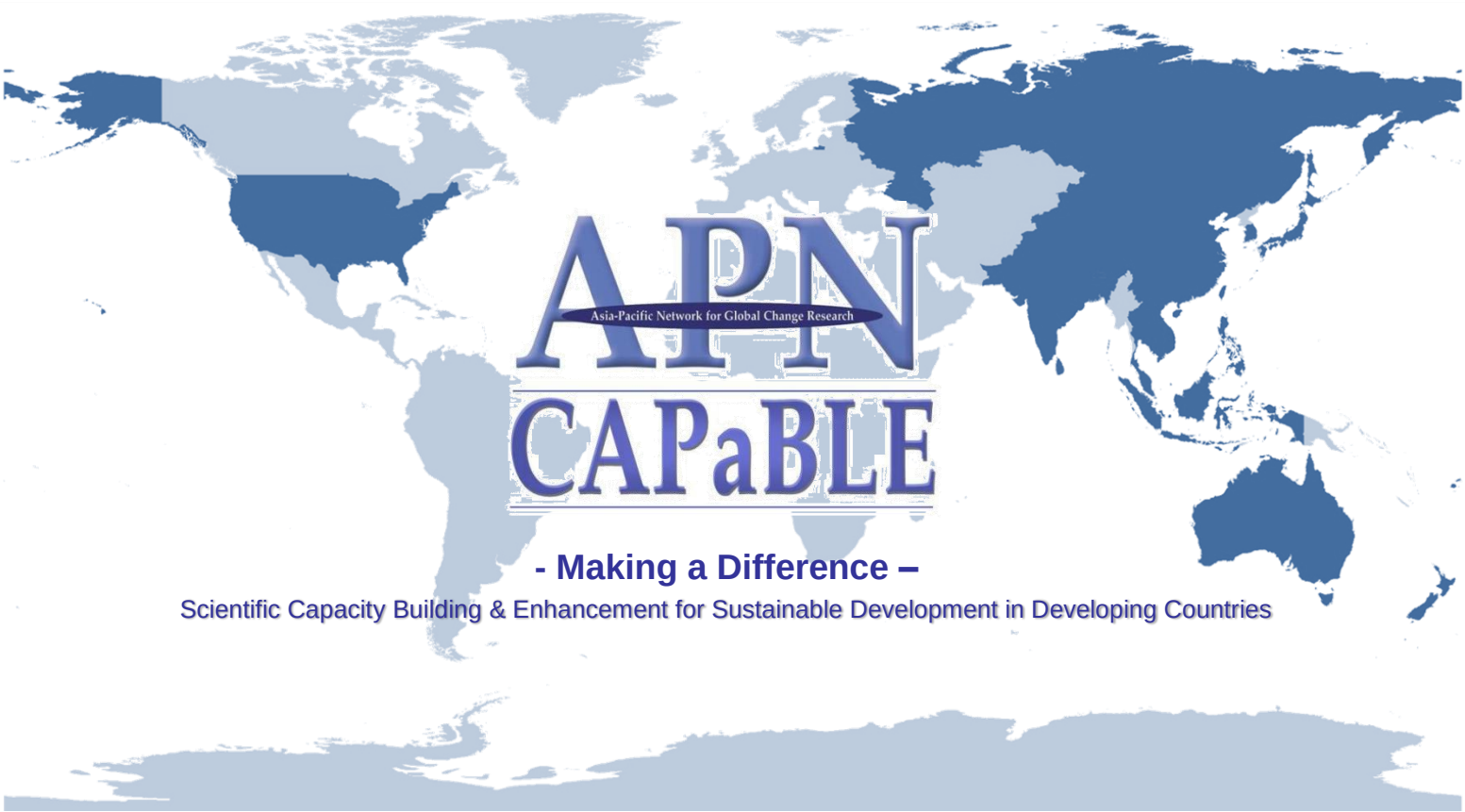
FINAL REPORT for APN PROJECT

Project Reference Number: CRP2011-01CMY-Pereira

Strengthening capacity for policy research on mainstreaming adaptation to climate change in agriculture and water sectors



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Final Report submitted to APN

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OVERVIEW OF PROJECT WORK AND OUTCOMES

