Forum on Natural Resources Management series. It was so designed to create a venue to discuss some of today's key concerns, such as:

- How do we climate proof agriculture?
- What strategies should we prioritize to meet food security needs in the face of a changing climate?
- How do we prioritize water use to ensure both food security needs and the continued resilience of natural resources to the changing environment?

From our end, SEARCA has developed a flagship program – the Climate Change Adaptation and Mitigation Program for Agriculture and Natural Resource Management in Southeast Asia or CChAMP. This learning event is one of CChAMP's building blocks in enabling Southeast Asian institutions working for agriculture and rural development to address the challenges of climate change. Also, part of CChAMP is the Knowledge Center on Climate Change or the KC3 an online portal where we hope to encourage the dynamic exchange of science-based knowledge solutions and good practices. May I invite you to visit the KC3 website and join its online community.

There's much more to share in the discussions regarding the topic of this forum so I will not take much of your time. Let me close by wishing everyone a productive three-day interaction and exchange.

A pleasant morning to all.

Forum Overview

Rationale

Addressing the millennium development goal of halving the proportion of malnourished people by 2015 is an enormous agricultural enterprise as well as the world's largest water-resource challenge (Falkenmark and Rockström, 2006). Clearly, changing climate and environment are redefining areas of opportunities for food production and requires the urgent review of current and future risks and opportunities for investment in future food security and rural development strategy. Now is the appropriate time in contemporary environmental history and development for science communities to share their knowledge and link with local communities and governments in finding effective ways and means for fail-safe climate-proof natural resources use and management planning and implementation.

This seminar-workshop aimed to provide an avenue for the exchange of knowledge and wisdom by local government executives and planners, and scientists, experts and practitioners, on contemporary issues, challenges and imperatives of development and environment. This was hoped to build foundations for community-based adaptation strategies that promote water-efficient food production; support the establishment of climate-resilient communities; and reduce climate-related risks and disasters. The seminar-workshop also aimed to provide scientific basis for integrating local knowledge with applicable science and improve awareness among planners and decision makers at all levels on adapting proactive actions on climate-related risks. It further sought to encourage them to mainstream these actions into local development and disaster risk management programs.

Objectives

The seminar-workshop sought to:

1. Create greater awareness on current experiences and application of knowledge elaborating on the roles of science and scientific communities in developing management strategies to reduce *climate-related risks on food availability in a changing environment;*

2. Sensitize national and local executives on related global environmental change (GEC) issues and challenges to facilitate mainstreaming proactive policies that support green growth and adopt science-based program and development strategies; and

3. Engage participants in reflection, dialogue and exchange of knowledge and experiences on the impacts of changing environment on water, food and ecology as input to science-based policy formulation for climate-proof, safe and water efficient-food production.

Scope

The seminar-workshop course focused on three sub-themes:

Sub-theme 1: Current Knowledge on Global Environment Change (GEC) Issues and its Implications on Water Management for Food Production presented up-to-date information and knowledge on global environmental change (GEC) science, including climate change. Emphasis was on how these global changes are related to local challenges and issues pertaining to local agriculture and natural resources conditions.

KEYNOTE: Ecology-related Risks on Water, Food Safety and Security, and Health	**Dr. Ryohei Kada** Yokohama National University, Japan
Practical Issues on Managing Risks on Water and Food from the Point of View of Terrestrial Ecology	**Dr. Damasa Macandog** Institute of Biological Sciences, University of the Philippines Los Baños
Practical Issues on Managing Risks on Water and Food from the Point of View of Climate Change Science	**Dr. Rodel D. Lasco** World Agroforestry Centre, Philippines
Local Lessons and Transboundary Challenges for Governing Shared Water Resources in Asia	**Dr. Ashutosh Sarker** Monash University Sunway Campus, Malaysia
Technical Principles for Water-efficient Food Production	**Engr. Samuel Contreras** Bureau of Soils and Water Management, Philippines

Sub-theme 2: Climate Risk Management Strategies towards Water-efficient Food Production will present a survey of potential as well as successful science-based measures and community-based climate risk management strategies focused on building resilience in the agriculture sector and water resource systems. Prerequisites and lessons learned to successfully implement response measures will also be discussed to help the participants relate the discussion to their respective local conditions.

Assessing and Improving Community Resiliency in a Changing Climate and Environment	**Dr. Bam H.N. Razafindrabe** Ryukyu University, Japan
Tools for Early Warning System	**Dr. Flaviana Hilario** Philippine Atmospheric, Geophysical and Astronomical Services Administration
Tools for Watershed Monitoring and Evaluation	**Dr. Rex Victor O. Cruz** University of the Philippines Los Baños
Science-enhanced Community-based Coping Strategies	**Dr. Juan M. Pulhin** UPLB College of Forestry and Natural Resources

Sub-theme 3: Water-efficient Food Production in Climate-based Local Planning and Management aims to enable participants to relate global scenarios to their respective local situations. Pre-requirements and guidelines for the successful implementation, challenges encountered, and lessons learned will be further discussed. These experiences and activities will guide the participants in formulating their CRM strategies and action plans as applicable to their respective areas.

Water Resources Development for Sustainable Agricultural Cultivation in the Mekong Delta: Adapting to Climate Change and Sea Level Rise	**Mr. To Quang Toan** Southern Institute of Water Resources Research, Vietnam
Climate Field School: Experiences in Iloilo, Philippines	**Hon. Ronaldo B. Golez** Municipality of Dumangas, Iloilo, Philippines
Focused-Food Production Assistance for Vulnerable Sectors (FPAVAS) Cases	**Dr. Bessie M. Burgos** SEARCA

Forum Highlights

Sub-theme 1
Current Knowledge on Global Environment Change (GEC) Issues and its Implications on Water Management for Food Production

KEYNOTE: Ecology-related Risks on Water, Food Safety and Security, and Health

Dr. Ryohei Kada
Yokohama National University, Japan

Dr. Kada in his keynote message emphasized the rationale for the topic on "water and food security in a changing environment". First, he said that we are now entering into a more risky, more unsustainable, and more unpredictable society. He cited Dr. Saguiguit, who mentioned in his opening remarks that water resource management is an intriguing and one of the most difficult, toughest issues we are facing now to feed the growing population in Asia with a very rapidly changing economic condition. Southeast Asia compared with other parts of the world is really a hot spot, he added.

He said that managing environmental risks to food and health security in the Laguna Watershed has been the subject of his research work with the University of the Philippines Los Baños and University of the Philippines Manila. Laguna Lake is a typical example of ecological degradation, which affects food health and water security. This scientific analysis will have a profound implication to the rest of Asia.

Dr. Kada noted declining agricultural productivity in the region and attributed this situation to the declining quality of soil and water. Other issues and challenges are environmental problems, land and tenure security, water shortage, and climate change. Thus, human beings face high risk and vulnerability with respect to these issues.

Given this situation, Dr. Kada specifically shared on the subject of his research that focuses on the relationship between ecological deterioration and food-health risks. Deterioration of ecosystem services may be chemical, e.g., heavy metal pollution; biological, through loss of biodiversity; and physical, such as abnormality of water cycle and soil degradation. These have impact on food security (decline of soil fertility, food supply) and human health (food safety, contamination, infectious diseases).

Dr. Kada also asserted that the issue is global and therefore, the solution cannot be addressed by one country alone – it would require an international effort. The current research he is currently spearheading is international in scope, with the participation of the governments of Japan and the Philippines.

Dr. Kada cited some literature on the global nature of the issue. For instance, UNDP has identified that land and soil degradation is most serious in Southeast Asia, Southern Africa and Amazon Areas of Brazil. Disasters are also internationally linked .Some examples of these natural disasters and occurrences were in many cases in Southeast Asia. Tsunamis and earthquakes have

affected nearly 5,000 hectares of paddy field. He cited one of the best rice producing areas in Miyagi, Japan, which was hit by tsunami and seems very difficult to revive. This is because soil liquidation and land subsidence of one to three meters took place in wide areas of Eastern Japan after the earthquake in July 2011.

Flood Risk Management is important. Flooding after Typhoon Ondoy (Ketsana) in the Philippines in 2009 has been expanding not only in Central Luzon but also in other urbanized areas.

Historical typhoon patterns have changed and so have the risks. For example, in the 1960's, typhoons only wrought losses to farmers particularly on agricultural lands that could be recovered in two to three years. The situation has changed as in the case of Chao Phraya River in Thailand, which affected flooding in large areas in Bangkok, and the many multinational companies in terms of the supply chain. Thus, the risks have expanded.

From the global perspective of the issue on environmental degradation, Dr. Kada zeroed in on the importance of watershed management as the basis for food and health security. For instance, water quality in Laguna de Bay, Philippines has seriously deteriorated due to pollution from soil erosion, effluents from chemical industries, and agricultural and household discharges.

The research being undertaken in Laguna de Bay aims to investigate two things. First, it seeks to identify and analyze land use changes as they affect water and sediment-related risks to people's health within the Laguna Lake region in the Philippines. Second, it aims to examine the link between environmental degradation and people's food and health securities.

Dr. Kada enumerated some data sets used in identifying environmental risks which include soil quality, soil erosion and sedimentation, land cover changes, water quality, and flooding; and how these affect food security and human health. The research was a collaboration between and among Japanese universities and the Research Institute for Humanity and Nature (RIHN), University of the Philippines Manila (UPM) and University of the Philippines Los Baños (UPLB), Laguna Lake Development Authority (LLDA), local people, and other key stakeholders.

The research site is the Laguna Lake Region in Sta. Rosa Sub-Watershed, where there are primary and complex drivers of Lake Ecosystem change. These are population expansion, rapid economic development, industrial and commercial development, widespread urban sprawl, land use conversion, introduction of exotic and invasive species, and under-coordinated and conflicting policies. The impacts of these on the ecosystem are siltation and sedimentation; increased input of pollutants, solid wastes, sewage, industrial effluents, and agricultural wastes; degraded water quality; flooding problems; and loss of biodiversity.

The research procedures and methods include: 1) terrestrial and socio-economic evaluation by UPLB and RIHN; 2) environmental risk assessment by UPLB, RIHN, and Yokohama National University (YNU); and 3) assessment of environmental impact on human health (UPLB, UPM, YNU). All three teams will identify what is happening from upstream to downstream in the watershed. Emerging issues facing Laguna Lake include declining productivity in agriculture and fisheries, increasing domestic wastes and health issues, pollution and environmental degradation, household food insecurity, and health risks and vulnerabilities.

Dr. Kada also identified pathways of pollutants from source to end-point. The source pollutants are mining, industry, urbanization and agriculture. These pass through ground water, river water, and lake water and sediments, as vessel or route of pollutants. In turn, they contaminate farm products, edible fish, edible plant and drinking water. The end-points are economic risks, social risks, health risks and environmental risks.

According to Dr. Kada, through continuous efforts with the collaboration of the local people, it is possible to revive the Laguna Lake Watershed. He is dreaming of the day, perhaps after 20 or 30 years, that this Laguna lake area could be another beautiful

recreational spot for the people. He added that regulation from the government is needed.

Dr. Kada went on to elaborate on his research projects to underscore how water quality affects food security and human welfare.

One of his teams is undertaking analyses of water, fish aquatic plant, and sediment samples and how they are related. He noted how such analyses had not been done before. LLDA and UPLB are helping them in collecting water samples and bringing these samples to his research institute at Kyoto.

An example of research outcomes is the case of lead contamination found in Laguna Lake by a UPM scientist. Lead content was found in water from upstream to downstream. Findings indicate that fish we are eating has more substance that comes from the upstream to downstream paths of harmful sediments through plankton and fish. A similar result is coming out for cadmium.

Other heavy metals such as chromium, arsenic, and mercury have been found in many parts of the lake water and river water. Some are exceeding the prescribed safe level in international standards. As research on sediments containing high levels of contamination is limited, further investigation on these is much needed. Heavy metals only represent one component of the total waste pollutants.

More frequent flooding and pollution from human activities are also escalating and increasing and with these, there is higher possibility of infectious diseases. UP public health teams are specifically analyzing infectious water-borne illnesses. LLDA is regularly conducting and monitoring these and the research institutes are also helping in a undertaking detailed analyses on heavy metals.

Dr. Kada further presented his study on oil palm plantations in Indonesia, where they are rapidly expanding. The study found a huge environmental cost attached to the introduction of biofuel crops, as Indonesia has been identified as one of the largest greenhouse gas emitter.

In Japan, degradation of resources due to limited capacity to manage them is a serious problem. The aging population and structures have resulted in poor resource management in coastal rural communities. Landslides and serious ecological problems in the 1970's plus a variety of factors such as rural to urban migration, industrialization, other land use changes, and adoption of modern technologies in agriculture and fisheries have resulted to extensive degradation.

Dr. Kada said there are two types of resource management. The first is too much use of resources, and the second is under-use, which is happening in East Asia and probably more so in the near future. Alternative resources are therefore needed by those who will take care of such unpaid resources. For instance, too much export of lumber 20 or 30 years ago has resulted in poorer soil quality, soil content, water retention capacity of the soil, and vegetation.

Dr. Kada then pointed out how some governments have enforced policies for Payment for Ecosystem Services (PES). As an example, he said that if you change the land use pattern, e.g. through industrial or housing development, you might be able to get benefits such as money in the short run. However, the cost to the environment is high in terms of its degradation, water cycle troubles, and flooding. The society may then opt to invest in forest conservation by paying the people upstream to undertake necessary conservation measures.

Dr. Kada then enumerated the challenges in achieving and sustaining food and water security, as established by humanity's experience and research: 1) adoption of incentives for farmers to remain in agriculture in the face of rapid economic growth and expanding opportunities outside the farm sectors; 2) further agricultural land conversion in the light of increasing demand for housing, industrial uses, and commercial uses, resulting in poor quality of water and soil; 3) declining soil fertility from intensive farming, over-use of agro chemicals, leading to productivity decline over many years and aggravating food safety and quality; and 4) food and water insecurity in the lakeshore

community due to diminished food accessibility as a result of high cost of food.

In conclusion, Dr. Kada said that both the natural and socio-economic sciences have to work together in addressing issues on water and food. Public health should also not be neglected because health condition is highly attached to ecological condition. He encouraged other countries to work together using the research framework he has espoused. Some practices in contemporary society may pose risks to food safety, negatively affecting food utilization; hence, integrated watershed risk management is important these days.

Practical Issues on Managing Risks on Water and Food from the Point of View of Terrestrial Ecology

Dr. Damasa Macandog
Institute of Biological Sciences,
University of the Philippines Los Baños

Dr. Macandog discussed global changes, local scenario in the Philippines; factors that would affect the risks of water and food; impacts on food production in the Philippines; basic concepts on food security; and various technological practices in the various upland areas to address water and food risks.

In her introduction, she said that the Philippines is facing multiple hazards due to its geographical location and physical environment being in the Pacific ring of fire. She showed photos of Mt. Mayon volcanic eruption in Albay, landslides and typhoons. This proves that the Philippines has a dynamic tectonic setting. It is situated in a region where the different plates are colliding, converging and sub ducting beneath the Philippine archipelago, and that is why this country is experiencing lots of earthquakes and volcanoes. She also showed some photos of earthquakes and typhoon events in the Philippines.

According to her, these various events pose tremendous risks to national food security, and lately it has been aggravated by global climatic change. The different factors that affect the risks of water and food from a terrestrial point of view are climate change, land use change, soil erosion, environmental degradation and pollution. She also showed the annual rainfall pattern that the Philippines experienced from 1954 nearly in the last 65 years. It is been erratic because there are times of heavy drought and recently, the country has experienced extremely heavy rainfall.

The strong typhoons that come to the Philippines have wrought lots of damages on the environment, food production, and infrastructure. She showed tables of typhoons from the 1990's. Typhoon Pepeng, which occurred in October 2009, cost 27.3 billion of damages in property and lives. Typhoons Thelma and Uring in 1991 also claimed about 8,000 lives.

Land use change has also exacerbated the risks to food security. Dr. Macandog presented the Sta. Rosa sub watershed map. The 1993 and 2008 land cover map of Makabling watershed show build-up of residential/commercial areas in the eastern side of the Laguna Watershed. According to her, land cover refers to the physical materials and biological cover over the surface of land; whereas land use is defined as how man utilizes the land to improve his state of living.

Dr. Macandog explained that Laguna Watershed is an important subject of research because it has a unique urban-rural feature. From serene rural landscape 40 or 50 years ago, it has become converted into a busy center of human activity. In the past 40 or 50 years, hundreds of hectares of productive farmlands were converted into various land uses like commercial, industrial and residential centers just across the watershed. The west side of the lake has more urbanization where Metro Manila is located. In the Southern and eastern sides, most of the agricultural land uses still prevail.

It has been stated that a lot of factors affect the health of Laguna the Bay. These are population growth, urban sprawl, deforestation in the upstream areas, intense fisheries, aquaculture, fish feeds, among others. These factors have resulted in various problems. One of these is that of solid wastes coming from the residential areas and liquid wastes from the industries. She emphasized that sanitation and public health is a big concern. Water- borne diseases, congestion, loss of biodiversity, soil erosion, and sedimentation in the lake are just some of the effects of this land conversion. The average depth of the lake is now only 2.5 meters, which is very shallow. The main reason is heavy sedimentation. Soil erosion and flooding also pose a huge concern. Also, unregulated inputs of pollutants like heavy metals from industrial activities have resulted to deterioration of water quality in the lake, river and even in the ground water.

Dr. Macandog further presented one study that her team has conducted nearly one and a half years ago. It was on rapid assessment and comparative analysis of land use change, land use pattern, and drivers and impacts of these land use changes in three sub watersheds—Sta. Rosa, Los Baños and Victoria. In each sub watershed, her team chose three sites to represent upstream, midstream and downstream. The study chose Sta. Rosa as site because it represents a highly urbanized sub-watershed. During the visit, the upstream area was found mainly agricultural and dominated by agro forestry systems. The midstream area is still undergoing conversion from sugarcane to commercial/residential areas. The lakeshore is dominantly residential and highly congested. The downstream area is mostly residential.

The study found that environmental impacts of these various activities are problems in agricultural wastes where farmers are applying fertilizers and pesticides in pineapple and corn. Land conversion to residential areas and cutting of trees and planting of pineapple in rolling areas also resulted to soil erosion in the upstream areas. In the midstream areas, industrial wastes laden with heavy metals was the main problem; while the downstream areas had much of domestic wastes. All of these wastes end up in Laguna Lake. Therefore, the three sub-watersheds contribute to the problem in Laguna Watershed.

Dr. Macandog also showed a diagram which is an integration of the various impacts of the various activities observed in the lake. Forest clearing and forest conversion into agricultural areas contribute to soil erosion and run-off leading to the lake. Industrialization would open up employment opportunities that will lead to increase in population settlement and again, solid and liquid wastes end up in the lake. Such lake pollution would have impact in the quality of the fish and productivity of aquatic resources. Therefore all of these activities would have impact on the food security and health of the people living in the watershed.

Another study conducted is on impact of the land use change on the water yield. Her master's student did GIS-based modeling to look into water yield. This is also part of the participatory rural appraisal that Dr. Macandog's group conducted. Timeline showed the different crops planted in the area. As early as 1920's, settlers had already started cutting the trees and replaced them with abaca. In 1940, they started to cultivate rice with potato and started planting coconut tress coming from nearby areas. In 1960's, farmers started to plant coffee and in the 1970's, pineapple. Today, the place is more residential and commercial.

The focus of this study was to observe and predict discharge height and increase in built-up areas resulting to increase in water yield.

Findings imply that less water is going into the ground water because of the lesser ability of the water to penetrate hard surfaces.

Soil erosion is another factor to study. Most upland areas in the country, and not just the Laguna watershed, are characterized by farms in rolling areas. These upland farms produce subsistence crops that take the heaviest toll from increasing population pressure. Because of this population pressure on the lowland in the 1950's, many of the farmers migrated toward the upland areas near the marginal lands. The sloping areas have been shifted to permanent and intensive farming.

Banawe Rice Terraces in the Cordillera Province, for instance, have also been experiencing soil erosion even though they have Muyong-Payo System – the forest is in the upstream areas and terraces are for growing rice paddy field because the residential areas are moving into the Muyong-Payo System.

Practical Issues in Managing Risks on Water and Food, from the Point of View of Climate Change Science

Dr. Rodel D. Lasco
World Agroforestry Centre, Philippines

In discussing changes in climate, Dr. Lasco used the Philippines as an example based on the assumption that the scenario in Southeast Asia would not be too different from what may be expected in this country. He pointed out the projected rising temperature from now all the way to the next 100 years, and this is a common global as well as regional scenario. He further projected the rainfall scenario up to 2050 using different models, with the main message that the dry season will be dryer and the wet season, wetter. He said that probably, there is less certainty on the rainfall pattern and more conformity in terms of temperature. Warmer temperature rainfall may change to maybe higher total rainfall, but seasonally will be distributed differently.

One risk that creates worry in this country is extreme weather events. Typhoons and tropical cyclones are highly likely according to the projection that hot temperature and heavy precipitation will continue with more frequency in the future. The number of the maximum temperature greater than 35 degrees is expected to increase in all parts of our country in the next 2250 years. Extreme rainfall is also projected in Luzon and also in Visayas.

Impact on Food Supply

Dr. Lasco discussed the global picture in term of food supply. Crop responses will vary depending on latitude – at high latitude, there could be an increase and at low latitude, production could decrease at 1 to 2 degrees rise in local temperature. There could also be more drought and flood frequency that would especially affect subsistence or small holder farmers. Globally local temperature will increase at 1 to 3 degrees but then after that it will go down, according to the global projection of IPCC.

Dr. Lasco illustrated as example the impacts of changing climate on maize production. From mid- to high latitude, there is a wide variation of uncertainty. There is a downward trend although it is not that pronounced. In low latitudes, lowering of yields is more distinct.

In rice, a generally declining trend is seen with higher temperature increase at about 3 degrees. Dr. Lasco cited an ADB report that stated that rice yield could decline up to 50% if there is no adaptation option, so this is a part of climate risk associated with changing world climate.

Modeling work by the International Food Policy Research Institute (IFPRI) in Washington, DC shows that irrigated rice by 2050 would decline greater than 25% based on the model they used.

Dr. Lasco went on to present the projections of other researchers that showed similar possibilities of yield decline with differences in details.

Water and Climate Change

Dr. Lasco emphasized that water is important because 2.5 billion people live in highly water stressed environments. He discussed two types of water scarcity:

- Physical Scarcity, where there is no water and the rainfall is very low; and
- Economic water scarcity, where water is out there but because of lack of money, distribution system and poverty, people cannot access the water. The main problem in all countries is basically economic.

The bottom line is that smallholders, the subsistence farmers, and pastoralist fisher folks are the most vulnerable and at risk in terms of the impact of climate change.

In the longer term, he said that there will be additional negative impact on other related climate processes including sea level rise, spread of human diseases also affecting agricultural labor supply, and again, with small holders as the most vulnerable and at risk part of the population.

Moreover, food supply would be at risk and rice is very important where the biggest consumer of rice is Asia. The Philippines is the biggest importer of rice in the world.

Local Lessons and Transboundary Challenges for Governing Shared Water Resources in Asia

Dr. Ashutosh Sarker
Monash University Sunway Campus, Malaysia

Dr. Sarker's presentation was divided into three parts: Part I covered theory on local and transboundary commons, evolution of local commons and simple game theory, then experience and implications; Part 2 covered irrigation commons in Asia based on literature review, design principles for managing irrigation commons and case study of irrigation commons in Japan, particularly Japanese irrigation management system; and Part 3 covered linking other Asian experience, especially Japan's experience, to transboundary or international commons, such as in the Mekong River.

In order to properly understand the concept of "commons", such as irrigation pond and Mekong River, Dr. Sarker mentioned the presence of two attributes. The first attribute is

high subtractability of benefits, with benefits referring to "water". High subtractability is explained as follows: when 1 gal of water is withdrawn from the pond/river, it is no longer available to other users. For example, in the case of Mekong River, if some water were withdrawn in China, the same water is not available for Vietnam. Second attribute is low excludability of beneficiaries, beneficiaries referring to users or countries. One cannot exclude the beneficiaries. For example, China

cannot ask Myanmar not to withdraw water attribute makes a system technically called Common Good Resource. Given a pond which is a local common, there are normally hundreds of irrigators. Due to climate change, global warming and evaporation, water supply becomes short year by year. Irrigators would then try to withdraw as much water as they wish. For example, Irrigator 1 will withdraw all the water and Irrigator 2 will have no water at all. There will be fights and conflict among users, and cooperative activities will be discouraged. This system will also face tragedy of the commons.

Dr. Sarker proceeded to present that there are many theories on how irrigators can manage this situation. Some scholars say that government should take ownership of the pond and should take on the role of distributing water to the irrigators. This has not been successful in many parts of the world because government does not know the local situation. Some scholars say that this should be privatized. But with privatization, users normally over-exploit. Then, due to the government not knowing much about the local situation/norms/culture, it is advised not to get involved. Instead, users should build up their own management policies based on their tradition/culture/norms. In this case, irrigators should have strong communication, strong cooperation, and develop institutional management for self-governance. This has been successful in many parts of the world, with only few failures.

In terms of transboundary (international) commons, Dr. Sarker gave as an example the Mekong River which is bounded by several countries such as China, Myanmar, Thailand, and Cambodia. He further explained that if China will withdraw as much water as it likes, or pollute a part of the river, this will affect the rest of the countries connected. China can say that they own it and have the right to exploit the river. But actually, this is a common-good resource. Myanmar should not say Thailand could not withdraw water and Thailand cannot tell Vietnam the same thing. If outside organizations come to enforce rules, then there will be fight among countries. Dr. Sarker emphasized that what we can learn from local common is the need for “cooperation”. He also from Mekong River and vice versa. This noted that outsiders cannot make the concerned countries cooperate and distribute water fairly.

Dr. Sarker cited several authors and studies relating to managing the common. Olson in 1965 wrote *Logic of Collective Action* and Hardin in 1968 wrote *Tragedy of the Commons*. These two authors said that government ownership and privatization are the only two ways to manage the commons. However, Ostrom said in her book *Governing the Commons* in 1990 that there is a “third” alternative – self-governance – because users have their own capability to develop their own self-governing institutional analysis, thereby avoiding the tragedy of the commons.

Then, Dr. Sarker mentioned his research with Dr. Itoh, “Theory Based on Japanese Irrigation Management: A Case Study”. They stated in that research that government is not necessarily a destructive power/ coercive force, but has the ability to go well with resource users. Resource users might have their traditions/norms, but they lack scientific information. This is the reason why government should get involved. Government should reinforce self-governance but must not interfere at the local level in the aspect of irrigation management.

Of course, the Japanese government has seized some freedom of the farmers because it is highly protective and highly subsidized. The Japanese government makes farmers sell their rice to the government. In the irrigation management case, government has given full authority and full autonomy to the water resource users to develop their own rules. Government does not come at the local level to give instructions on how to distribute the water. But in many other Asian countries, when the government provides technical/economic assistance, it also interferes at the local level. This is the reason many irrigation commons could not be successful.

Dr. Sarker also presented game theory. If there will be cooperation, payoff would be 15:15 for Irrigator 1 and Irrigator 2. They will develop binding agreements that they will

share water, but when one defects, the defector payoff is 20 and the one who cooperates is -5. This is for the first time. But for the second time, it will be reversed. Then, it will face tragedy of the commons. Therefore, cooperation between irrigators, or cooperation among China, Myanmar, Laos, Vietnam, Thailand, is very important, then the pay-off would be 15:15 conceptually.

Dr. Sarker showed a photo with Prof. Kada and Prof. Ostrom in Nepal exhibiting the commons. He said it was from a published article by Prof. Ostrom which says that when government spends money in substituting physical facilities, the system does not work. This means that government thinks that irrigators do not have the ability to manage their own resources, hence, it tries to take control of the management – a great mistake that government does in many Asian countries. Dr. Sarker expressed his view that it is all right for government to spend money and provide technical support, but it should not ignore local norms and capability of the local people to manage their resources, despite not being engineers or not having scientific or technical knowledge. He said this is a great mistake on the part of the government. The system does not work, he said, because there is no cooperation between the government and the irrigators.

Dr. Sarker showed traditional common management. It has not been highly successful, but it is sustainable. Cooperation has been higher and irrigators came to resolve their own conflicts based on discussion and communication. But when government invested in highly sophisticated facilities, they destroy the opportunity of their coming together to discuss and manage the resources. This is an important lesson at the local level. He reiterated that government involvement is important, to provide scientific, economic, statutory support, but it should not interfere at the local level. Otherwise, they will destroy irrigators' ability to develop their own rules based on local traditions and norms.

Dr. Sarker proceeded to discuss the principles in Japanese irrigation management. He said he patterned it on the eight principles established by Prof. Ostrom based on hundreds of case stories collected from different parts of the world. Furthermore, he said that it is not a blueprint idea, but rather, it is just a guide. He explained the principles using the case study in Nishinkanbara Land Improvement District (LID), in Japan, which demonstrates post-war irrigation management.

One principle is well-defined boundaries. More than a hundred years ago, the case study area was flooded. The people participated and constructed an artificial channel, 10 km long, so that excess water could be controlled and would go to the Sea of Japan. When water would go to the river (19,000 ha; 14,000 irrrigators managed the local common), it became common property, while paddy field was a private land. So, there is a mixture of property lines: private paddy field but water is a common good.

Dr. Sarker added that a farmer cannot withdraw water as s/he likes. This led to another principle which is on rules developed by the farmers/irrigators themselves, despite government's political, legal, and economic help. The government subsidized the project. It was a cost-sharing endeavour between the government and LID. In the case of a big project dam, government shares 80-90% of the cost, which for a medium or prefectural project, government shares 76%. Government involvement is high in terms of spending lots of money. Once facilities are constructed, management is almost entirely given to the farmer organization. It then becomes the farmers' responsibility to manage the resources. Farmers pay 100% of operation and maintenance. Government does not subsidize until it serves non-irrigators too.

In the case study area, if someone has 1 ha of land, he has to pay USD 1,410/year. If one has 2 ha of land, he will pay double. This means applying the same proportional principle, i.e., proportional equivalence of benefits and cost. Another example is the pumping station. It is Government that invests, but it entirely entrusts operation to LID. Dr. Sarker then gave more examples of government/farmer investments that are eventually managed solely by LID.

According to Dr. Sarker, local people already had the capability to work together even

before the establishment of LID. Notably, even after the LID, people are still working together. Government did not instruct the people how to manage the common. This is in contrast to a case in Nepal which did not become successful.

Dr. Sarker showed some photos showing the use of highly sophisticated machineries in different parts of the world. He said that this would not work in developing countries because if the government provides subsidy, government would try to control the local people and management of the common.

Another principle emphasized by Dr. Sarker was on monitoring. He explained that this involves both behaviour and water allocation. Before, users do not know how much water is being drawn/used from the river and the difference between users from upstream and downstream. Then, through developed technologies, LIDs are able to monitor from the office aside from on-the-spot or on-site monitoring. For transboundary common, China, Myanmar, Laos, and Thailand, can develop international monitoring system. This would help to remove doubt and suspicion and reduce a great amount of conflict among countries around Mekong River.

Use of graduated sanctions or punishments is another principle highlighted in Dr. Sarker's presentation. In the Japanese case, violators would be punished. But in the case of his study area, no violation was observed. One LID even has no sanctions, because there are no violators based on their monitoring. In case of transboundary commons, developing monitoring systems for behaviour and scientific information sharing is important to reduce conflict and forge stronger cooperation.

Then, there's the principle of resolving the conflict. In the case study area, elected representatives among the irrigators resolve the conflicts. They do not rely on outside political or other forces such as police. Minor conflicts are discussed and resolved.

LID is also organized. Employees and technical persons work at the LID, in different sections, managing resources and collecting data to make sure that distribution of water is rationalized. Dr. Sarker added that this is important and may be applied to Mekong River (transboundary commons).

Dr. Sarker proceeded to explain that in Japan, there are approximately 5,000 LID with National Federation, Prefectural Federation and LID at the local level and branches of LID. The Ministry has an independent center of authority. It interacts with the LIDs but does not interfere with their authority. Corruption occurs but not as badly as in other developing countries. Communication and cooperation between the national government and federations are independent and interdependent. Up to the local level, interaction (bilateral, unilateral) is present, along with a network of connections and inter-relations. One center of authority does not interfere with the sovereignty of other institutions. They co-exist. This principle can be applied to Mekong River.

Dr. Sarker shared the prediction of World Bank Vice-President Dr. Ismail Serageldin in a 1995 interview: "Many of the wars this century were about oil, but those of the next century will be over water."

Dr. Sarker added that there is no "war" but there might be a hidden "war" on water resource. For instance, 16 million people depend on the Mekong River for their livelihood. If China develops a dam, it would definitely create environmental issues. Other countries should cooperate and minimize the environmental impact of such a move. Building a dam is not necessarily a bad idea, because it helps control water during drought and flood. But cooperation is necessary.

Dr. Sarker then listed the following problems of the Mekong Subregion:

- Lack of cooperation (China is not included in the Mekong River Commission; China does not agree in the negotiation of water uses. It defies the opinion of the United Nations. From a scientific point of view, a friendly relationship is necessary and China should be included as member of the Mekong River Commission.
- Political party imbalance: Mekong River Commission is not a strong

authority. Other countries, such as Laos and Cambodia, heavily depend on the development programs of China.

- No country is yet seriously concerned about environmental issues because they do look at the Mekong River as a natural common.
- Seawater intrudes in Vietnam and Cambodia when China blocks the water.
- Navigation is poor in the downstream area of Cambodia.
- Population has doubled over 30 years in downstream Mekong River areas.
- Deforestation
- Pesticide pollution

In summary, Dr. Sarker said that what he presented may be conceptual, but it would be a good starting point, and drawn based on Japanese experience. He suggested that China, Cambodia, Lao PDR, Myanmar, and Vietnam should develop an international federation with independent authority that will not interfere but rather cooperate and share scientific information. He also advised the establishment of a national federation in every country which should all be linked. A representative from every country should be selected/elected.

If one country violates the rule, provision should be in place for sanctions against that country. Local federations of fresh water, similar to LID, or a branch freshwater district, e.g, in Thailand, may communicate with NGOs or universities. Similarly, NGOs should not also interfere, but would interdependently communicate information.

Finally, Dr. Sarker said that as rivers are interconnected, people should also be interconnected. A sophisticated network of cooperation and communication should be developed, which can take actions to resolve problems. Finally, he acknowledged that these things cannot be implemented overnight. He then enjoined everyone to make best use of the organizations, including the Mekong River Commission, and existing networks.

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Dr. Gina P. Nilo: That was an amazing presentation, introducing a new vision regarding environmental management. It is special and unique in that it talks of cooperation and communication as keys to environmental management, including the vital role of governance. Dr. Sarker has underscored human interconnectedness.

Dr. Buenaventura B. Dargantes: Comparing the Japanese LID with the Mekong River is actually a problem of scale. If you notice, this is an international water common and is governed by in-country water-use rules. The water-use rules in each country are quite different and coming up with a unified set of rules requires coming together. During the ASEAN Summit, it was proposed to have a regional federation with governance powers over Mekong with a set of unified environmental rules and later obstruction rules. I don't know how it will fit into this.

On the level of governance, going to branch level is complicated despite the Game theory. We tried it in the Philippines. Philippine rivers are considered streams. Assuming that rivers are streams, it'll be complicated as you go down the level of scale of governance. I hope that there'll be more cooperation/dialogue. Maybe when you presented the set of examples, in the river branch of Mekong, you can look at the comparison.

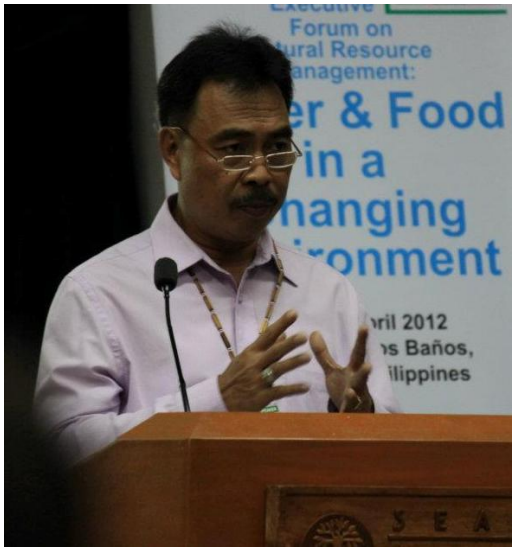
Dr. Sarker: The commonality is, if water is being withdrawn fairly, the monitoring system should be developed so that every country would withdraw water according to the agreement and according to negotiations. China should not say to Lao PDR that it has developed the rules. When Japan established LID, the government did not ignore the old set of rules. Rules may be different, but they should be independent of the rules of other LIDs. This will not totally solve the problem, but it helps to an extent.

Dr. Kada: The conventional irrigation commons had to deal only with irrigation purposes, supply of water among the recipient farmers. Today, society is mindful of environmental concerns aside from production. By adding such environmental concerns, do you think the nature of irrigation commons changes?