Minimum 2 pages (maximum 4 pages)

Non-technical summary

The Project was initiated in August 2009 strengthen research capacity on mainstreaming climate change adaptation concerns into agricultural and water policies and foster networking for adaptation policy research in Asia. Research activities were carried out collaboratively by four institutes from India, Japan, Malaysia and Vietnam, and had later been expanded to involve researchers from Cambodia, Indonesia and the Philippines. The technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels were assessed and approaches for addressing the barriers were identified. The priority issues in developing indicators to monitor mainstreaming of adaptation measures were identified and country-specific menu of indicators to track effectiveness of such measures were developed. Case studies were conducted in evaluating effectiveness and to identify characteristics of selected policies that will enhance adaptive capacity. The Project played a catalytic role in exchange of information between policy makers and researchers. Linkages have been established with several of the active networks and institutions that have on-going work on climate change adaptation at the regional level. Multiple channels were established for disseminating research findings, including a Project website, leaflet, dialogues and workshops, and publishing in two special issue of a peer-reviewed academic journal.

Keywords

Climate change adaptation, mainstreaming, adaptive capacity, indicators, networking.

Objectives

The main objectives of the project were:

1. To assess technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels and propose countermeasures;
2. To develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations;
3. To identify characteristics of selected policies that will enhance adaptive capacity;
4. To create a ARPNAP network linking adaptation research and policymakers in Asia; and
5. To disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

Amount received and number years supported

The Grant awarded to this project was:
US$ 70,000 for Year 1
US$ 70,000 for Year 2
US$ 70,000 for Year 3

Activity undertaken

This study is based on literature review, questionnaire surveys, consultation workshop, and interviews conducted with stakeholders at various government agencies, academic and research institutes, and extension agencies. Reviewed literatures include the reports and documents published by the national/local governments and research institutes, peer reviewed journals, academic remarks, and other technical books. Information from both primary and secondary sources was collected and evaluated through multi-criteria analysis methods, including the analytical hierarchy process (AHP). Several workshops were also organized to consult further opinions from stakeholders while to disseminate results attained through the project activities. A Project website (http://www.ukm.my/apn) and leaflet was prepared for dissemination of project information.

The Project held a total of six meetings. Four meetings were held in Malaysia and one each in Bangkok, Thailand and Incheon, Republic of Korea, respectively. The meetings were mainly carried out in conjunction with other events that UKM jointly organised. Therefore it provided opportunities for Project Partners to share respective research findings with stakeholders, who are essentially policy-makers and researchers in the region.

Results

The Project accomplished its aims in strengthening research capacity on mainstreaming climate change adaptation concerns into agricultural and water policies and networking for adaptation policy research in Asia. The technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels were assessed and approaches for addressing the barriers were identified. The assessment reveals the need for capacity building of local stakeholders for science-based adaptation as well as to improve the communication and coordination between different administrative levels so that lessons learned at the local level could be shared effectively.

The priority issues in developing indicators to monitor mainstreaming of adaptation measures were identified and country-specific menu of indicators to track effectiveness of such measures were developed. The indicators are essential for prioritising adaptation, but the purpose and context must be established and communicated to stakeholder clearly. It is also necessary to maintain flexibility enough to accommodate changes as experiences accumulate.

Case studies were conducted in evaluating effectiveness and to identify characteristics of selected policies that will enhance adaptive capacity. It is evident from the case studies that mere ability to respond to policy imperatives is not sufficient for a policy to be effective. It is also critical to base assumptions on which the policies were introduced and how clearly the threat has been perceived by the stakeholders engaged in the policy process.

The Project played a catalytic role in exchange of information between and among policy makers and researchers. Linkages have been established with several of the active networks and institutions that have on-going work on climate adaptation at the regional level. The APN Project Partners, as a cohesive unit, had used the networks as entry points to disseminate the project findings.

The Project established multiple channels in engaging stakeholders and for disseminating research findings. A Project website has been established and a leaflet was prepared for dissemination of information about the Project. The Project conducted dialogues, either by itself or in synergy with other networks, at regional, national and local levels. In addition to presentation in these sessions, the research findings were also peer-reviewed for publishing in academic journal. Among others, the study results were compiled in two Special Issues of the Asian Journal on Environment and Disaster Management in 2010 and 2012, respectively.