Dr. Sarker: The idea is to accept complexity not complications, embracing different interests and rationalizing the distribution of water e.g., as a result of constructing a dam. Nowadays, LIDs have realized this reality of complexity of interests. In Japan, during the non-irrigation period, not much water could be accessed in the irrigation channel. Now, the LID is concerned about this issue. They have negotiated with the government for the water to flow in the area for non-irrigation use (when industries use the water). LID is not only concerned about water distribution but also other environmental issues, which they resolve. The main river is managed by the government. Both industries and LIDs negotiated with each other through the government and not directly with the other. So, there's no direct conflict between the LIDs and industries.

Technical Principles for Water-efficient Food Production

Engr. Samuel Contreras
Bureau of Soils and Water Management, Philippines



Challenges Affecting Water Resources

Engr. Contreras said that water efficiency is basically an indicator of the relationship between water, amount of water required and the amount of water that is diverted or used. In many ways, there's a proposition that we could improve water efficiency by reducing wasteful use and not restricting such use. Applied to agriculture, we need to meet the level of production in the agricultural sector with least water necessary, which could be gauged not in terms of percentage but in terms of total production; such as dry matter production or marketable products per amount of water applied. Water use efficiency, agronomic water use efficiency, crop water use efficiency and water productivity are just varying terms with nuances in their definitions. This merely illustrates the complexity of the concept.

He tried to go beyond the boundaries of the topic and emphasized water security, which he said he firmly believes is the pathway towards food security. His outline started with a backgrounder that dwelt on the challenges affecting the water resources sector. His ideas and thoughts on the underlying principles for efficient use in the water sector followed. He then shared experiences and principles that he learned from other countries on what must be done, with emphasis on convergence and community mobilization.

By way of introduction, Engr. Contreras said there are varying perceptions of water availability. Some experts argue that if current practices are not changed, the amount of water to be required to meet global food needs will nearly double in 2050. For others, the real issue is to go for intensive agriculture or start with which type of farming that would best meet the growing demand for food, but with reduced water availability in the future. These two schools of thought were put forward because agriculture is a predominant water user and yet uses it less efficiently. For instance, the average requirement of food commodities is 3,500 liters of water to produce 1 kg of food. Equating this with the requirement of 1 person/day, if he needs 1/4 kilo of food, he would be utilizing 1,000 liters of water. Yet, our per capita requirement is just only 100 liters: 10 liters for drinking, 20

liters for cooking, 30 liters for personal washing, and 40 liters for washing clothes. This is 100 liters as against 1,000 liters required to produce the food we would eat daily.

The question is what must be done? They said that water is life because water is the lifeblood of human productive activity, particularly agriculture. With increasing population, urbanization, expanding economy, demand for water may increase and go beyond what is available within the context of a basin. This is because availability could only be determined within a hydrologic boundary or within a closed system, that is to know what is available and how much is the present extraction. In a nutshell, it would mean pressures on water resources. If there are more pressures on water resources, there are more conflicts and more tensions among competing users.

Adding to these are climatic drivers and non-climatic drivers. For water, the potential impact of climate change to the sector would mean more troubled waters ahead because of the observed and projected increases in temperature, sea level rises, extreme climate events, and rainfall variability, which will have some sort of domino effect on the sector. This means destruction of agricultural infrastructures, flooding, high erosion/severe erosion and disruption of the cropping system. For farmers, climate change creates uncertainties – it forces them to veer away from the usual cropping pattern and disrupts the activities that they are familiar with.

Non-climatic drivers, on the other hand, pertain to human activities. With growing population and rising standards of living, it would mean increased water demand, which means rise of waste water discharge and subsequently, deteriorating quality of rivers. Moreover, increased water demand would also mean increased withdrawal from ground water and surface water sources and basically it would mean the need to increase water availability per capita. Rising economic growth is also parallel to land use change, which is equivalent to watershed degradation in other areas, such as in forestry areas that are completely turning into pavements. There is increased run-off and big discharges from watersheds, altering hydrologic processes within the watershed. It only means two things: during the rainy season, it would increase overland flow and more floods, while in the dry season it would reduce groundwater recharge. Meanwhile, reduced surface stream flow would mean water supply instability. Combining competition among water users with water instability would mean increased vulnerability of the sector. Thus, water sources are under threat because of the population growth under climatic and nonclimatic drivers.

In particular, freshwater resources will remain a vital resource under threat. Agriculture accounts for 70% of the total freshwater withdrawals, and yet is less efficient in using water. The tall order is for the sector to be more efficient but following and reflecting fundamental beliefs, practices and attitudes to attain highly efficient food production.

Underlying Principles to Efficient Water Use

Engr. Contreras emphasized that we need to recognize that freshwater is a finite and vulnerable resource. Because of this, we need to monitor and regulate development and utilization of water resources. We should properly match water demand and water availability, that is, to look at the concern in the context of watersheds. We should look into a closed system not guided by administrative boundaries but by hydrological boundaries. Downstream, there should be an element of accountability so that each water user may self-regulate. With this, they would be encouraged to apply good farming practices, such as water conservation, improved cultural management, and farming systems that would contribute to increasing water production.

There are two elements to consider: **production**, i.e., improved cultural management and farming systems; and **volume of water for production**, or water conservation. We should also take note of water use recycling as an important means to save water. These concerns do not lie within the domain of agencies and farmers alone, but rather, in everybody. It is incumbent upon everybody to conserve water to ensure water efficiency and water productivity.

What Must be Done and Options

With increasing water withdrawal, the order of the day is to make food production efficient. This may be addressed in a holistic way by looking at an entire watershed. This requires looking at the interdependent and interrelated programs within a watershed so as to determine overlaps and gaps within the project and use efficiently the limited resources that exist.

Examples of water resource management programs include those that address water management when water is in excess; water supply augmentation and conservation when water is a constraint during dry season; water use efficiency improvement; water quality production; waste water treatment and re-use; and on top of these, watershed management and disaster risk reduction particularly water-related risks. Water security is a pathway towards food security.

Foremost in pursuing water security is the need to **explore traditional and science-based knowledge to make water available.** Engr. Contreras noted the abundance of technologies in the Philippines and neighboring countries that may be replicated elsewhere. This, he said, should start in highland ecosystems through watershed management because it is a key element to save the forest, protect soils and to store water for the future.

Watershed management options include forest protection, agroforestry, and application of soil conservation measures like vegetative strips and contour farming, as may be appropriate to specific to ecosystems or local conditions. In the sub-watershed, farmers may capture so much water during the rainy season in order to have water for the dry season. Rainwater harvesting is possible through small water impounding systems in the upper watershed. The impounded water could be used for supplemental irrigation, livestock watering, domestic purposes, and even ground recharge and flood mitigation.

At a bigger scale, water impounding may be community-managed as in Talugtog, Nueva Ecija, Philippines. Engr. Contreras also showed examples of small farm reservoirs managed individually by farmers without subsidies. These are examples of farmer responses to changing climate in the Philippines and Timor Leste.

Engr. Contreras then showed a system of collecting rainwater efficiently using a small water impounding system upstream, reinforced by a network of water retention reservoirs downstream for optimimum water availability. Spill or excess water from the small water impounding upstream could still be collected downstream for efficient use further downstream.

Rural households also employ simple rooftop rainwater harvesting as practiced in the Philippines. Rainwater harvesting may also use a more sophisticated system as done in Seoul, South Korea. This system uses two or three underground chambers and controls flood while saving water for various uses in an urban setting, such as cooling, cleaning, gardening, flushing, and filling up fire trucks.

Engr. Contreras then showed various groundwater recharge systems in India and Australia. These are systems of collecting runoff and rainwater and channeling them into the ground to replenish underground water. While showing the merits of these technologies, Engr. Contreras recommended investing in irrigation infrastructure that is climate-proof and continued restoration, rehabilitation and improvement of existing systems.

He added that utilization of renewable energy will contribute to increased efficiency and water availability and in the long term could contribute to sustainable water resource management. Some of the technologies for reusing renewable energy include solar power, water pump, ram pump and wind power pump.

He further showed systems of 1) water supply augmentation through regulated shallow tube well installation; and 2) wastewater re-use for agricultural purposes.

Engr. Contreras underscored the importance of **ensuring efficient use of available water** either through irrigation and drainage

management or improved irrigation method or farming system integration. These ought to factor the supply side as well as the demand side towards increased and sustained water productivity. He cited the Sustainable System of Irrigated Agriculture developed by the Philippines' National Irrigation Administration. It involves controlled irrigation through intermittent irrigation method/alternate wetting and drying in combination of good cultural management to increase yield.

Engr. Contreras showed the water saving technology developed by the Philippine Rice Research Institute (PhilRice) and International Rice Research Institute (IRRI). The method could generate 15% of water savings compared to continued flooding method and has been introduced in the Philippines through Department of Agriculture Order 25 Series of 2009, "Guidelines for the Adoption of Water Saving Technologies in Irrigated Rice Production System in the Philippines.

On the other hand, highly efficient irrigation systems introduced by developed countries such as overhead irrigation, sprinklers and micro sprinklers require high investment. They are appropriate for high value commercial crops. Meanwhile, a localized drip irrigation system which is applied directly to the plant has been found to reach 92% efficiency.

Excess water management is also part of attaining water security. This involves improving the drainage system of existing irrigation systems.

Farming system integration also provides ways of ensuring efficient use of available water. Examples of these include 1) an agroforestry-vegetable-rice terrace farming system in Ifugao Province, Philippines; 2) upland soil conservation farming system using various soil conservation measures such as contour farming and establishment of hedge rows of close-growing crops, composting of farm waste and residues, mulching, and establishment of brush dams across gullies; 3) cropping pattern and calendar adjustment in irrigated agriculture; and 4) organic farming systems.

In the Philippines, the usual practice of adjusting the pattern in the cropping calendar is fallow period during dry months. But now, with the large losses incurred during the months of September, October and November when strong typhoons come, farmers adjust the fallow period from dry months to the period of these extreme climatic conditions

Convergence and Mobilization of Communities

Convergence and mobilization of communities are needed in putting all these strategies into action. Engr. Contreras said it is important to examine overlaps and gaps using the watershed approach in order to strengthen implementation of programs through convergence of action and alliance among stakeholders. He cited the case of three government line agencies in the Philippines, those of agriculture (Food and Water Security), agrarian reform (Social and Tenurial Security), and environment and natural resources (Environmental Security). He said that to have more coherent programs, gaps and overlaps in the programs of these three agencies may be examined, with the participation of local government units, civil society organizations, academe and indigenous people communities within the watershed.

Likewise, there is a need to **mobilize the community**. Community-based watershed protection and management needs to begin with creating awareness among and motivating various stakeholders so that they may be encouraged to participate in watershed management initiatives. Training may then follow, using a technology approach such as the Farmer Water School. Engr. Contreras cited the Farmer Managed Ground Water System implemented by farmers through a Farmer Water School approach or learning by doing and farmer empowerment in India. This involved learning the dynamics of water supply and demand, crop plan preparation, and water management strategy planning and implementation.

Conclusion

Engr. Contreras concluded his presentation by reiterating how food production depends

on water availability in the future, given that renewable freshwater supply is becoming scarce.

With the increasing trend of water withdrawal, agriculture must stand to the challenge of increasing water productivity, maintaining more water-efficient production system and ensuring water security as a pathway toward food security, he said. Because freshwater is a finite and vulnerable resource, the development and utilization of water resources should be properly regulated and the element of accountability and self-regulation should be adopted by water users. With water becoming scarce, good farming practices, water re-use and re-cycling would increase water use efficiency within a basin; Strengthening institutional linkages within a basin could facilitate better collaboration and partnership for more coherent programs on water conservation, water use efficiency, and productivity improvement.

With agriculture currently using 70 percent of the available freshwater, the big challenge for the sector is to reduce its "water footprints" by increasing water efficiency on farms. Finally, an enabling environment is also important in terms of unified water-related policies, institutional arrangements, and financing mechanisms to address the threat of the present and future water insecurity.

Sub-theme 2
Climate Risk Management Strategies towards Water-efficient Food Production

Assessing and Improving Community Resiliency in a Changing Climate and Environment

Dr. Bam H.N. Razafindrabe
Ryukyu University, Japan

Overview of Disaster Risk Management and Resilience

Dr. Razafindrabe introduced his topic stating that resiliency is actually a broader concept that can relate with fisheries, agriculture, forestry and disaster risk management.

He cited the Special Report on Extreme Events by the IPCC that Dr. Lasco had mentioned. The report showed the number of hydrological disasters like flood, rainfall, landslide and meteorological disasters like storms, climatological disasters, extreme temperatures, droughts and wildfires. In the report, damages are high in America, Europe and Asia but few in Africa. While it shows that most developing countries invest more on climate risk management, they are also the communities that are left behind and are more vulnerable. This underscores the hydrological and meteorological importance of Asia.

He said that we need to combine disaster risk management and climate change adaptation to address climatic problems for the purpose of building community resilience. In 1970-2009, the IPCC report says that while the number of cyclones seemed not to increase, their intensities and the damage wrought are increasing. Disasters reported in terms of percentage of countries hit by tropical cyclones are apparently increasing.

Dr. Bam gave a short overview of his presentation, including 1) defining context and system, 2) assessing resilience, and 3) options to improve resilience. He gave three steps. First is to determine resilience of what – the key assets, depending on our level of focus, whether individual or community. Or are we talking about governments, ecosystem service, whether provisional or regulatory? We have to clarify the system boundaries,

scales and stakeholders. For instance, applying the millennium ecosystem assessment framework depends on our focus. Second, we need to consider resilience of what to what, such as resilience of people to disturbances, or resilience of forests to typhoons or climate change. These are the things that we need to clarify before undertaking an assessment of resilience.

Showing the global risk landscape, Dr. Razafindrabe noted a high level of hazards in the agricultural sector and fisheries sector. The greater concern of agriculture development practitioners and researchers are societal and environmental risks like extreme weather, drought, desertification, water scarcity, and coastal flooding; and societal risks such as pandemics, migration, infectious diseases and problems in climate change; with human wellbeing as the ultimate concern. He cited as example the big earthquake in Indonesia on 11 April 2012 to illustrate how people need to be resilient.

After defining the context and system, plus resilience of what to what, comes assessment. There are many characteristics to consider: the thresholds, influencing factors, controlling variables, and drivers. Need to analyze adaptability and transformability. He said that in analyzing risks or vulnerability he usually use the What What makes it that way? We need to analyze adaptability and the extent that the situation can be transformed. Assessing vulnerability and resilience usually involves asking the following questions: who are at risk? What are at risk? What are people at risk of, their resilience of what, to what? What factors are responsible for those risks? How does action of the people affect vulnerability to risks? How do local people exposed to hazards perceive or cope? What is their perception of risks? What are the coping strategies of local people? What are the actions that should be taken to help people to enhance their adaptive capacity and resilience?

Disaster Risk Management

Disaster risk reduction refers to the conceptual framework of elements considered with possibilities to minimizing vulnerabilities and disaster risks to avoid or limit adverse impact of hazards. On the other hand, disaster risk management is disaster risk reduction combined with a management perspective combined with mitigation, prevention, preparedness, and response. It includes emergency management, recovery, and reconstruction.

The Hyogo Framework for Action (HFA) is a framework led by the initiative of the International Strategy for Disaster Risk Reduction (ISDRR). It has five priorities for action. The Framework states that disaster risk reduction ought to be the local and national priority of every country. It should be integrated in every policy that is also in line with climate change adaptation. It requires identifying, monitoring and assessing disaster risks, enhancing early warning, and use of knowledge to create a culture of safety and resilience at all levels.

The Disaster Risk Management Cycle underscores that before disaster strikes, we need mitigation, preparedness, response, relief, rehabilitation, and reconstruction.

He stressed that everyone ought to be proactive than reactive. This requires knowledge on and capacity to undertake pre-disaster efforts. They include conducting evacuations, drills, and exercises. Also, reconstruction and recovery are important, with the caveat that rebuilding should avoid the same risks that made the disaster possible in the first place.

Resilience is the ability or capacity of a system or society to cope, learn adapt, recover or bounce back. In disaster risk reduction, Build Back Better (BBB) refers to bringing the level higher than the previous

status to improve the wellbeing of people. In essence resilience is the capacity to absorb stress, capacity to maintain functions, and capacity to recover or bounce back better.

Risk includes death, loss, or injury. Vulnerability may be economic, political, and physical. The idea is, if vulnerability increases, if risk increases, resilience decreases. On the other way around, if vulnerability decreases, risk decreases, resilience increases. To bring risk lower, we need to act on vulnerability and capacity; and control the factor that we can control. To do so, we need to act mainly on vulnerability and capacity.

Assessing Resilience

The first tool for assessing resilience is the coastal community resilience method, a kind of index style. This considers governance, coastal management, land use, risk and knowledge, warning, emergency response, recovery and giving weights to each of those.

Hazard becomes disaster when there is loss of life and economic loss. The amount of damage depends on the ability to address it.

In assessing resilience of society and resilience of critical infrastructure, the method that different sectors use are data collection, vulnerability analysis, consequence analysis, and resilience analysis with various indicators coming come up with vulnerability index, criticality index, resilience index, and combining those, one may get the risks index. For vulnerability index, the factors considered include physical security such as access, control fence, gate; security management like business continuity plan, emergency action plan, threats level, and security. Criticality combines the relative measures of the consequences of failure mode and frequency of occurrence.

He emphasized that, in order to be resilient one needs to be robust, to be redundant in a positive way to address the problems, to be resourceful to address the issues and to be rapid to have a good result in a short time.

Another method is vulnerability-resilience index method (VRIM). It considers two main variables: sensitivity and adaptation capacity, such as sensitivity to food, water, settlement, health, and ecosystem; and adaptation capacity of human resources, economic capacity, and environmental capacity.

Another tool in assessing resiliency is the Climate Disaster Resiliency Index (CDRI). It studies specific resilience and over-all resilience in different Southeast Asian countries – specific in the sense of physical resilience, natural, social, institutional, economic, within those we have different indicators. If you have one index here like electricity it means electricity interruption in normal time, electricity interruption in disaster time, how long it takes, who is taking the decision, how do governments address this issue. Each of these parameters have many variables giving the index.

Dr. Razafindrabe also explained the variables that address specific resilience. In physical resilience we address electricity, water, sanitation and solid waste disposal, accessibility of roads, housing and land use. One method to elaborate the questionnaire is asking directly and this needs to consider the respondents' interpretation. Another weightage system is using another statistical tool like Principal Component Analysis (PCA) or various methodologies. Local workshops with all the city officers, municipality officers, are also another tool to be considered.

Another methodology is the ISET for understanding vulnerability. Food security vulnerability assessment depends on how to build resilience – vulnerability of who, why, where we are considering climate change, urban system and learning, how do you predict the next threats, resilience strategy development and implementation. Stakeholders include academe, the implementing officers, practitioners, and students.