Relevance to the APN Goals, Science Agenda and to Policy Processes

The project used the latest scientific information on climate change impacts for assessing the technical, institutional and regulatory barriers to mainstream climate change considerations in developmental planning. The processes created or strengthened interface and ties between policy- and decision-making with science. The means of assessing the effectiveness of adaptation actions were identified. Such knowledge will help in prioritisation of adaptation investments and further help in facilitating successful implementation of local adaptation initiatives particularly in the developing countries.

The Project played a catalytic role in exchange of information between and among policy makers and researchers. Researchers of the Project team are key members in several active networks in the region and disseminated the Project findings to different groups of stakeholders. All institutions in the member countries had contributed considerable in-kind contributions indicating a strong ownership in the project. Though the project mainly involves India, Japan, Malaysia and Vietnam, the Project expanded its partnership, with funding from UKM, to include country participation from Cambodia, the Philippines and Indonesia.

Self evaluation

Achievement of the Project is as follows:

- Objective 1 (100%): The technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels were assessed and approaches for addressing the barriers were identified.
- Objective 2 (100%): The priority issues in developing indicators to monitor mainstreaming of adaptation measures were identified and country-specific menu of indicators to track effectiveness of such measures were developed.
- Objective 3 (100%): Case studies were conducted in evaluating effectiveness and to identify characteristics of selected policies that will enhance adaptive capacity.
- Objective 4 (100%): Linkages have been established with several of the active networks and institutions, which have ongoing work on climate change adaptation at the regional level, for collaboration of relevant activities and to disseminate the Project findings.
- Objective 5 (100%): A Project website (http://www.ukm.my/apn/) has been established and a leaflet was prepared for dissemination of information about the Project. In addition regional, national and local-level events, study results were published in two Special Issues of the Asian Journal on Environment and Disaster Management (AJEDM) in 2010 (Volume 2, Issue 4, on "Climate Change Adaptation: Perspectives in the Asia Pacific") and 2012 (Volume 4, Issue 3, on "Strengthening Regional Agenda on Climate Change Adaptation"), respectively.

Potential for further work

Several methodological frameworks and approaches have been developed and tested in specific cases by the respective Project Partners. While the study focus was on the water and agriculture sectors, the assessment on mainstreaming climate change adaptation can be extended to other inter-disciplinary research areas such as ecosystems based adaptation, climate smart agriculture and green growth and economy. The frameworks could be further comprehensively improved and used to effectively rank and compare adaptation measures across a broad spectrum and provide critical feedback for mainstreaming adaptation into relevant policy areas.

The Project generates results from bottom-up approaches that are useful for considering goals, nationally or sectorally, on climate change adaptation. Such adaptation goals may constitute an array of non-empirical aspirations for different sectors. Sector based goals and aspirations are critical for developing a meaningful roadmap at the national level. The potential impacts of climate change are area specific and essentially occurring at the local level. Many adaptation actions will, therefore, require specific spatial consideration and should take into account the different jurisdictions in the country's multi-level government structure.

Publications (please write the complete citation)

Alam, M.M., Chamhuri, S. & Al-Amin. 2010. Climate Change Adaptation Policy for Agricultural Livelihood in Malaysia. AJEDM 2(4): 463-470.

Nambi, A.A. & Prabhakar, S.V.R.K. 2010. Mainstreaming Adaptation to Climate Change in the Agriculture and Water Sectors in India: An Overview of the Challenges. AJEDM 2(4): 443-452.

Pereira, J.J. 2009. Strengthening capacity for policy research on mainstreaming adaptation to climate