Improving Resilience

To improve resilience, one first has to know the context and status, i.e., how vulnerable we are, what are the driving forces, what are the trends, and available resources. Risk evaluation and prioritization are also essential because we don't just assess risks and vulnerability but we also need to prioritize

which risks to address. Early identification and prioritization of risks enable societies to increase their resilience by preventing, reducing, and adapting to them.

Sustainable Livelihood Framework or the livelihood security framework is one step to improving resilience. Its objective is to analyze the context – livelihood resources, natural capital, physical capital, financial capital, then the institutional processes, organizational structures, and livelihood strategies (what do the farmers do, what do the dwellers do, what are the coping strategies to reach nutritional security, food security, and income security).

Dr. Razafindrabe also presented his study in Madagascar that showed areas most hit by soil erosion in the world. Sometimes the whole mountain is disappearing. This extreme erosion is due to deforestation, poor soil type, human behavior, wildfire, sediments that go to the river, and droughts. This shows how applying the sustainable livelihood framework helps arrive at solutions. Its purpose is to address hazards in great calamities and develop coping strategies appropriate to the threats with the means that are available.

Another tool to assess and to improve resilience is to assess vulnerability. Vulnerability progresses in this way: the hazard becomes disaster because of the economic pressure, with the soil conditions as root cause. To address this problem, we need to address first the root cause, reduce the pressure, and achieve the safe condition. In this case, we will have less disaster, during flooding and typhoon. This should be combined with measures to reduce hazards, such as through flood control, shelter breaks, dikes, and fire breaks. For instance, in the Philippines, there is debate on whether or not to construct a ring dike around Laguna Lake. The government, however, has undertaken several measures to improve the resilience of people. All these measures should be appropriate.

One approach is the CARDIAC methodology, where CARDIAC is an acronym for **C**ommunicate, **A**nalyze vulnerability, focus on **R**everse of Pressure and Release (PAR) Model (i.e., reversing the problem by addressing the root causing pressure), emphasize sustainable **D**evelopment in every step, **I**mprove livelihoods (as livelihoods are always at the center), **A**dd recovery, and extend to **C**ulture (extend to the local condition or indigenous knowledge).

In capping his presentation, Dr. Razafindrabe underscored the importance of integrating disaster risk reduction and climate change adaptation towards reaching the Millennium Development Goals by 2015.

He noted that despite advances in natural and social sciences and other medical advances, hazards and disasters happen and losses continue to increase. This is unless we spend time and exert effort to learn. In addition, academicians, practitioners and policy makers need to work together. One avenue of working together is through integrated research and development through knowledge-based initiatives that translate scientific findings to practical measures.

Tools for Early Warning System

Dr. Flaviana Hilario
Philippine Atmospheric, Geophysical and Astronomical Services Administration

Dr. Hilario shared her insights regarding the early warning systems used in the Philippines, in particular at the Philippine Atmospheric Geophysical Astronomical Services Administration (PAGASA), which is the weather bureau of the country. Her presentation first defined early warning systems (EWS), then centered on their meteorological applications.

EWS is defined by the American Heritage Dictionary as a network of sensing devices such as satellites or radars for detecting an enemy attack in time to take defensive or counter-offensive measures. The military used them first. A second dictionary definition is that EWS is a system or procedure designed to warn of a potential or impending problem. While they have many applications, Dr. Hilario focused on the meteorological aspects, citing their applicability also in socioeconomic sectors like agriculture and health. EWS are also defined as mitigating operational structures that integrate people, institutions, and instrumentation. Their main goal is to take immediate response measures in the eventuality of a natural phenomenon that may cause natural as well as man-made disasters.

Early warning systems help save human lives and mitigate damages caused by natural hazards. They allow local authorities and communities to plan and act accordingly in the event of a disaster. An example was the need to warn people residing in areas where debris could fall from North Korea's first space missile launch, using wind direction as one factor that informed projections.

EWS are thus part of measures for disaster preparedness and complement the setting up of emergency committees, emergency planning, posting of evacuation routes, simulations, and exercises. In essence, they are a tool for risk reduction in a climate change context. The first step of risk reduction is to monitor weather conditions and then analyze the data to generate forecasts. Forecasts of large events would require that warnings would be issued. For instance, a

tsunami alert was issued in Indonesia recently because of a strong earthquake in Banda Aceh, although the tsunami did not happen.

In the context of meteorological applications, Dr. Hilario discussed the early warning systems for tropical cyclones, floods, and for seasonal climate forecasts based on the work of her weather bureau or PAGASA. It first and foremost gathers observations or data as a basis for the weather forecast. This requires use of various equipment, like meteorological satellites in space; Doppler radars, ground stations, automatic weather stations, and synoptic stations on the ground. Data collected are complemented by information from other meteorological institutes or weather bureaus throughout the world, as climate or in weather has no boundaries.

The data then undergo processing and analysis. PAGASA uses some models on which it is able to base its forecasts or warnings. If there is a tropical cyclone, it issues a tropical cyclone bulletin via the ordinary weather forecast. Currently, it is developing a rainfall alert system. PAGASA disseminates its forecasts and warnings primarily to the country's national disaster risk-reduction management council that is in the forefront of giving the warnings to the public or to the community. It also uses social networks such as Facebook and Twitter for easy public access to the information.

One of the newest equipment that PAGASA uses is the Integrated High Performance Computing System. It can process the 72-

hour forecast in about an hour. It is also called cluster computer.

Dr. Hilario presented PAGASA's different observation networks that are mainly the land-based observation networks including synoptic stations, Doppler weather radar, wind profiler, and meteorological buoys. She elaborated on the technical aspects and categories of tropical cyclones, and PAGASA's protocol in issuing warnings about cyclones and floods. She explained the difference between tele-metered and community-based flood warning systems. The latter involves consultation with the local government; site survey by a hydrologist, assessment of existing communication systems; installation of weather monitoring facilities including rain gauges and flood signages; analysis of data by community members; conducting of a seminar for the local government units, an information and education campaign, and a flood drill; and identification of an evacuation site.

Dr. Hilario further elaborated on the flood warning system used by PAGASA at its three levels of "Ready, Get Set, and Go", using color codes for different water levels and the instruments used for issuing warnings, i.e., sirens and bells. She pointed out that in the Philippines, local governments have disaster operation centers down to the municipal level.

Finally, Dr. Hilario explained the EWS used for the El Niño Southern Oscillation (ENSO). ENSO is a two-phased phenomenon, including El Niño or having less rain than normal including drought, and La Niña, wherein there is more rain than normal. ENSO is actually happening in central and eastern equatorial Pacific, but Indonesia is also highly affected by El Niño or ENSO. El Niño effects vary across the globe. In the Philippines and most of Southeast Asia, the effect of El Niño is dry weather or climate, but in other countries it is wet. Actually, climate regimes are shifting throughout the world. The effect of ENSO on rainfall compromises gross value added in rice production.

PAGASA issues early warning for El Niño or La Niña based on local climate forecasts, comprising monthly rainfall forecasts. If there will be El Niño or La Niña, PAGASA organizes a National Climate Forum, inviting different stakeholders including government agencies; the private sector, such as fertilizer and grain producers; and other sectors, to brief them on PAG ASA's climate forecast. This has equipped these stakeholders to plan for these extreme climatic changes. For example, mango producers were able to reschedule the initiation of the flowering of the mango trees based on PAGASA's forecasts.

As a final message, Dr. Hilario said that EWSs also have limitations in saving lives if they are not combined with people-centered networks, especially in the case of floods. To be effective, EWSs, must be understandable, trusted by and be relevant to the communities that they serve. Warnings would have little value unless they save the people at most risk, who need to be trained to respond appropriately to an approaching hazard.

She closed with an anecdote about how a whole community in Southern Philippines perished due to a strong cyclone that brought heavy rainfall. The community was located in the middle of a river, where it should not be. She urged the participants to also revisit land use plans if they expect early warning systems to work in saving lives and property.

Tools for Watershed Monitoring and Evaluation

Dr. Rex Victor O. Cruz
University of the Philippines Los Baños

Dr. Cruz began his presentation by giving a background on the challenges related to climate change vis-à-vis water resources. These include water stress and problems related to floods, drought and diseases, which are related to the way the hydrologic cycle is behaving.

Importance of Watersheds

Dr. Cruz showed examples of the scope of watersheds in the Philippines. He showed how the River Basin Approach is applied in managing water resources for agriculture and other needs in the watersheds. Its goal is to regulate water flow to ensure sufficient flow of clean water in the watersheds for various needs of communities surrounding it.

He defined Hydrologic Cycle as a process where water flows in a cyclical movement. The movements in the cycle are affected by many factors. Many economic and social activities affect the hydrologic cycle in many different pathways. One of these is the simple use of water resources that can lead to water stress. As population grows, certain activities need to be sustained such as food production – it uses water that can lead to water stress. Every human activity produces greenhouse gas emission and this will affect climate, land use, hydrologic cycle, and livelihood/production.

A lot of what is happening in the hydrologic cycle is a function of what we have in terms of policy and environment. What is going on is dictated so much by the policy that governs many of the economic and social activities of communities. As what is projected, the hydrologic cycle in climate change is going to be enhanced. Stream flow is expected to have an increase in the average annual run-off in wet areas between 10 to 40 percent. During dry season, 10 to 30 percent decrease is possible in areas that are water stressed. There will also be an increase in maximum river flows, like extreme flooding in the wet season. On the other hand, minimum river flows are hitting rock bottom in the dry season.

Dr. Cruz emphasized that what is going on in watersheds is caused by stress brought by climate change. However, even without climate change, watersheds are already stressed and degraded by many factors like increase in human activities, food production, and wood/fiber production. Climate change exacerbates these socio-economic and even policy stressors in degrading watersheds.

To promote proper adaptation to changing climate, Dr. Cruz underscored the role of risk management and risk assessment. In addition, climate change adaptation should be mainstreamed in larger development plans and require supportive legislation and enforcement of policies and regulations, funding for implementation, access to appropriate knowledge and information, and information education/communication programs, policies and institutions.

Monitoring and Evaluation of Watersheds

In general, information is needed in all of these activities. Monitoring and evaluation at this point become important, because these generate information for promoting informed policies and decisions. Every decision to be made must be dictated by information that is scientifically valid, accurate, fresh and up-to-date, and relevant.

Dr. Cruz cited **GIS-based watershed management information system (MIS)** as an example of what researchers have developed for many watersheds in the Philippines. The objective of MIS is to

generate basic information database on natural resources, social and other watershed assets. He advised that when developing databases for watershed, other resources that are interlinked with other water resources must be taken into consideration.

The database must be comprehensive. Aside from water, it should include information on social aspects that relate to the stakeholders such as water assets, policies, and the impact of other activities on the condition of the watershed.

Dr. Cruz discussed the **Grid-Based GIS Analytical Framework** that his research team has applied for several watersheds in the Philippines. Its objective is to monitor not only certain portions of the watershed but practically its every space. The concept is to grid the entire watershed system so that each cell in the grid would have its own identity containing all information available for that particular cell/unit. This system also allows visualizing properly all the resources found inside the watershed. It makes possible modeling of the impacts that may arise from any management decision if implemented in the watershed. Lastly, these make it possible to prescribe appropriate mitigation and adaptation measures to ensure sustainability of water resources.

Dr. Cruz said that the Grid System had been applied in Surigao del Sur watershed, Angat and Caliraya watersheds, and Mt. Makiling watershed. It is being developed for five other watersheds. As example, he showed photos of the work done in Makiling and Angat.

Another activity in relation to evaluation is **Land Capability Evaluation**. This is a process of identifying what particular project can be best implemented for each and every unit in the watershed. The process includes sub-dividing the whole watershed then deciding for this particular unit its best or most sustainable use in terms of physical capability of the land. Policy, economics, social and cultural dimensions need to be considered in deciding the particular use for a particular area. The primary concern in deciding the particular use of a particular area in a watershed should be physical.

Further, Dr. Cruz mentioned that his research team has developed a simple scheme of determining land capability based on soil erosion potential. The basic idea is the highly prone or susceptible the area is to erosion, the more it cannot be used for intensive land uses; but the more resistant the area is to soil erosion, the more it can be subjected to intensive uses, such as agriculture. His team has likewise included hazards, including climate-related ones, in classifying land capability for eventual zoning according to particular major uses.

He emphasized the importance of including climate hazard as a factor in determining the sustainability and suitability of a particular use for a watershed area, even if this was not done so in past studies. He then showed an example of land capability zoning in one watershed in Negros Oriental.

Dr. Cruz added that **Climate Risk and Vulnerability Assessment** is an important evaluation activity and procedure for watershed. Hazard maps are being developed, informed by future climatic changes that are projected using historical information or data. For purposes of watershed management, researchers are trying to incorporate projected future rainfall and temperature in preparing the hazard maps. Chancellor Cruz showed an example of a drought hazard map that his team has developed for one watershed in Mt. Apo in Davao.

Comprehensive water field monitoring is critical because that is where primary information on many different variables is derived such as stream flow, surface and ground water quality, water level, flow velocity and many different measuring systems. Now, telemeters are very useful for monitoring stations as they make things easier and less complicated.

Dr. Cruz mentioned that researchers are in the process of developing a network of learning watersheds in the Philippines, starting with three watersheds. The idea is to fully instrument the three watersheds with telemeters and other types of sensors that can remotely send data being collected directly into the computers. UPLB has partnered with

the Department of Science and Technology (DOST) and PAG-ASA in this undertaking. The basic data that they need to collect from the field are surface and ground water quality using auto water samplers. The study had just started that month.

He showed photos of the ultrasonic sensor for water levels, developed in the Philippines with spare parts from the United States, Australia, and perhaps Japan. He also showed other instruments that Filipino researchers have assembled and are using in the field.

Dr. Cruz underscored the importance of partnering with various government line agencies in monitoring soil moisture for water production and agriculture.

The team also monitors groundwater, climate and biodiversity as key components of their research. This is to come up with a comprehensive resource inventory. For instance, this involves installing a system of radio frequency and biometrics to identify particular plants. The importance of biometrics is that it already captures all the information available in a particular area. The plan is to install these instruments in Mt. Makiling through a government-funded project.

Closing

Dr. Cruz closed his presentation by underscoring the need to monitor watersheds closely because water and agricultural production are very much tied up. He urged continued advocacy for policy makers, government leaders, and academe and research institutions to provide more support for monitoring and evaluation as critical activity in the watershed.

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Dr. Sarker: In case of the Philippines, what do you think about the issue on transfer of technology vis-à-vis Intellectual Property Rights (IPR)?

Dr. Cruz: In the Philippines, DOST is the institution in charge of technology transfer, and it has established protocols on how to go about this issue on IPR. They are also keen in making sure that their protocol complies with national and international IPR guidelines and rules.

Dr. Phan: Are you saying that monitoring and evaluation of watersheds is not up to date? Convincing governments to support monitoring and evaluation of watersheds is by itself a challenge, more so with the issues on varying quality of data and problems in their availability and on willingness of researchers to share information. Historical data is necessary in studying climate change and making plans for adaptation.

Dr. Cruz: Indeed, we need historical monitoring and evaluation data of watersheds. Unfortunately, the difficulty of accessing such data is true for many of our watersheds. While the Philippines has neglected this in the past, we are now convincing the government and are trying to get more funding for this kind of activities. On this score, we perhaps lag behind in monitoring and evaluating our watersheds, but I'm glad that we are starting now.

Dr. Hilario: DOST has a new project called Nationwide Operational Assessment of Hazards (NOAH). The plan is to put up monitoring stations within 13 major river basins. PAG-ASA has existing four or five of these stations and will set up 13 more for big watersheds. The plan is to put up automatic weather stations, automatic rain gauges and water level sensors to monitor for and project flooding. This will help provide additional data in monitoring and evaluation of watersheds.

Dr. Concepcion: This discussion on watersheds underscores the need for sectoral agencies to work together. The watershed approach calls for "transectoral" work. Project NOAH is creating a database that is indicative of what can be done when you go downscaling. Let us understand the multiple problems in the watershed. When analyzing watersheds as a natural resource, we need a higher level of information that would allow a certain level of generalization. When we go into a discussion like this, let's agree on a common platform. From there, we may develop our respective indicators on generating local scenarios and plans from the available data. It is important to clarify our assumptions regarding scale because

sometimes, we are not really analyzing the local situation from the higher scale of analysis for watersheds. We really need to ascertain the hierarchy of needs, hierarchy of risks, hierarchy of vulnerability, and hierarchy of who will be at risk and where the risk will happen.

Ms. Borja: In addition to NOAH, the Laguna Lake Development Authority (LLDA) is currently establishing the Laguna the Bay Regional Telemetering System. As of now, we are coordinating with various provincial offices to co-locate our proposed tower. There will be three towers each in Antipolo, Mt. Makiling, including the control tower is in LLDA.

How much it will cost us to avail grid-based monitoring system? We would like to know the vulnerability of the lake resource in relation to climate change in the region.

Dr. Cruz: The cost of grid-based monitoring is highly affordable. We would like to present to your General Manager the concept of the project and if he is interested, LLDA may replicate it in other watersheds at Laguna Lake.

Science-enhanced Community-based Coping Strategies

Dr. Juan M. Pulhin
UPLB College of Forestry and Natural Resources

Dr. Pulhin presented a brief background on the importance of coping strategies, then zeroed in on community-based coping strategy, presenting examples in the agriculture and the water sectors in Asia. He highlighted the importance of drawing from science to enhance coping strategies.

He noted that the history of humankind is a story of adaptation, and because of that, humans would always be able to adapt hence they need not bother about climate change. Some anthropologists even argue that civilization is in itself is a story of adaptation. But some scientists argue that some of the potential harms of climate change are actually beyond human experience, and this is where the problem lies, because some of the changes cannot actually be anticipated.

Twigg (2004 cited in Dewi, 2007) equated coping mechanism with the application of indigenous knowledge to face threats and hazards. Examples of climate-related hazards and threats are drought and precipitation. When people apply local knowledge to respond to these hazards, we call them coping strategies, implying that they are able to respond positively to a threat. But because coping strategies are affected by a number of factors, they are site-specific and vary from one place to another. In the same manner, when we talk about climate change adaptation, it is always in a local context because adaptations in one place will necessarily differ from those in other places. Thus, coping strategies vary from one place to another, and the source of variation is multiple. Coping strategies vary depending on geographic location, exposure, social acceptability, farmers' capacity, and institutional factors. In terms of scope, coping strategies may be broad in scope or primarily economic or managerial coping strategies. An example of an economically-related coping strategy is selling one's assets given famine or drought; or cutting of food intake, also

called belt-tightening. Philippine farming employs various technical coping strategies, from contour farming to different ways of watering farms. Meanwhile, service or assistance rendered to one's neighbor is a social coping strategy. On the other hand, community-based coping draws from collective action.