change in agriculture and water sectors. APN Newsletter 15(4): 26. Japan: APN Secretariat.
Prabhakar, SVRK & Kyoto Matsumoto. 2010. Mainstreaming Climate Change Adaptation in the Asia Pacific: Current Status and Way Forward for the Agriculture and Water Sectors. AJEDM 2(4): 363-370.
Prabhakar, S.V.R.K. & Kobashi,T . 2010. Monitoring the Progress of Adaptation to Climate Change: The Use of Adaptation Metrics. AJEDM 2(4): 435-442.
Prabhakar, S.V.R.K. 2011/10. Climate Change Impacts in Japan and Southeast Asia: Implications for Crop Adaptation. In Crop Adaptation to Climate Change, edited by S. Yadav, B. Redden, J. L. Hatfield, H. Lotze-Campen and A. Hall. 30. USA. John Wiley.
Pulhin, J.M., Rose Jane J. Peras & Maricel A. Tapia. 2010. Climate Change Adaptation in Water and Agricultural Sectors in the Philippines. AJEDM 2(4): 471-484.
Reza, M.I.H. & Alatas, S.M. (2012). A Decision Support System to Deal with Contemporary Issues of Climate Change Induced Vulnerability and Human Security in Peninsular Malaysia. AJEDM 4(3).
Srinivasan, A. & Al-Amin, A.Q. 2010. Climate Change Adaptation: An Overview of Financing Mechanisms in the Agriculture and Water Sectors. AJEDM 2(4): 427-434.
Tan, C.T. & Pereira, J.J. 2010. Climate Change Adaptation: An Overview of Southeast Asia. AJEDM 2(4): 371-398.
Tan, C.T. & Pereira, J.J., Mazlin, M., Ibrahim, K. & Nadzri, Y. 2010. Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector in Malaysia. AJEDM 2(4): 453-462.
Tran, T., Nguyen Van Thang and Tran Dinh Trong. 2010. Climate Change Adaptation in the Agriculture and Water Sectors: An Overview of Vietnam. AJEDM 2(4): 485-494.
Tran, T., Nguyen Van Thang and Tran Dinh Trong. (2012). Climate Change Impacts and Adaptation on the Water Resources and Agriculture in Vietnam: Case Studies in Mekong and Red River Deltas. AJEDM 4(3).
Tran, T., Nguyen Van Thang and Tran Dinh Trong. (2012). Climate Disasters and Climate Change in Vietnam: Tendency, Strategic Tasks, and Action Plans. AJEDM 4(3).

References

APN Science Bulletin Issue 1 (CRP2010-02CMY-Pereira). Submitted to APN on 17 January 2011.
Interim Report for CAPaBLE Project (CRP2009-02NMY-Pereira). Submitted to APN on 7 January 2010.
Minutes of Meeting. First Project Meeting. 11 August 2009. Kuala Lumpur, Malaysia.
Minutes of Meeting. Second Project Meeting. 26 June 2010. Port Dickson, Malaysia.
Minutes of Meeting. Third Project Meeting. 16 November 2011. Putrajaya, Malaysia.
Minutes of Meeting. Fourth Project Meeting. 11 March 2012. Bangkok, Thailand.
Minutes of Meeting. Fifth Project Meeting. 6 November 2012. Bangi, Malaysia.
Progress Report for Year 1 (CRP2009-02NMY-Pereira). Submitted to APN on 11 February 2010.
Year 2 Progress Report for APN Project (CRP2010-02CMY-Pereira). Submitted to APN on 1 February 2011.

Acknowledgments

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4. Kyoto University
5. Asia Pacific Adaptation Network (APAN)
6. Orbicom – Network of UNESCO Chairs in Communication
7. University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR)
8. Nanyang Technology University

TECHNICAL REPORT

Minimum 15-20 pages (excluding appendix)

Preface (Limit to 100 words)

"Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors" was initiated in August 2009 by four research institutions in Asia to strengthen research capacity on mainstreaming climate change adaptation concerns into agricultural and water policies and networking for adaptation policy research in Asia. The research project contributed to the development of a sound scientific base for decision- and policy-making related to climate change adaptation in the region. It also established and engaged in multiple platforms to enhance policy-science interface and disseminate research findings, build capacity, and strengthen network for adaptation policy research.

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1. Introduction

Adaptation to climate change is a critical issue in the Asia Pacific. Academic and policy attention are increasing sharply as a result of the growing evidence on unavoidable impacts in the region. The Asia Pacific region is one of the most vulnerable regions to climatic hazards globally (Prabhakar & Matsumoto, 2010). Most, if not all, countries already are experiencing stresses from climate-related events and phenomena. The situation could be exacerbated by future climate change, which would lead to an increase in frequency and intensity of extreme events. Vulnerability to climatic hazards is expected to increase, especially in island states and countries with long coastlines and low-lying areas. The key vulnerable concerns encompass agriculture and food security, water resources, coastal zones and marine ecosystems, terrestrial ecosystems, human health, settlements, fisheries, and others (Tan & Pereira, 2010).

Already initiatives have been carried out and planned in the regions, especially within national boundaries, to either reduce vulnerability or cope and adapt to future climatic hazards. However, there are several factors affecting adaptation in the regions, particularly the developing countries. As summarised in Tan & Pereira (2010), these constraints are wide-ranging and may differ in specific to country circumstances, encompassing methodological issues, biophysical limitations, socio-economic factors, technological barriers, and institutional and technical aspects. More efforts are required to drive further responses, covering such aspects as vulnerability and adaptation assessments; methodology and approaches for modelling and data gathering; building of human and institutional capacity; financial and technical support; education, training and public awareness; and networking and information. Furthermore, there are no efforts in the published literature that takes the stock of the ongoing efforts and analyse strengths and weaknesses of the same in the light of climate change adaptation (Prabhakar & Matsumoto, 2010).

Analysis of policies in select countries revealed that important decisions in the agriculture and water sectors, including reservoir construction and canal design, are often implemented without consideration of projected impacts of climate change (IGES, 2007). One of the most important barriers identified was the limited capacity of researchers in the region to provide adaptation policy-relevant information (Srinivasan, 2006). For example, research on indicators for monitoring the effectiveness of adaptation options at different spatial scales is completely lacking. Networking and communication among researchers and policymakers focusing on adaptation is also extremely limited. The proposed activity addresses these barriers and enhances capacity to bridge gaps in adaptation research, policy and implementation.

"Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors" was initiated in August 2009 by four research institutions in Asia to strengthen research capacity on mainstreaming climate change adaptation concerns into agricultural and water policies and networking for adaptation policy research in Asia. Key objectives of the Project are as follows:

- To assess technical, institutional and regulatory barriers to integrate climate change adaptation concerns at both policy and operational levels and propose countermeasures;
- To develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations;
- To identify characteristics of selected policies that will enhance adaptive capacity, and examine how such policies can adapt to a range of conditions;
- To create ARPNAP network linking adaptation research and policy makers in Asia; and
- To disseminate project findings to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

1.1 Understanding Mainstreaming

Several definitions exist to explain the concept of mainstreaming. Some of them are given below:

- "Integration of policies and measures that address climate change into developmental planning and sectoral decision making"—Klein, 2006, p. 4.
- ". . . information, policies and measures addressing climate change are streamed into ongoing, general development planning and decision making"—Huq and Ayers, 2008, p. 1.
- ". . . encompassing the process(es) by which environmental considerations are brought to the attention of organisations and individuals involved in decision-making . . . – IIED, 2008, p. 1.
- ". . .mainstreaming refers to the integration of environmental considerations into core institutional thinking and decision-making—UNDP, 2004, p. 9.
- ". . . a process to fully incorporate disaster risk reduction into relief and development policy and practice—Tearfund, 2005, p. 16.

A glimpse at the above definitions of mainstreaming, derived from climate change, environment, and disaster risk reduction literature, indicate that the mainstreaming is integrating some consideration (climate change or environmental management or disaster risk reduction) into institutional or sectoral or policy processes such that the aspect integrated becomes part of the operations of the entity it is integrated into. Hence, in this paper, mainstreaming climate change considerations in agriculture and water sectors means that the developmental plans and programs in these sectors are aware about the imminent risks of climate change and that suitable countermeasures are planned.

1.2 Current Status and Challenges of Mainstreaming Adaptation in Asia-Pacific

A review of current adaptation initiatives in agriculture and water sectors in Asia-Pacific region indicate that many countries have number of initiatives to deal with the climate change related challenges (Table 1.1). Vulnerability assessment is the first and foremost important step before planning any kind of adaptation initiatives. Some of the countries have already initiated vulnerability assessments with respect to the climate change. These vulnerability assessments consisted of identifying and analysing the impact of climate change and variability on natural eco-systems, socio-economic systems, and human health. Some assessments also considered the institutional and financial capacities of the local communities, assessing the spontaneous and planned adaptation measures already taken up, and developing technical, institutional and financial strategies to reduce vulnerabilities. The adaptation initiatives in agriculture sector can be grouped into five broad categories listed below.