Community-based coping strategies, in practice, are more reactive than anticipatory. Thus, they have much room for enhancement through science. There is a great difference between anticipating and planning ahead before the impact, and responding only when the impact has already happened. Dr. Pulhin asserted the need to improve coping strategies to be more planned and anticipatory in approach, applying science.

Small-holder farmers tilling rainfed lands are among the most vulnerable to climate change. Some of them have actually developed, over time, indigenous coping strategies, including several traditional technologies in response to changing climate. These coping strategies and traditional technologies need to be documented and studied – as they may have scientific basis or may be further enhanced using scientific knowledge. However, farmers have might have their own criteria for accepting or not science-enhanced coping strategies.

Some local coping strategies in response to changing climate, as practiced in different parts of Asia, include simple methods, such as consumption of wild fruits and vegetable that survive during drought; and more complex, mostly site-specific methods, such as cultivation of more than one type of grain staple crop through a combination of land uses, through intercropping, through mix cropping, and the like. Dr. Pulhin then described various coping strategies adopted by farmers in various parts of Asia in response to changing climate.

Integrating Science and Local Knowledge

In spite of the practice of various coping strategies in many parts of Asia, studies and literature note that adaptive capacity remains weak in most Asian countries. Coping strategies by themselves, while useful, are not sufficient in order to fully address the problems related to climate change. Coping or adaptation strategies are site-specific; hence it is hard to come up with a universal overarching adaptation approach. This is partly also the reason why in terms of advances in knowledge and science, the science of mitigation is far ahead in terms of scientific knowledge, than the science of adaptation.

Even if there is similar climate stressor such as drought, the appropriate approach in Bangladesh would be different in the Philippines; or within the Philippines, at different regions, because of variability in context. Despite the need to harvest local knowledge in designing adaptation strategies, local knowledge has rarely been taken into account or considered by policy makers in designing adaptation strategies. Also, not all adaptations are effective. The literature on adaptation also cites mal adaptation, or one that produces a paradoxical or negative.

Institutional mechanisms for mainstreaming traditional coping and adaptation strategies are few. In the Philippines, a law was signed in 2009, but few practitioners build on existing coping strategies, partly because there are few institutional mechanisms to do that. Again, coping strategies respond to to past and present stressors, but may or may not necessarily address future problems on climate change. Some or many of them are effective as much as current situations allow, but there is no guarantee that if you employ the same strategy in the future, perhaps at two to three degrees centigrade higher temperature, it will produce the same results. The challenge facing the science of adaptation then is that while it addresses current problems on climate, it has limited applicability in future changes caused by changing climate.

Dr. Pulhin said that information databases on local coping strategies are available, where the information seeker may indicate and click on the climate stressor (drought, flood, etc.), then click the country, or region in Southeast Asia, and some of the required parameters, to generate available documentation on local coping strategies. It would be useful to integrate these in building policies and

assessing spatial and temporal impacts of different adaptation options. In particular, planners have started to marry GIS, Geomatics, and related technologies, with participatory approaches to help build capacities of local communities toward improving their current adaptation strategies.

Dr. Pulhin then illustrated an example of marrying science and local knowledge. Social scientists have used rapid rural appraisal (RRA), which has graduated into participatory rural appraisal (PRA). Among its menu of methods is community mapping, which Dr. Pulhin's research team adapted to understand vulnerability in a locality using a participatory approach. His team ran a focus group discussion (FGD) in a Philippine village to come up with a vulnerability map. Through the FGD, his team did a participatory impact assessment on climate variability in the area including drought, flood and storms, then determined their impacts on different socio-economic groupings. Initially, his team just grouped all farmers together, but later found during the participatory assessment that farmers differentiated between poor farmers, who don't have access to much land and have no initial capital, and richer farmers, who have both. The participatory mapping exercise gave the community the chance to determine and map, after debating and discussing, which groups were adversely affected by climate-related stresses. For better-endowed farmers, the impact of climate change had not been much because besides farming, they lent seeds to poor farmers, and had more flexibility with their resources. On the other hand, sectors comprising employees and business persons were moderately affected by climate change, showing that it affects everyone regardless of socio-economic grouping. However, the greater impact falls on the poorer sector in the case that Dr. Pulhin illustrated.

Dr. Pulhin added that his team allowed the community to identify vulnerable areas based on their experience. They defined vulnerability by citing examples of vulnerable areas, such as places that flood right away, or frequent occurrence of forest fires. They arrived at the observation on double vulnerability, where vulnerable people are found living in vulnerable places – a situation found in most Philippine localities and perhaps, many other parts of the world.

The importance of local knowledge is that GIS at a high resolution would still not capture the dynamics that can be elicited in the participatory mapping exercise with the community. With a GIS map based on bio-physical parameters such as slope, the research team came up with high and mediocre vulnerability categories. When the communities identified the vulnerable locations, the research team appointed GIS readings in the identified locations throughout the watershed, made GPS readings, then superimposed all these. The result is a map showing vulnerable areas marked by the communities along with GIS readings having 85 percent congruence.

Combining such local knowledge with advanced GIS allows a more robust assessment as a basis for enhancing adaptation planning. Planning adaptive strategies for these areas can therefore appropriately address the realities of vulnerable sectors. Otherwise, the normal research approach to assess vulnerability may simply result in helping the richer farmers rather than the more vulnerable poor farmers living in less vulnerable areas.

The standard practice of scientists is to enhance employ crop modeling and on the basis of crop models, improve on farmers' cropping schemes. On the other hand, incorporating local knowledge in the recommendations may ensure that the coping strategy recommended is acceptable and technically feasible from the farmers' point of view. Dr. Pulhin further illustrated his point by citing how the Province of Albay applied the principles he discussed earlier.

He capped his presentation by asserting that local coping strategies in the agriculture and the water sectors, including community-based ones, are actually practiced in many parts of Asia. However, these strategies need to be documented, analyzed and potentially enhanced by science to promote systematically planned and effective adaptation.

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Dr. Sarker: Distinctions between reactive and anticipatory coping strategies, and coping and adaptive strategies, are not clear. Admittedly, this is perhaps due to disciplinary nuances or terminologies that specific institutions prefer to use. While I understand their subtle differences, their practices seem to be practically the same.

Dr. Pulhin: Some institutions explain the differences between "coping" and "adapting" as part of a continuum. For instance, an ADB report of 2009 explains coping strategy and business strategy as part of a continuum where existing coping strategies are located at one end, and at the other end lie more proactive and planned adaptation strategies. While the literature often uses "coping" and "adaptive" strategies interchangeably, the Intergovernmental Panel on Climate Change (IPCC) hardly uses "coping" strategy. Rather, the Panel uses "adaptation" and categorizes different types of adaptation.

The nuance is that "coping" seems a more passive response while "adaptation" implies being able to manage the impact and further seize opportunities associated with the impact. When I used "coping" it is normally associated with present changes in response to present and past realities. On the other hand, adaptation in general includes future, deliberately planned actions in anticipation of expected changes.

The question now is how current coping (to climate change) may lead to adaptation in the future. A way forward is to build on current coping strategy by integrating it with scientific knowledge towards more effective and more comprehensive planned strategies.

Dr. Kao Sochivi: How do we assess whether a coping strategy is effective? What indicators or variables would demonstrate such effectiveness?

Also, please tell me more about the experience of growing fish in upland farms so that we can adopt the same in Cambodia.

Finally, how are community-based coping mechanisms in aquaculture done based on geography, technology, or other related factors so that Cambodia may develop its own adaptation strategies in fisheries?

Dr. Pulhin: Because adaptations are site-specific and highly contextual, it would be unrealistic to apply a universal indicator of their effectiveness that would apply across time and space. Approaching the question from the opposite end, the IPCC literature also has a section on the limits of adaptation. The two most commonly cited limiting factors to climate change adaptation are constraints in technology and unaffordable cost. Hence, soundness of technology and cost of implementing the adaptation are two commonly used criteria for assessing the impact of climate change adaptation. The nature of resources, social acceptability, and immediacy and magnitude of impact of the adaptation are additional criteria. A number of studies use multi-criteria indicators for assessing adaptation. Planners normally look at cost-effectiveness, magnitude of impact, applicability, acceptability, and technical soundness as criteria for a successful adaptation strategy.

On the question about inland fishing, we have upland fishponds in the Philippines. Essentially, a number of communities, depending on the availability of water, integrate fish ponds in their farming systems using principles of aquaculture. It may be practiced where water is abundant and there are technologies that enable farmers to practice integrated crop-aquaculture systems.

In answer to the third question, I as a social scientist strongly advocate building on local knowledge first, because adaptation is a site-specific response to local realities. Also, it is people who decide on adopting certain coping strategies, hence their point of view and own criteria count.

Further, they know best their own situation, what works and what will work there. Lastly, there is a huge opportunity for integrating science and local knowledge in developing adaptation strategies that anticipate future changes due to climate.

A favorite example of anticipatory adaptation to climate change is Canada's construction of the confederation bridge that links Prince Edward Island to mainland Canada. Canada's decision was to build the bridge one meter higher than a scientific projection of a 0.6 meter average sea level rise globally, based on a cost-benefit analysis between building the bridge higher now or rebuilding it in the future. The same principle of developing anticipatory adaptation strategies may be applied in the agriculture and water sectors as climate-proof investments.

By the way, "coping" strategies are also used sometimes to refer to spontaneous adaptation, or spontaneously doing them even without knowledge about climate change. This is when farmers experience drought or any extreme weather event and simply respond to the situation without necessarily building on knowledge from past experience.

Dr. Kao Sochivi: Please elaborate on the Philippines' strategy to cope/adapt to climate change in the agricultural sector.

Dr.Pulhin: We undertook a nation-wide study and came up with a proposal, but after submitting our report, we have not yet monitored the extent of adoption of our recommendations.

Sub-theme 3
Water-efficient Food Production in Climate-based Local Planning and Management

Water Resources Development for Sustainable Agricultural Cultivation in the Mekong Delta: Adapting to Climate Change and Sea Level Rise

Mr. To Quang Toan
Southern Institute of Water Resources Research, Vietnam

Mr. To Quang Toan started his presentation with a brief overview of the fundamentals to be discussed: an introduction of the Mekong Delta in Vietnam, the methods for modelling the impact of climate change and sea level rise, and the chain of impacts that would occur in the condition of water resources given these scenarios of change on salinity intrusion and flooding. He then touched on the possible adaptation startegies of Vietnam in connection to water resources for food security.

The Mekong Delta

According to Mr. Toan, the Mekong Delta in Vietnam has a land area of about 3.9 million hectares, two million of which are cultivated lands. This flat and low-lying land, with an elevation of about one meter above sea level, has a total population of about 18 million people who are engaged in agricultural production. Farmers in the Mekong Delta usually plant two to three crops per year, with a maximum of seven crops per year interspersed with one another. At present, the Mekong Delta is subjected to environmental problems such as salt intrusion and annual flooding. About 1.6 million hectares are exposed to salt intrusion because of sea level rise (SLR). The Delta was submerged due to flooding in 2000 and 2006 (50% and 30%, respectively). Based on historical records, the return period is about once every three years

and the inundation period lasts up to five or six months, depending on flood severity. Moreover, other problems in the Delta include acid water, drought, bank erosion, estuaries sedimentation and environmental pollution. Additional threats include upstream development and climate change.

Mr. Toan pointed out evidences of climate change in the Mekong Delta. These include increase in the number and intensity of typhoons and hurricanes, early start of the rainy season, presence of heavy rainfall in the dry season, and variations in temperature. He even cited as an example the change in a storm's path that was observed in April 2012, wherein Pakhar storm started its path in Ho Chi Minh City then ventured its way to Northern Vietnam. This track was noticeable since storms would normally start their path in Northern Vietnam and would land in Ho Chi Minh City in the past. He also presented a graph showing the unusual climate condition in the South of Vietnam.

Modeling for Impact of Climate Change

To proactively adapt from the threats that are or may be posed by climate change, Mr. Toan and his team modeled the impact of national climate change scenarios for the Mekong Delta vis-à-vis sea level rise in Vietnam. For this, the spatial computational framework for the Mekong River Basin was applied. This framework is composed of three models: a hydrological model, a simulation model and a hydrodynamic model. He further explained in detail the variables that were considered for each model and explained how the different impact scenarios are generated.

Some outputs include simulated scenarios for salinity intrusion and tidal inundation, change of salinity level, flood/inundation duration, and map of flood changes using data from the Mekong River flood in year 2000 and projected sea level rise. They show that the irrigation systems and projects in Gò công, Ba water management zones. Lai, South Măng Thít, Sóc trăng will be affected. Moreover, simulation results show a decrease in rice yield and production. He then discussed, using these pre-simulated findings, the possible impacts of climate change and sea level rise to the Mekong Delta, the possible impacts to biodiversity and to infrastructures. Mr. Toan predicted a large change in natural conditions (soil-inundated area, water resources, floods, salinity intrusion, and water quality, among others), ecology (plants, animals, insects and microorganisms) which would affect changes in infrastructure, socio-economic development and sustainable development in the Mekong Delta.

Water Resources Planning for Food Security

With these pre-simulated impact scenarios, Mr. Toan reported that water resources planning was done in 2010 to come up with possible adaptations. These adaptations include the establishment of water management zones, as some areas require partial and full protection and the establishment of buffer zones among these water management zones. Aside from these measures, Vietnam allotted 3.8 million hectares of land for agricultural cultivation, 1.7 million hectares of which are situated in the Mekong Delta. This adaptation was done to address the projected decrease in rice yield and production so as to ensure the food security of Vietnam.

The research presented by Mr. Toan emphasizes the dynamic interactions that are usually intertwined with the management of resources and risks, in this case the Mekong Delta and climate change coupled with sea level rise. Findings could inform the development of policies that take into account the impacts of a changing climate.

Climate Field School: Experiences in Iloilo, Philippines

Hon. Ronaldo B. Golez
Municipality of Dumangas, Iloilo, Philippines

Mayor Ronaldo Golez started his presentation by introducing the municipality of Dumangas in the province of Iloilo thru a location and barangay boundary map. Dumangas is a first-class municipality whose lands are mainly devoted for agriculture and fishing operations (6,128 has. and 4,535 has., respectively). It is a coastal town, with 45 villages and 14,359 households (NSO Census,2010).

The municipality of Dumangas faces two extreme conditions, drought during dry season and flooding during rainy season. These climate-related extremes pose impacts to the physical, social, and human resources present. The insufficient water supply during dry season in Dumangas yields to damages in agriculture and fishpond operations that ultimately trickle negative impacts in the people's livelihood.

In addition to these hazards, Mayor Golez mentioned that the town is geographically located at the tail-end of the Jaluar River, one of the biggest waterways in Panay Island and is traversed by six other rivers (Tala-ugis, Dumangas, Linao, Paloc Sool, Talusan and Sulangan). The town is bounded by the sea at its southern side. These conditions expose the area and the 68,889 people residing there to flooding. In fact, there was a time when about 65% of the municipality was commonly flooded during rainy season.

Responses to Hazards

Mayor Golez expounded on the adaptations that the municipality of Dumangas came up with in response to the climatic hazards it had experienced.

First, they constructed a mega dike, which decreases the percent of land area prone to flooding to 15%. Second, they established and now maintain the Dumangas Agro-Meteorological (Agro-Met) Station. This facility, which was supported by the Asian Disaster Preparedness Center (ADPC), was established as part of the pilot project of Astronomical Services Administration

PAGASA and the ADPC in the Philippines. Through the Dumangas Agro-Met Station, local climate-weather forecasts for information and advisories are issued to stakeholders, especially farmers and end-users of agricultural applications. The establishment of a system for local climate-weather forecasting is considered as the third adaptation measure employed.

Mayor Golez stressed that they are working hard in order to maintain this facility with financial and technical support from ADPC. Moreover, they have been actively outsourcing funds from international partners. They also allocated a budget of Php 200,000 per annum thru the enactment of an ordinance. Meanwhile, a percentage of the local funds (5% calamity funds, 30% rehabilitation: 70% mitigation and preparedness budgets and 20% Internal Revenue Allotment or IRA Development Funds) is allocated for the maintenance of the station. In addition, the municipality was able to avail of solicitations from the provincial and national governments. The presence of this Agro-Met station paved the way for the endorsement of the municipality to be a pilot-testing site for a Climate Field School (CFS), which is the fourth adaptation measure.

Climate Field School

A CFS is an innovation which aims to address the problems brought by climate change, climate variability and climate extremes. It focuses on building and increasing farmers' adaptive capacity thru the provision of information, such as guidelines on planning what crops are suitable to be grown at the

onset of a predicted climate event and on the scheduling of farm operations.

The CFS program aims to establish sustainable end-to-end institutional system for the generation and application of locally-tailored climate information tools, to build capacity to apply these tools in real-time and to mitigate the impacts of calamity.

Mayor Golez further explained that in the context of the CFS in Dumangas, the farmer participants and agricultural workers were taught the following:

- different climate-related risks in agriculture including the weather parameters that influence crop growth and development,
- weather and climate information
- weather forecast interpretation, and
- disaster risk management (DRM), and adaptation and coping mechanisms

As the farmers' awareness on the relationships among climate, plants pests and diseases expand through this Program, it is expected that they will have a better understanding of the direct and indirect effects of climate to the plants' growth and development and the climate's relationship to the pest and diseases of plants. One of the most important lessons learned in the CFS of Dumangas is that farmers need to understand and practice the translation of vital climate information into a decision outlook so that they will be able to tailor-fit their own agriculture and water resource management strategies toward improved crop production.

Mayor Golez emphasized that the Dumangas Climate Field School, which was established in November 2007, is both an output of the municipality of Dumangas' disaster risk management efforts and a flagship activity under the Climate Forecast Application for Agriculture and Climate Change Adaptation of Dumangas. Further, it is institutionalized as a as a Learning Institution for the Climate Forecast Application for Agriculture by virtue of Municipal Ordinance No. 2011-02. He added that the budget appropriations for the four trainings that CFS has conducted are from the grants of ADPC (Batch 1 and 2) and the development fund of LGU (Batch 3 and 4). Their administration believed in the program, thus to ensure its sustainability, 20% of the development fund of their LGU has been appropriated to the trainings conducted by CFS

After explaining the definition, objectives and goals of CFS to the group, Mayor Golez discussed how CFS training is implemented. Briefly, he mentioned and discussed the CFS' eight modular topics, which were taught by the Program's trained agricultural technologists in a span of 12 sessions (one session per week). The topics are

- Climate, Pest and Diseases, Crop Growth and Development
- Cropping System/Pattern and Climate-Related Risks
- Understanding Weather and Climate and Climate Parameters
- Weather and Climate Information Products and Forecasts Generation
- Forecast Interpretation, Translation and Communication and Incorporating Climate Forecasts in Decision Making
- Learning and Implementing the Rice Integrated Crop Management System "Palay Check"
- Summary of Key Checks and Assessment, Monitoring, Analysis and Improvement
- Establishing Cropping Calendar and Review Philippine Seed Board (PSB/NSIC) Rice Varieties

Impacts of Climate Field School

Based on the statistics he presented, the amount of rice produced by the municipality significantly increased in 2008 and 2011, and these bountiful harvests are attributed to CFS. Likewise, The farmers testify that rice production increased by 20%,while the expenses on farms decreased and the tending time of crops has become shorter. Mayor Golez articulated that thru the CFS, the locals (both the farmers and fish pond operators) were introduced to diversified agricultural practices such as rice-fruit production, rice-vegetable production, and rice-fishery production. Other benefits include subsidized supply of certified rice seeds and seeds of alternative crops.

Mayor Golez reported the frequency of distribution of practicing and non-practicing farmers. Out of the 370 graduates for the four batches, only 56 farmers are not practicing what they have learned and went back to traditional farming practices. He attributed this shift to the conservativeness of Filipinos, in general. On the other hand, he presented the feedback from the farmers who adapted and applied best practices. These benefits included:

- Increase in rice production (irrigated) from 4.20 metric tons per ha to 5.46 metric tons per ha.
- Increase in rice production (non-irrigated) from 3.36 metric tons per ha to 4.62 metric tons per ha.
- Increase in income in farming activities from 20% to 25%
- Decrease in farm input utilization of farmers from 15% to 20%
- Decrease in pesticide utilization
- Diversified farming system (rice-rice, monggo) (rice-rice, watermelon) (rice-rice, vegetables) (rice-rice, corn)
- Enhanced knowledge and skills

Moreover, farmers maintained the same quantity of rice produced with less cost of farm inputs. Also, some farmers reported that natural calamities/erratic weather condition like heavy rains, strong winds which cause the occurrence of pests and diseases have led to a decrease in rice production. These statistics and observations show that CFS has impacts in the socio-economic and biophysical conditions of the people and the municipality, respectively. Furthermore, these show that with proper understanding of the process of forecast interpretation, translation, and communication for agricultural applications, which are provided by the CFS, farmers are able to identify available management options in order to mitigate climate related risks or take advantage of a favorable climate.

Mayor Golez attributed the success of the CFS's activities to proper planning (e.g. formulation of training design for modules and budgetary requirements), proper allocation of funds and implementation of activities, strong partnerships and proper coordination with partners and stakeholders, proper orientation of barangay officials and farmer participants; monitoring, evaluation and assessment of outputs; and fund sourcing. To inspire change in the mindsets of the participants, he presented the citations received by the CFS (Special Citation, 2010 Gawad KALASAG Award; 2011 Gawad KALASAG Award as Best in Community-Based DRM by National Disaster Risk Reduction and Management Council).

Mayor Golez capped his presentation by articulating, "the impacts of climate change can be mitigated through proper disaster risk management and climate change adaptation and innovation. So let us not worry of the cost of disaster risk reduction and climate resiliency programs but let us be concerned of protecting and uplifting the lives of our people." This is the heart behind the success of this Program.

OPEN FORUM

Dr. Razafindrabe: I would like to ask you about resource mobilization. First, did your municipality take the initiative to approach donors for both the Agro-Met Station and the CFS in Dumangas? Or did the national government, thru a program, give the municipality of Dumangas the appropriation to establish the Agro-Met station and the CFS facilities (since 65% of the land area is prone to flooding)?

Second, how do you plan to source the necessary funds for the construction of the dike that was damaged?

Mayor Golez: For your first question, Dumangas is one of the very first and few local government units that was identified by PAGASA for the establishment of a weather forecast station. Dumangas' Agro-Met station was established in 2002, with support from ADPC. In 2007, Dumangas was identified and recommended by PAGASA, through the ADPC program, to be the pilot-testing site of the Climate Field School in the Philippines. It was my predecessor who initiated the CFS, I continued to believe in the CSF program and targeted to make it happen as part of my initiatives. Now, CSF is locally funded as a portion of the development fund was allotted for its implementation.

Mr. Andres: How did you come up with the assessment that the volume of rice production increased vis-à-vis the implementation of the lessons learned from CSF? How do you coordinate with the farmers?

Mayor Golez: The 45 villages were divided into nine districts; and in every district, there is an assigned farm worker to monitor all agricultural operations. All activities from planting to harvesting are monitored and recorded whole year round. We were able to come up with a monitoring system, hence the records.

Ms. Borja: Do you have a program that will train the graduates of the CFS so that they become trainers for other farmers, too? By doing so, the farmer-resource persons will increase in number.

Mayor Golez: We actually have a program for that as we have foreseen that we'll be running short of manpower. Out of the 11 trained personnel in our municipal agricultural office, three of them already retired and three more will retire this year. Thus, we have institutionalized in this program that all retired personnel would be hired as consultants. In addition, we have identified four to five farmers who employ CSF's practices and whom we have good partnerships with, to train with us as we open the CFS institution this June 2012.

Ms. Borja: Just a follow up question, could you please share with us some of the farmers' practices regarding water management now that the mega dike was destroyed by Typhoon Frank?

Mayor Golez: We do not depend on the river for water inputs of the farms in Dumangas. We have irrigation canals but some of them are already silted. Thus we have programs that will focus on the rehabilitation of all our irrigation canals.

Dr. Kao Sochivi: Thank you very much for your very interesting presentation. I have three questions. First, how do you motivate and encourage the farmers, who have different cultures and beliefs, to participate in CFS? Second, what are the criteria used in the selection of participants who will be involved in this program? And third, what is the mechanism to establish this successful climate change field school?

Mayor Golez: For the first question, we motivate them by providing them certificates of completion of the program. Since not all of them are high school graduates, this recognition boosts their morale. There was one 67-year-old farmer who wept when she went up the stage to receive her certificate, as that was the first time that she was able to receive a certificate from an institution. More so, all graduates of CFS are given the first priority in terms of government support and subsidies. We motivate them to learn more because we want to establish food security in our municipality.

One of the major components of success is the proper identification of the farmer participant, so that we can identify the real farmers (defined as those who till the land, not necessarily land owners) who have no political accommodation and with the right motivation. Thus, we have this partnership with our local leaders so that they could guide us in screening and identifying participants and operators too, who have the heart to join the program. We place a heart into the program as we believe in its objectives, goals and ways of implementation. I think that is why the program is successful. In addition, we're gender-sensitive and a large portion of our graduates are women farmers. Lady farmers have the patience to attend the sessions and we observed that they are able to discuss and echo the learning. In this case, the adaptive capacity and resiliency of the community to disaster and risk-related hazards increase, linearly increasing the chance to become a progressive and productive community. Also, we always make sure that the farmers should feel that we are their partners.

Focused-Food Production Assistance for Vulnerable Sectors (FPAVAS) Cases

Dr. Bessie M. Burgos
SEARCA

Dr. Burgos shared SEARCA's experience in climate-based local planning to promote sustainable food production under the European Union Focused Food Production Assistance to Vulnerable Sectors (FPAVAS). Her presentation included 1) a short background of the FPAVAS project; 2) the overall climate change mainstreaming process employed by the project 3) the various methodologies, tools, and some results on the vulnerability assessment phase of the mainstreaming process; 4) the process of mainstreaming climate change in development planning; 5), piloting of Climate Change Adaptation and Mitigation Programs; and 6) concluding statements.

The project was funded by the European Union (EU) under its Food Facility for Rapid Response to Soaring Food Prices in Developing Countries in response to the 2008 food price crisis. The project was completed in October 2011. Its overall goals were to enhance food security and poverty alleviation in six target provinces to buffer the effects of increasing food prices and buffer the effects of climate change.
The project covered six provinces in the Philippines selected based on specific set of criteria, one of which is vulnerability to climate change. Within these six provinces, the project covered six 36 municipalities and 193 villages (barangays). The project component on mainstreaming climate change adaptation had the end goal of sustained agricultural production and aimed to build up local governance on climate change. The main outputs of the project included vulnerability assessment reports for the six provinces, generating 284 vulnerability maps and six climate change adaptation and mitigation plans, one each for each province. The project informed the public and key stakeholders in the provinces on climate change impacts in the agriculture sector. It also initiated pilot testing of some of the components of the climate chance adaptation and mitigation plans of the provinces.

Mainstreaming of climate change into government policy formulation has legal basis in the Philippines as articulated in the country's Climate Change Act of 2009 or Republic Act 9729. The Law mandates local government units to serve as frontline agencies in the formulation, planning, and implementation of climate change action plans in their respective areas. The Climate Change Commission defines mainstreaming as the integration of policies and measures that address climate change in developing, planning and sectoral decision making.

The overall mainstreaming process used by FPAVAS project is divided into three phases. Phase 1 involved multi-level, cross-sectoral, participatory, vulnerability, and adaptation assessment. Phase 2 involved mainstreaming of climate change adaptation in development planning. The project reached Phase 3 as far as initiating pilot testing of some of the components of the climate change plans including setting up of community-based early warning system and piloting of other components at the municipal level involving people's organizations.

The first single step in participatory vulnerability assessment was formation of the provincial climate change technical working group. This group is composed of provincial managers who could champion and rally behind the local government units in their effort to mainstream climate change adaptation in their local development lands. The provincial managers comprised a multi-sectoral group including those from the Provincial Planning and Development Office, Office of the Provincial Agriculturist, the Provincial Government, Natural Resources

Office, Local Risk Reduction and Management Council, the Bureau of Fisheries, and provincial information agency. For instance, the provincial officer usually leads in the preparation and coordination of disaster management and food production plans and programs for the province. Thus, he or she has the institutional knowledge and memory about the specific locations and climate related risks and hazards and problems in the province, making them reliable key informants.

The next step is identifying and ascertaining climatic risk and hazards through hierarchical risk perception assessment. This assessment is multi-level and participatory, focused on the status of climate-related risk and hazards and their impacts on agriculture and food production. This involves key persons in the province and municipal LGUs. It employs different methods, tools and processes to double check and cross check various results – a sort of triangulation method.

The first level assessment took place during a training workshop where participants learned to conduct vulnerability and adaptation assessment in selected municipalities in the six provinces. They focused their assessment on climate related risks in agriculture in three ecosystems: lowland, upland, and coastal. Second level assessment followed during a validation workshop wherein the preliminary results of the risk perception assessment were presented for review by the provincial technical working group and key persons from the identified vulnerable municipalities.

Using a framework on hierarchical risk perception assessment, participants during the validation workshop evaluated the project villages and beneficiaries in terms of perceived level of exposure and vulnerability to various parameters like inadequate financial resources, to flood, to erosion, and to landslide. Dr. Burgos then demonstrated application of the analytical framework, pointing out that the process of analysis and validation with stakeholders is iterative and multi-level.

Third level assessment involved identification of risk at the household or farm level using targeted structured interviews with 100 key informants comprising affected and vulnerable constituents. All interviews were located on Global Positioning System (GPS) to ensure that the information can be integrated as primary database for the GIS risk and vulnerability mapping. Level three thus provided ground truthing for the level four activities on GIS mapping. The level four assessments used GIS to develop municipal based vulnerability maps. In short, the whole process generated many vulnerability maps from the project. The GIS maps provided a common framework for combining data on local knowledge-based risk perception with data from use of various scientific tools and research in vulnerability assessment.
The GIS then provided the basis for determining adaptation technologies and measures to address specific problems on food production in affected areas and communities of the FPAVAS project.

Dr. Burgos then showed the results in specific cases of FPAVAS localities, using the vulnerability maps generated. For instance, in Jose Panganiban which is occupied by indigenous peoples, the barangays in this municipality were perceived to be at high risk in terms of changes in rainfall patterns and seasonally inefficient irrigation system respectively. Meanwhile, the coastal ecosystems where FPAVAS had different projects like grouper cage culture, tilapia cage project, and crab fattening project were perceived as flood prone.

The problems identified by local government units in the project included absence of climate change adaptation in disaster risk reduction plan, no existing clear-cut policies on ensuring sustainability of efforts in climate-change adaptation. In terms of institutional arrangements, they identified as key issues the unclear role of identified potential champions, undefined line of coordination, and absence of centralized units to handle climate change issues.

Towards mainstreaming climate change adaptation in the local government units, the project conducted visioning and mission-setting exercises; review of provincial government objectives; and brainstorming on the objectives and the implications of recent climate change events and potential risks.

These outputs were further refined during actual workshops and mentoring workshops. Experts like Dr. Conception and Dr. Espaldon facilitated several workshops with the provincial technical working group to come up with sound climate change adaptation and mitigation plans for the respective provinces.

The project then chose to pilot some of the proposed interventions and funded for instance the setting up of community-based early warning system because this came out as a common analysis in the six provinces.

OPEN FORUM

Dr. Burgos: Dr. Romeo Labios is also part of the FPAVAS project. He introduced climate resilient rice verities especially in affected areas of the project by linking it to IRRI.

Dr. Labios: The slides presented also show the stress tolerant rice varieties that were developed by IRRI in the Philippines, which we disseminated in the six provinces. They were the drought tolerant, submergence tolerant, and salt-tolerant rice varieties. In the Philippines three such varieties that are commercially available. We have done that also in Indonesia, Cambodia, Vietnam, Myanmar, and Thailand.

Dr. Suharnoto: I'd like to know more about the multi-level methodology for vulnerability assessment. Would it be applicable for the hot structure, water infrastructure? It would be interesting to see FPAVAS' metrics on resiliency and vulnerability vis-à-vis the damage.

Burgos: The framework is generic enough to apply to other settings. For the specific methodology, we may ask Dr. Roger Conception, especially the GIS Technology, how they have integrated several maps into one map that could guide in analyzing what best strategies should be adopted by the provinces down to the barangay (village) level.

Dr. Concepcion: As you know, the issue with climate is its uncertainty – nobody can predict it except people on the ground who are exposed to the hazard at any given time and they remember it very well. In the project, we tried to find out if the spatial occurrences and their variation across the landscape can be validated both by the farmer and a scientific tool which we called GIS. GIS allows developing algorithms that would allow us to use simple criteria to map climate-related expressions of resources around the area, and land use. We map out areas which are susceptible to drought in response to low rainfall. For the other season, we also map out areas that are prone to flood during excess typhoon and prolonged rainfall. The two situations, the dry and wet, give some variation across time. GIS prepares a spatial map that is expressed as a polygon.

Meanwhile, the farmers identified areas in the sitio, the smallest unit of a village and we asked them how vulnerable these areas are in a spot map. We then superimposed the GIS map with the farmers' spot maps based on their traditional knowledge.

Workshop Presentations and Forum Synthesis

During the executive forum, participants grouped by country to address the following four questions:

1. What are the **top five priorities** (R&D, policy, tools or science, socio-institutional, etc.) in managing water resources for agriculture to meet food & health security requirements in the face of a changing environment?
2. Of answers to no. 1, what has been mainstreamed to forward **water-efficient food production** in local planning and management and how successful have these efforts been?
3. What **coping strategies (reducing vulnerability or increasing resiliency)** are considered best practices in your respective areas of responsibility?
4. What are the possible areas for **regional cooperation**?

Their selected representatives delivered their respective country presentations after Dr. Burgos' presentation. Their outputs are in the Appendices.

The country presentations proceeded as follows: Indonesia's by Prof. Dr. Ir. Azwar Maas; Cambodia's by Dr. Kao Sochivi; Thailand's by Dr. Ed Sarabol; Malaysia's by Mr. Zulkefli Malik; and Philippines' by Dr. Ma. Luz L. Soriano.

Dr. Kada wrapped up the presentations and the forum by noting the relevance of its theme in the face of serious natural resource issues posed by our changing environment shared across the globe. Among them are floods, drought and pollution – which impact on food production and food security in Southeast Asia.

From the rich presentations of resource speakers and country representatives, Dr. Kada asserted a need for a forum in an information network in order to continue sharing of ideas, technologies, and accomplishments in terms of policy and institutional interventions including people's participation. He elaborated that there are many lessons to be shared and a continuous need to update each other, both through South-South and North-South exchanges and collaborations.

Dr. Kada underscored the value of partnership and cooperation, complimenting the presenters and participants alike for the richness of exchanges that impressed him.

Pointing out the urgency of addressing water and food issues, he emphasized the importance of having deliberate coping strategies at different levels, from international, national, regional, down to local levels.

He exhorted everyone to review and study more deeply the rich material generated by the forum, both from the presentations, discussions, and workshop outputs.

Dr. Kada closed by raising his hope for greater collaboration between ASEAN members and Japan, specifically through his research institute and SEARCA. He suggested strengthening the network of participants in the forum, and inviting funding agencies and intellectual societies in an advisory capacity, as they resume interacting and collaborating via a regional platform like SEARCA's Knowledge Center on Climate Change Adaptation for Agriculture and Natural Resource Management in Southeast Asia (KC3).

Closing Remarks

PARTICIPANTS

Prof. Dr. Ir. Azwar Maas, Gadjah Mada University, Indonesia

This may be the end of our forum meeting but the beginning of our future action. On behalf of the universities among ASEAN countries, I wish to thank the organizers, experts and fellow participants. We have discussed in a scientific way how people's lives and natural resources are intertwined. We have also married theory and practice in our discussions.

We have all agreed that experiences, practices, and lessons from the field are valuable contributions to the body of knowledge on climate change.
Further, we all came with different backgrounds, views, and experiences that enabled us to learn from each other.

While the three-day meeting was too short for us to know each other and our respective field experiences, it is imperative for us to act now, as climate is changing even without us doing anything. The issues we face are the same, hence it is important for our Asian countries to work together. We should cooperate to influence our governments so that we can bring the lessons from the cases presented in this forum in our own countries.

I hope beyond sharing data and information, we can really collaborate in the future. We suggest more fora like this, and for future fora to involve more stakeholders and have counterpart support from participating countries and organizations, including universities.

Certainly, closing this forum is not the end. Let us begin our new actions with more cooperation among us.

Dr. Huong Thuy Phan Nguyen, Mekong River Commission Secretariat

I've learned much because I do not come from the agriculture sector. Rather,I head the climate program of the Mekong River Commission. Under my responsibility, we are going to undertake a few initiatives related to assessment of climate impact on the agriculture and food sectors in the region.

Thus, this event gave me a lot of knowledge along with a new network, or friends and colleagues who work in the sector which would be source of support and assistance when we mobilize for our work in the future. The Mekong River Commission is not an R&D institution. Rather, it is a regional cooperation body whose main work is to assist member countries in making decisions.

We provide technical information and knowledge and administer assistance to our member countries. Member countries are the ones who advise us what information or knowledge they need in decision-making, and we respond to their requests.

I wish to thank and congratulate the organizers of this forum, the speakers, and all participants. Everyone contributed to make

the learning event interesting and useful. I appreciate all the inspiring presentations as well as thought-provoking questions from the participants.

I also appreciate not only the rich knowledge but also everyone's high spirits in tackling the issues. These have all been highly informative for my own presentation for the coming Mekong forum. I wish you all success in your work tackling the "good" and "bad" aspects in the field of water and food in a changing environment field.

Mrs. Pham Tuyet Mai, Ministry of Agriculture and Rural Development, Vietnam

It has become evident that climate change is a major problem now affecting many countries. In Vietnam, it is affecting our two rivers as discussed by Mr. Toan. Now, we have our plan for climate change adaption.

The three-day forum ended very quickly. It has been very useful for my group, as we learned from the experiences of the other countries on climate change adaptation. We hope to cooperate in a climate change project with the other countries in the future.

On behalf of our group from Vietnam, I thank SEARCA and partners who sponsored this seminar. Thank you all.

Dr. Francisco F. Peñalba, SEARCA Deputy Director

Our Director Dr. Gil Saguiguit, Jr. would very much wish to personally close this Executive Forum, but he was forced to send me to send his high regard to this group and our partners in this undertaking instead. Unfortunately, he has a prior engagement in Metro Manila.

On his behalf, I wish to congratulate you all for a successful and fruitful three-day forum. We look forward to having future collaborative endeavors with you in our goal of facilitating regional collaboration in research and development, capacity building, and knowledge management. We offer to you the online portal, KC3 or Knowledge Center on Climate Change Adaptation in Agriculture and Natural Resource Management in Southeast Asia, as a platform to use for continued discussion, peer mentoring, and sharing of solutions. We hope you will actively participate in the KC3 Community.

We also hope you enjoyed your brief stay here in Los Baños and at SEARCA. I understand that you have a campus tour later on so you have more chance to see what Los Baños has to offer. We wish you a safe trip home tomorrow. Thank you very much and good day!

Forum Evaluation

Participants accomplished two sets of evaluation instruments to gather immediate feedback about the executive forum. They helped participants assess if the forum and its contents met the stated objectives, their own expectations, and their knowledge and information needs. The session evaluation was administered after each forum session while the summative evaluation was administered at the end of the three-day forum.

From the participants' feedback, the forum garnered an overall positive rating of 4.34 on a scale of 1 to 5, with 5 being the most favourable rating. This is in terms of its content/topics, clarity and attainability of forum objectives, time allotted per session, and administrative arrangements (Table 1). Based on the evaluation, the 23 government executives and planners, scientists, experts, and practitioners representing eight Asian countries, found the course relevant, informative and practical. The forum became "a very platform for getting new knowledge, and (acquiring) new and practical approaches on dealing with climate change." The forum was also evaluated as a well-organized learning event, with good logistics arrangement in terms of the venue and the working environment, accommodation, food, and transport services.

Table 1. Summary of summative evaluation

Summative evaluation criteria	**Rating***
Assessment on the clarity of forum objectives	4.48
Assessment on the attainability of forum objectives	4.45
Time allotment	4.02
Content/topics	4.32
Administrative arrangements	4.43
Overall rating	**4.34**

** The 1 to 5 rating scale was used, with 5 being the highest.*

Session Topics and Scope

As indicated in the results of the summative evaluation, the participants were able to get a deeper understanding of the forum contents through the coherent sessions that built towards attainment of forum objectives. The participants gave an overall rating ranging from 4.23 to 4.69 for the 12 sessions of the forum (Table 2). On the other hand, an overall rating of 4.45 was given by the participants when they were asked if the forum objectives were achieved. These ratings show that the participants gained a greater awareness on current experiences and application of knowledge elaborating on the roles of science and scientific communities in developing management strategies to reduce climate-related risks on food availability in a changing environment. They have become more sensitive to the issues and challenges related to global environmental change (GEC) and they were able to form new collaborations that will facilitate reflection, dialogue and exchange of knowledge and experiences on the impacts of changing environment on water, food and ecology. The three sessions with ranked most favorably included Technical Principles for Water-efficient Food Production; Climate Field School: Experiences in Iloilo, Philippines; and Ecology-related Risks on Water, Food Safety and Security, and Health.

Table. Summary of session evaluation

Session	Session objective/s stated very clearly	Session objective/s fully achieved	Session topic very relevant to course	Session content very useful for job	Session content sufficientl y added to knowledge	Overall average
Ecology-related Risks on Water, Food Safety and Security, and Health	4.59	4.45	4.73	4.62	4.62	4.60
Practical Issues on Managing Risks on Water and Food from the Point of View of Terrestrial Ecology	4.55	4.41	4.59	4.50	4.50	4.51
Practical Issues on Managing Risks on Water and Food from the Point of View of Climate Change Science	4.59	4.45	4.59	4.55	4.55	4.55
Local Lessons and Transboundary Challenges for Governing Shared Water Resources in Asia	4.14	4.18	4.32	4.18	4.32	4.23
Technical Principles for Water-efficient Food Production	4.59	4.68	4.77	4.82	4.59	4.69
Assessing and Improving Community Resiliency in a Changing Climate and Environment	4.57	4.48	4.65	4.52	4.48	4.54
Tools for Early Warning System	4.57	4.48	4.61	4.48	4.57	4.54
Tools for Watershed Monitoring and Evaluation	4.61	4.52	4.65	4.61	4.57	4.59
Science-enhanced Community-based Coping Strategies	4.35	4.30	4.61	4.57	4.39	4.44
Water Resources Development for Sustainable Agricultural Cultivation in the Mekong Delta: Adapting to Climate Change and Sea Level Rise	4.32	4.32	4.59	4.45	4.36	4.41
Climate Field School: Experiences in Iloilo, Philippines	4.68	4.64	4.77	4.64	4.64	4.67
Focused-Food Production Assistance for Vulnerable Sectors (FPAVAS) Cases	4.50	4.45	4.45	4.41	4.36	4.44

Eight participants found all the forum sessions to be beneficial while the individual sessions that stood out were Climate Field School: Experiences in Iloilo, Philippines; Tools for Watershed Monitoring and Evaluation; and Water Resources Development for Sustainable Agricultural Cultivation in the Mekong Delta: Adapting to Climate Change and Sea Level Rise (Table 3).

Table 3. Sessions identified as most beneficial

Session	Frequency	Percent
All topics	8	38.1
Climate Field School: Experiences in Iloilo, Philippines	5	23.81
Tools for Watershed Monitoring and Evaluation	3	14.29
Water Resources Development for Sustainable Agricultural Cultivation in the Mekong Delta: Adapting to Climate Change and Sea Level Rise	3	14.29
Practical Issues on Managing Risks on Water and Food from the Point of View of Climate Change Science	2	9.52
Tools for Early Warning System	2	9.52
Focused-Food Production Assistance for Vulnerable Sectors (FPAVAS) Cases	2	9.52
Ecology-related Risks on Water, Food Safety and Security, and Health	1	4.76
Practical Issues on Managing Risks on Water and Food from the Point of View of Terrestrial Ecology	1	4.76
Local Lessons and Transboundary Challenges for Governing Shared Water Resources in Asia	1	4.76
Technical Principles for Water-efficient Food Production	1	4.76
Assessing and Improving Community Resiliency in a Changing Climate and Environment	1	4.76
Science-enhanced Community-based Coping Strategies	1	4.76

Time allotment

Of the 23 participants, only two (9%) indicated that the forum period was insufficient and suggested to prolonging it to a five-day learning event. This was validated when some participants articulated that more time was needed for the open forum, wherein questions and clarifications can have been raised. Shown in Table 4 are the time allotments requested by the participants to properly facilitate the exchange of knowledge and sharing of experiences among themselves and the resource speakers. Two sessions were also proposed to be shortened, including presentations on both the technical aspect and modeling.

The responses of the participants regarding which session should be lengthened were diverse, as almost all of the presentations under the three sub-themes were mentioned. This shows that the group of participants had heterogeneous interests and is involved in the different aspects of climate change (such as climate change science, adaptation and resiliency, policy implications etc.) and other climate-change related issues. This also indicates the relatively equal relevance of the various topics discussed in the forum.

Table 4. Suggested time allotment per session

Session	Suggested time allotment (per hour)
Ecology-related Risks on Water, Food Safety and Security, and Health	1.0
Practical Issues on Managing Risks on Water and Food from the Point of View of Terrestrial Ecology	1.5
Practical Issues on Managing Risks on Water and Food from the Point of View of Climate Change Science	1.0
Local Lessons and Transboundary Challenges for Governing Shared Water Resources in Asia	1.0
Technical Principles for Water-efficient Food Production	1.0
Assessing and Improving Community Resiliency in a Changing Climate and Environment	1.05
Tools for Early Warning System	1-1.5
Tools for Watershed Monitoring and Evaluation	1-1.5
Science-enhanced Community-based Coping Strategies	1.5-2
Water Resources Development for Sustainable Agricultural Cultivation in the Mekong Delta: Adapting to Climate Change and Sea Level Rise	1.2
Climate Field School: Experiences in Iloilo, Philippines	0.8
Focused-Food Production Assistance for Vulnerable Sectors (FPAVAS) Cases	1.3

Recommendation

Pre-forum preparation of participants. The two constraining factors that are considered in planning for the duration of the course are the availability of grants and the number of travel days that a participant can afford to be absent from work. One possible solution for the need of a longer forum period is through the provision of advance reading assignments, which has been suggested by the resource speakers, to prepare and familiarize them with the upcoming forum. This could lessen time allotted for presentations and allow hands-on exercises and freer sharing of experiences. Another option is to lengthen the forum period to four or five days and spice up the inputs with a field visit on the third day. This may be done to bridge the gap(s) between the theories and the practical applications.

Appendices

DIRECTORY

Sixth Executive Forum on Natural Resources Management: Water & Food in a Changing Environment

11-13 April 2012 | SEARCA, Los Baños, Laguna, Philippines

CAMBODIA

Name	Dr. Kao Sochivi
Position	Deputy Director General, Fisheries Administration
Organization	Ministry of Agriculture, Forestry and Fisheries, Cambodia
Office Address	PO. Box: 582, # 186, Norodom Blvd., Phnom Penh, Cambodia
Office phone	(855) 23 221 013
Office fax	(855) 23 220417 / 23 221 013
Mobile number	(855) 12 202 805
Email	kaosochivi2007@yahoo.com

Name	Dr. Seng Vang
Position	Deputy Director
Organization	Cambodian Agricultural Research and Development Institute
Office Address	Sangkat Prateah Lang, Khan Dangkor, Phnom Penh, Cambodia
Office phone	-
Office fax	-
Mobile number	(855) 12 804 181
Email	vseng@cardi.org.kh

Name	Mr. Ek Sopheap
Position	Vice Dean, Faculty of Agro-industry
Organization	Royal University of Agriculture
Office Address	Royal University of Agriculture, Chamkar Daung, Dangkor District, P.O. Box 2696,Phnom Penh, Cambodia
Office phone	(855) 23 692 1918 / 219 829 / 219 753
Office fax	(855) 23 219 753 / 23 219 690
Mobile number	(855) 12 641 165
Email	RUA@camnet.com.kh

Name	Dr. Ly Sophorn
Position	Deputy Director, General Department of Administration for Nature Conservation and Protection
Organization	Ministry of Environment, Cambodia
Office Address	#48, Samdach Preah Sihanouk, Chamkarmon, Tonle Bassac, Phnom Penh, Cambodia
Office phone	(855) 23 21 5925
Office fax	(855) 23 21 5925
Mobile number	(855) 16 86 3455
Email	sophorn_ly@yahoo.com; sophorn.ly@gmail.com

INDONESIA

Name	Ir. M. Samsul Huda
Position	Head, Sub-directorate of Water Resources Development, Directorate General of Agricultural Infrastructure and Facilities
Organization	Ministry of Agriculture, Indonesia
Office Address	Jl. Taman Margasatwa No. 3, Ragunan, Pasar Minggu, Jakarta Selatan, Indonesia
Office phone	(62) 021 782 3975
Office fax	(62) 021 782 3975
Mobile number	(62) 816 145 3112 / 812 8095 1272
Email	m_shuda@yahoo.co.id, m_samsulhuda@hotmail.com

Name	Prof. Dr. Ir. Azwar Maas
Position	Soil Scientist and Lecturer, Faculty of Agriculture
Organization	Gadjah Mada University
Office Address	Flora Street, Bulaksumur, Yogyakarta, Indonesia
Office phone	(62) 274 548 814
Office fax	(62) 274 548 814
Mobile number	(62) 811 250 5324
Email	azwar.maas@gmail.com

Name	Dr. Yuli Suharnoto
Position	Researcher, Center for Climate Risk and Opportunity Management in Southeast Asia and Pacific
Organization	Bogor Agricultural University
Office Address	Gedung Fisik dan Botani Lantai 2, Kampus IPB Baranangsiang Jl. Pajajaran Bogor 16143, West Java, Indonesia
Office phone	(62) 251 831 3709 / 831 0779
Office fax	(62) 251 831 3709 / 831 0779
Mobile number	(62) 813 8017 3372
Email	suharnoto@gmail.com

JAPAN

Name	Dr. Kiyoyuki Yaota
Position	Researcher
Organization	Research Institute for Humanity and Nature
Office Address	457-4 Motoyama, Kamigamo, Kita-ku, Kyoto, 603-8047 Japan
Office phone	(81) 75 707 2441
Office fax	(81) 75 707 2106
Mobile number	-
Email	k-yaota@chikyu.ac.jp

LAO PDR

Name	Mr. Vanthieng Phommasoulin
Position	Senior Officer, Department of Agriculture
Organization	Ministry of Agriculture and Fisheries, Lao PDR
Office Address	Lane Xang Avenue, Patuxay Square, P.O Box: 811, Vientiane, Lao PDR
Office phone	(856) 21 412 350
Office fax	(856) 21 412 349
Mobile number	(856) 20 2223 2776
Email	vanthieng_06@yahoo.com

Name	Mr. Leetoua Chialue
Position	Lecturer and Head, Economic Unit, Dept. of Rural Economics and Food Technology, Faculty of Agriculture
Organization	National University of Laos
Office Address	P. O. BOX 3779, Vientiane Capital, Lao PDR
Office phone	(856) 21 870 048
Office fax	(856) 21 870 131
Mobile number	(856) 20 2220 3079
Email	chialuefoa@gmail.com

MALAYSIA

Name	Dr. Mahmud T. Muda Mohamed
Position	Professor, Faculty of Agriculture
Organization	Universiti Putra Malaysia
Office Address	Department of Crop Science, UPM, 43400 Serdang, Selangor, Malaysia
Office phone	(60) 3 8947 4823
Office fax	(60) 3 8947 4918
Mobile number	(60) 19 266 7739
Email	mahmood@agri.upm.edu.my

Name	Mr. Zulkefli Malik
Position	Principal Research Officer
Organization	Malaysian Agricultural Research & Development Institute
Office Address	Soil and Water Management Programme, Strategic Resource Research Centre, MARDI, GPO Box 12301, 50774 Kuala Lumpur, Malaysia
Office phone	(60) 3 8943 7988
Office fax	(60) 3 8941 1499
Mobile number	(60) 33 355 468
Email	zulmalik@mardi.gov.my

PHILIPPINES

Name	Ms. Cheryl C. Batistel
Position	Planning and Extension Coordinator, College of Arts and Sciences
Organization	Camarines Norte State College
Office Address	Daet, Camarines Norte, Philippines
Office phone	-
Office fax	-
Mobile number	(63) 918 967 2438
Email	c_batistel@yahoo.com

Name	Dr. Ma. Luz L. Soriano
Position	Dean, College of Agriculture
Organization	Central Mindanao University
Office Address	Musuan, Bukidnon 8710 Philippines
Office phone	(63) 88 356 1910
Office fax	(63) 88 356 1912
Mobile number	(63) 917 476 4296
Email	ca_cmu1910@yahoo.com; lutinglicayan@yahoo.com

Name	Dr. Buenaventura B. Dargantes
Position	Professor of Socio-ecology, Institute of Social Research and Development Studies
Organization	Visayas State University
Office Address	Institute for Strategic Research and Development Studies, Visayas State University, Baybay, Leyte, Philippines
Office phone	(63) 53 563 7912
Office fax	(63) 53 335 2621
Mobile number	(63) 919 349 0974
Email	vsuwaterresearch@yahoo.com.ph

Name	Mr. Jamesly T. Andres
Position	Instructor, College of Agriculture
Organization	Benguet State University
Office Address	La Trinidad, Benguet, Philippines
Office phone	(63) 74 422 1877
Office fax	(63) 74 422 1877
Mobile number	(63) 928 588 3276
Email	jam_sly@yahoo.com

Name	Ms. Adelina C. Santos-Borja
Position	OIC, Resource Management and Development Department
Organization	Laguna Lake Development Authority
Office Address	SRA Compound, North Avenue, Quezon City, Philippines
Office phone	(63) 2 385 4671
Office fax	-
Mobile number	(63) 916 552 9410
Email	lennieborja@yahoo.com; lennieborja@llda.gov.ph

Name	Dr. Romeo V. Labios
Position	Researcher
Organization	University of the Philippines Los Baños
Office Address	College, Los Baños, Laguna, Philippines
Office phone	(63) 49 536 4465
Office fax	(63) 49 536 5282
Mobile number	(63) 917 857 6814
Email	romeolabios@gmail.com

THAILAND

Name	Asst. Prof. Dr. Rakpong Petkam
Position	Asst. Prof. and Associate Dean for Administration, Faculty of Agriculture
Organization	Khon Kaen University
Office Address	Faculty of Agriculture, Khon Kaen University, Khon Kaen 40002 Thailand
Office phone	(66) 43 202 360
Office fax	(66) 43 202 361
Mobile number	(66) 89 841 3184
Email	rakpong@kku.ac.th

Name	Assoc. Prof. Dr. Ed Sarobol
Position	Associate Dean for Research and Academic Services, Agronomy Department, Faculty of Agriculture
Organization	Kasetsart University
Office Address	Agronomy Department, Faculty of Agriculture, Kasetsart University, Bangkok, Thailand
Office phone	(66) 2 579 4371
Office fax	(66) 2 579 8580
Mobile number	(66) 81 819 5097
Email	agred@ku.ac.th

VIETNAM

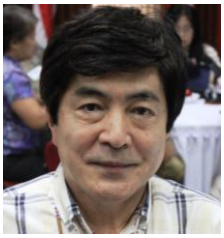
Name	Mrs. Pham Tuyet Mai
Position	Project Manager, Institute of Water Resources Planning
Organization	Ministry of Agriculture and Rural Development, Vietnam
Office Address	162A TranQuang Khai street, HoanKiem district, HaNoi, VietNam
Office phone	(84) 4 826 7020
Office fax	(84) 4 3825 2807
Mobile number	(63) 912 94 5506
Email	pmaivqh@gmail.com

Name	Mr. Nguyen Xuan Lam
Position	Researcher, Dept. of Water Resources and Climate Change, Institute for Water and Environment
Organization	Vietnam Academy for Water Resources
Office Address	No. 165/2 Chua Boc street, Dong Da district, Hanoi, Vietnam
Office phone	(84) 4 3563 2495
Office fax	(84) 4 3563 4809
Mobile number	(84) 9 1336 8685
Email	nguyenxuanlamiwe@gmail.com

Name	Mr. Nguyen Dinh Tien
Position	Researcher, Center for Agricultural Research and Ecological Studies
Organization	Hanoi University of Agriculture
Office Address	Trau Quy town, Gia Lam district, Hanoi city, Vietnam
Office phone	(84) 4 3876 5607
Office fax	(84) 4 3876 6642
Mobile number	(84) 9 8824 8596
Email	tiencpm@yahoo.com

Name	Dr. Huong Thuy Phan Nguyen
Position	Programme Coordinator, Climate Change Adaptation Initiative
Organization	Mekong River Commission Secretariat
Office Address	Office of the Secretariat in Vientiane, Office of the Chief Executive Officer 184 Fa Ngoum Road, P.O. Box 6101, Vientiane, Lao PDR
Office phone	(856) 21 263 263.
Office fax	(856) 21 263 264
Mobile number	-
Email	thuyphan@mrcmekong.org

RESOURCE SPEAKERS



Name	Dr. Ryohei Kada
Position	Leader, Food-Health Risk Research Project Research Institute for Humanity and Nature (RIHN), and Professor, Yokohama National University, Japan
Email	kada@chikyu.ac.jp

Dr. Ryohei Kada is a Professor at the Research Institute for Humanity and Nature (RIHN) in Kyoto, Japan and at Yokohama National University, where teaches food risk sciences at the Graduate School of Environment and Information Sciences. In 2001 and 2004, he served as Policy Research Coordinator at the Policy Research Institute, Japan Ministry of Agriculture, Forestry and Fisheries. He has a long career of research and teaching at the Kyoto University Graduate School where he taught agricultural and environmental economics and international food policy. His past teaching career includes teaching at Kasetsart University and University of Wisconsin-Madison. He has B.Sc. and M.Sc. degrees in agricultural economics from Kyoto University and Ph.D. from the University of Wisconsin-Madison.

Name	Dr. Damasa B. Magcale-Macandog
Position	Professor, Institute of Biological Science University of the Philippines Los Baños
Email	demi_macandog@yahoo.com

Dr. Damasa B. Magcale-Macandog is a Professor of ecology, natural sciences and biological sciences at the University of the Philippines Los Baños (UPLB) Institute of Biological Sciences, where she is also the Director. Her work in environmental biology is extensive. She received the 2007 UPLB Outstanding Researcher award, in recognition of her 20 years of study in Agriculture and Forestry. Her efforts focused on the sustainable management of natural resources and the environment. She has published fifteen papers in scientific journals and headed the implementation of an information support project of the Southeast Asian Regional Network on Soil Fertility and Improved Fallow Management for three years (2001-2004).

Name	Dr. Rodel D. Lasco
Position	Philippine Programme Coordinator World Agroforestry Centre (ICRAF)
Email	rdlasco@yahoo.com

Dr. Rodel D. Lasco has nearly 30 years of experience in natural resources and environmental research, conservation, education and development at the national and international level. His work has focused on issues related to natural resources conservation, climate change and land degradation. In the Philippines, he pioneered research on climate change adaptation in the natural resources sector and the role of tropical forests in climate change. He has over 80 technical publications in national and international journals dealing with the various aspects of natural resources conservation and environmental management. He has co-authored several reports of the Intergovernmental Panel on Climate Change (IPCC) and is one of the recipients of the 2007 Nobel Peace Prize to the IPCC. Since April 2004, Dr. Lasco has served as the Philippines Coordinator of the World Agroforestry Centre (ICRAF).

Name	Dr. Ashutosh Sarker
Position	Research Fellow, School of Business and Economics Monash University Sunway Campus, Malaysia
Email	asarker@yahoo.com

Dr. Ashutosh Sarker is an “environmental and natural resource” economist. He is currently working as Research Fellow at Monash University Sunway Campus, Malaysia. Formerly, he worked as Associate Professor at Yokohama National University, Japan. He conducted research at the University of Queensland, Australia, the University of British Columbia, Canada and Niigata University, Japan. His research encompasses areas of political economy, governance, institutional economics, and common property resource management within diverse contexts of developing and advanced nations in Asia and Australia. He has published articles in highly-ranked international journals such as *Society and Natural Resources*, *Ecological Economics*, *Human Ecology*, *Water Policy*, and made presentations at international conferences and seminars held in the Philippines, Australia, Canada, the U.S.A., Italy, the U.K., the Netherlands, Hong Kong, and Japan.

Name	Engr. Samuel M. Contreras
Position	Division Head, Bureau of Soils and Water Management Philippine Department of Agriculture
Email	sammycontreras@yahoo.com

Engr. Samuel M. Contreras is an Agricultural Engineer with the Philippine Bureau of Soils and Water Management. He is involved in the preparation of the Philippine Agriculture Strategic Framework on Climate Change Adaptation and is a member of the Project Technical Working Group on Strengthening the Philippine Institutional Capacity to Adapt to Climate Change since 2008. He was also involved in the preparation of a training module for mainstreaming disaster risk reduction into the agriculture sector led by the Asian Disaster Preparedness Center. He served as Technical Working Group Co-Chairman in preparing the guidelines for the adoption of water saving technologies in national and communal irrigation systems. He is also the country representative to the World Overview of Conservation Approaches and technologies. In 2005, he was awarded as Outstanding Agricultural Engineer in the field of soil and water management by the Philippine Society of Agricultural Engineers.

Name	Dr. Bam H.N. Razafindrabe
Position	Associate Professor Sub-Tropical Forest and Watershed Management Faculty of Agriculture, Ryukyu University, Japan
Email	bamrazaf@gmail.com

Dr. Bam H.N. Razafindrabe is an Associate Professor at the Faculty of Agriculture of Ryukyu University, Okinawa, Japan. He received his Ph.D. in Disaster Risk and Watershed Management from the Ehime University in 2007. He was awarded the JSPS Postdoctoral Fellowship in Kyoto University from 2007 to 2009, after which he joined the Global Center of Excellence Program at Yokohama National University, Japan. From 2010 to March 2012, he worked as a Senior Project Researcher at the Research Institute for Humanity and Nature (RIHN), Kyoto, Japan; and he was a Sub-Leader of the Research Project on "Managing Environmental Risks to Food and Health Security in Asian Watersheds", in which he is a core member to date in charge of the Disaster Risk Management component. Previously, he worked in Madagascar under the National Environmental program funded by the World Bank.

Name	Dr. Flaviana D. Hilario
Position	Acting Deputy Administrator for R&D Philippine Atmospheric, Geophysical and Astronomical Services Administration
Email	fhilarioph@yahoo.com

Dr. Flaviana D. Hilario is the Weather Services Chief of the Climatology and Agrometeorology Branch, Philippine Atmospheric, Geophysical and Astronomical Services Administration (DOST-PAGASA). This branch is responsible for the collection, quality control, processing, storage and retrieval of meteorological, agrometeorological, climatological and allied data and information in usable format; the provision of standard statistical products, customized climatological products and user services specially tailored for policy/decision makers and other users in the various sectors, such as in agriculture, energy and water resources; and, the preparation and issuance of long term climate predictions, seasonal climate outlooks and advisories on extreme climate events such as El Niño and La Niña. It also undertakes specialized climate and climate change studies and researches in support of national development.

Name	Dr. Rex Victor O. Cruz
Position	Chancellor, University of the Philippines Los Baños
Email	rexcruz@yahoo.com

Dr. Rex Victor O. Cruz is the Chancellor of the University of the Philippines Los Baños (UPLB). He has more than 30 years of experience in natural resources research with his work mostly focused on forest resources and watershed management, and climate and land use change. He has over a hundred journal articles and technical reports of national and international scope, the most recent ones focusing on the impacts, vulnerability and adaptation to climate change. Also notable among his publications is the watershed management guidelines of the Philippines, which contributed to the adoption of watershed management as the flagship program of the country's Department of Environmental and Natural Resources. He has also co-authored several IPCC reports and is co-recipient of the 2007 Nobel Peace Prize.

Name	Dr. Juan M. Pulhin
Position	Dean, College of Forestry and Natural Resources, UPLB
Email	jpulhin@yahoo.com

Dr. Juan M. Pulhin is a Professor and Dean of the UPLB College of Forestry and Natural Resources (CFNR). He has over 50 technical publications among those of note are the *Adaptation Chapter, Working Group II, Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (IPCC) and the *Forest and Woodland Systems Chapter, 2006 Millennium Ecosystem Assessment,* in both of which he served as one of the lead authors. He was also involved in several climate change related research and development projects, foremost of which is the *Assessment of Impacts, Vulnerability, and Adaptation to Climate Change in Selected Watersheds and Communities in Southeast Asia*. He is co-editor and co-author of three chapters in the book *Climate Change and Vulnerability* and co-author in a chapter of the book *Climate Change and Adaptation*, both published in 2008 by Earthscan. He is also one of the recipients of the 2007 Nobel Peace Prize to the IPCC.

Name	Mr. To Quang Toan
Position	Deputy Head of Training and International Coordination Department, Southern Institute of Water Resources Research, Hochiminh City, Vietnam
Email	toan_siwrr@yahoo.com

Mr. To Quang Toan has 18 years experience in the field of integrated land and water resources development and management. His experience is in basin development planning, flood control and water quality management in general and for the Mekong River Basin in particular. He has substantial knowledge about flood, salinity intrusion and acidification phenomenon and activities undertaken in Vietnam and in the Mekong River basin.

Name	Hon. Ronaldo B. Golez
Position	Mayor, Dumangas, Iloilo, Philippines
Email	municipalityofdumangas@yahoo.com

Hon. Ronaldo B. Golez is the Municipal Mayor of Dumangas in Iloilo Province, Philippines. The municipality has received several Gawad Kalasag awards, an honor given to government offices, non-government organizations, and individuals who have shown heroic acts in time of disasters and calamities and in working on disaster risk management (DRM). It received the Gawad Kalasag Hall of Fame Award on Disaster Coordinating and Management and the citation for being the Best Municipal Disaster Coordinating Council in Western Visayas in 2007. In 2011, the municipality received the Gawad Kalasag award for its Climate Field School as Best in Community-Based Disaster Risk Management and Climate Adaptation. The Climate Field School in Dumangas is the first in the Philippines and the second in Asia.

Name	Dr. Bessie M. Burgos
Position	Manager, Project Development and Management Department, SEARCA
Email	bmb@agri.searca.org

Dr. Bessie M. Burgos currently manages the SEARCA Project Development and Management Department (PRODEV). Before joining SEARCA, she worked for 30 years at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development - Department of Science and Technology (PCARRD-DOST) rising to the position of Director of the Technology Outreach and Promotion Division (TOPD) in 2002. As TOPD Director, she supervised various activities including technology packaging, intellectual property management, and technology transfer modality development and promotion; and evaluated proposed, ongoing and completed projects related to technology management. Dr. Burgos also led the formulation and packaging of technology transfer and commercialization programs for the agriculture, forestry and natural resources sectors; directed the evaluation and monitoring of programs, projects and activities related to technology management; and recommended policies on technology transfer and commercialization.

FORUM MANAGEMENT GROUP

Name	Dr. Gil C. Saguiguit, Jr.
Position	Director, SEARCA
Office phone	63 49 536 7044
Office fax	63 49 536 7097
Email	gcs@agri.searca.org

Dr. Gil C. Saguiguit, Jr. is the Director of SEARCA. Before assuming this position, he was SEARCA's Deputy Director for Administration (2002-2009) and Research and Development Manager (1998-2002). Several projects which he led and managed during his term as the RDD Manager received awards. Among them were the Data Management for Rural Development and Food Security Project which garnered "Best Linkage Project" from the Canadian International Development Agency, and the Ned Agro-industrial Development Project which earned SEARCA the "Most Outstanding NGO Partner" award from the Department of Agrarian Reform of the Philippine Government. His main fields of interest, expertise, and experience include project management and implementation, fund generation and financial management, rural development and extension, participatory and community-based approaches, and multidisciplinary research.

Name	Dr. Maria Celeste H. Cadiz
Position	Manager, Knowledge Management Department, SEARCA
Office phone	63 49 536 2290, 2365 to 67 loc. 173
Office fax	63 49 536 2283
Email	mchc@agri.searca.org

Dr. Maria Celeste H. Cadiz is manager of SEARCA's Knowledge Management Department. Dr. Cadiz also serves as Adjunct Associate Professor and was first Dean of the College of Development Communication of the University of the Philippines Los Baños (UPLB). She served as project leader in a number of national and international action-research programs in development communication; authored two books, a monograph, and several articles published in professional publications, as book chapters, or presented in international and national conferences; and produced more than 40 communication materials in various media formats, from print to audiovisual.

Name	Dr. Rogelio N. Concepcion
Position	Adjunct Professor, School of Environmental Science and Management, University of the Philippines Los Baños
Email	rogelio.concepcion@yahoo.com

Dr. Rogelio N. Concepcion is an Adjunct Professor of the UPLB School of Environmental Science and Management. His areas of expertise include sustainable agriculture, land use planning and policy, agricultural technology adaptation against climate change, food security planning, El Niño and drought strategic mitigation planning and upland agriculture development, among many others. He is an ASEAN expert for the multi-functionality of agriculture assessment and was the organizer and first president of the Philippine Society of Soil Science and Technology. He also served as the National Executive Director of the Department of Agriculture - Bureau of Soils and Water Management from 1997 to March 2007. He received a *Lingkod Bayan Award*, the highest civil service award given to a public official, for his role and leadership on food security, sustainable agriculture and land use planning through the spearheading of various national programs and policies aimed at developing agricultural land use and protecting prime agricultural lands. He was also the Philippine nominee to the *2000 World Food Price* for his achievement and contribution to Philippine food security.

Name	Dr. Gina P. Nilo
Position	Chief, Laboratory Services Division, Bureau of Soil and Water Management
Email	ginapnilo@ymail.com

Dr. Gina P. Nilo is the Chief of the Laboratory Services Division of the Philippine Bureau of Soils and Water Management (BSWM). She was previously Chief of the BSWM Soil and Water Resources Research Division (2002-2009). She is currently Project Leader of the watershed evaluation for sustainable use of sloping agricultural land in the southern Philippines; Focal Person of the Philippine Climate Change Adaptation Project subcomponent on enhancing delivery and effectiveness of extension services for farm-level climate risk; and BSWM Focal Representative-Vice Chair for the subcommittee on Land Resources of the Philippine Council for Sustainable Development - Committee on Conservation and Management of Resources for Development, Strengthening Coordination for Effective Environmental Management Project.

Name	Dr. Mariliza V. Ticsay
Position	Head, Knowledge Resources Unit, Knowledge Management Department, SEARCA
Office phone	63 49 536 2290, 2365 to 67 loc. 161
Office fax	63 49 536 2283
Email	mvt@agri.searca.org

Name	Ms. Julienne V. Bariuan
Position	Training Specialist, Knowledge Management Department, SEARCA
Office phone	63 49 536 2290, 2365 to 67 loc. 403
Office fax	63 49 536 2283
Email	jvb@agri.searca.org; juliennebariuan@gmail.com

Ms. Julienne V. Bariuan is working with SEARCA as Training Specialist. In this capacity, she assists in the development, marketing, coordination, implementation and evaluation of the Center's training programs. Prior to joining SEARCA, Ms. Bariuan was an Assistant Professor at the UPLB College of Development Communication (CDC) where she specialized in community broadcasting, educational communication and science communication. She also served as the Department Chair of UPLB CDC's Department of Development Broadcasting and Telecommunication. Ms. Bariuan holds a bachelor degree *(magna cum laude)* and masters degree in Development Communication.

Name	Ms. Maria Cristina L. Decena
Position	Office Assistant, Knowledge Management Department, SEARCA
Office phone	63 49 536 2290, 2365 to 67 loc. 417
Office fax	63 49 536 2283
Email	mcld@agri.searca.org

Ms. Ma. Cristina L. Decena is the Office Assistant of SEARCA's Knowledge Management Department. She has been with SEARCA for 18 years and assists in the coordination and implementation of SEARCA learning events.

Forum Schedule

Time	Day 1 11 Apr, Wed	Day 2 12 Apr, Thu	Day 3 13 Apr, Fri
9:00 – 10:00	Welcome remarks Overview of seminar-workshop Group picture	**Sub-theme 2: Climate Risk Management Strategies Towards Water-efficient Food Production** Assessing and Improving Community Resiliency in a Changing Climate and Environment (1hr)	**Sub-theme 3: Water-efficient Food Production in Climate-based Local Planning and Management** Water Resources Development for Sustainable Agricultural Cultivation in the Mekong Delta: Adapting to Climate Change and Sea Level Rise (1hr)
10:00 – 10:20	**Morning break**		
10:20 – 12:20	**Sub-theme 1: Current Knowledge on Global Environment Change (GEC) Issues and its Implications on Water Management for Food Production** ***Keynote:*** Ecology-related Risks on Water, Food Safety and Security, and Health (1hr) Practical Issues on Managing Risks on Water and Food from the Point of View of Terrestrial Ecology (1hr)	Tools for Early Warning System (1hr) Tools for Watershed Monitoring and Evaluation (1hr)	Climate Field School: Experiences in Iloilo, Philippines (1hr) Focused-Food Production Assistance for Vulnerable Sectors (FPAVAS) Cases (1hr)
12:20 – 13:20	**Lunch break**		
13:20 – 15:20	Practical Issues on Managing Risks on Water and Food from the Point of View of Climate Change Science (1hr) Local Lessons and Transboundary Challenges for Governing Shared Water Resources in Asia (1hr)	Science-enhanced Community-based Coping Strategies (1.5hrs) **Open Forum**	**Open Forum** **WORKSHOP:** **Efforts in mainstreaming water-efficient food production in local planning and management**
15:20 – 15:40	**Afternoon break**		
15:40 – 17:00	Technical Principles for Water-efficient Food Production (1hr) **Open Forum**	**WORKSHOP:** • **Concerns and measures to be prioritized** • **Coping strategies considered best practices**	Synthesis and Closing

Southeast Asian Regional Center for Graduate Study and Research in Agriculture

in cooperation with

University of Hohenheim
Food Security Center
Stuttgart, Germany

Research Institute for Humanity and Nature (RIHN)
Kyoto, Japan