- Development of crop varieties that are tolerant to perceived threats that includes droughts, pests and diseases (Australia, India, Indonesia, Malaysia, Vietnam).
- Expanding area under irrigation and efforts for better water management including watershed management practices (Australia, Bangladesh, China, India, Indonesia, Malaysia, Russia, Vietnam).
- Improving weather forecasts and linking with farm decision making (Australia and India).
- Drought monitoring systems are being put in place though do not completely cover the entire country or are in inception stage (China, India, Vietnam, Australia).
- Investment in rural infrastructure that promotes access to markets that in turn enhances the resilience of rural communities which is more relevant for the developing countries in the region (India, China, Sri Lanka).

In addition to the above sectoral approach to vulnerability reduction, countries in the region have also approached the problem through land and rural development, recognising the fact that the natural resource governance related issues, such as absence of land tenure, would put rural poor to

reduced access to natural resources (as in the case of China) resulting in high vulnerability. These initiatives are largely development driven initiatives with adaptation as a co-benefit. Some of the significant initiatives targeting land and rural development are listed in Table 1.2.

Table 1.1: List of significant initiatives to deal with water scarcity in some Asia-Pacific countries.

Country	**Initiatives**
Bangladesh	▪ National level comprehensive disaster management initiative that encompasses drought as a theme which in turn brings together various stakeholders. ▪ Promotion of groundwater use in Barind region. ▪ Development of appropriate land and crop management practices to reduce the drought risk.
China	▪ Drought monitoring using ground based observatories and remote sensing ▪ Drought risk zoning classification in place ▪ Massive plantations being planned and implemented to stabilize the desertification process
India	▪ National crop weather watch group that monitors drought during monsoon season ▪ Integrated watershed development projects being taken up in drought prone areas ▪ Desert development program (DDP) has been implemented in areas prone to desertification
Indonesia	▪ Integrated water resource management in Citarum river basin, climate field ▪ schools, SRI
Vietnam	▪ Laws and decrees exist that provides for drought and water management ▪ Peoples participation in water resource management ▪ Development of water resource monitoring network ▪ International cooperation in water resource management ▪ Establishment of Mekong River Commission

Source: Prabhakar, 2007

Table 1.2: Land and rural development initiatives that have adaptation as a co-benefit in selected Asian countries.

Country	**Land and rural development initiatives**
Bangladesh	▪ Livestock enterprise development ▪ Microfinance through self help groups
China	▪ Legal changes that would give farmers long-term security on the land (to provide tenure security)
India	▪ Secure drinking water supply ▪ Wage employment, employment assurance, food for work, rural housing, social security programs, land reforms etc ▪ Watershed development programs such as Drought Prone Areas Program (DPAP) and Desert Development Program (DDP)
Indonesia	▪ Food security enhancement program
Vietnam	▪ Agricultural diversification ▪ Strengthening the agriculture extension programs ▪ Ongoing efforts to improve access to rural water supply and sanitation

Source: Prabhakar, 2007.

A meta analysis of adaptation initiatives by World Resources Institute (WRI) suggest that the mainstreaming adaptation in development can happen in three stages i.e. serendipitous adaptation (where adaptation is an accidental rather than designed outcome of development), climate proofing of development (where adaptation is a planned intervention however the main focus is on development) and discrete adaptation (where adaptation is the sole intended outcome of the intervention) (McGray et al., 2007). On this scale, the current level of adaptation in agriculture and water sectors in the Asia-Pacific region can best be placed between serendipitous adaptation and climate-proofing of development since there are very few adaptation only initiatives taken up so far.

The current approach to adaptation decision making and mainstreaming faces several challenges. One of the major challenges is that most of the above listed initiatives are based on the experiences and observations of the past climate. This approach seems to assume that general developmental programs would suffice to take care of climate change, as inferred from the developmental programs listed in many national communications under adaptation initiatives. These initiatives also do not provide information on how much risk and vulnerabilities they intend to reduce during the course of their implementation, making it difficult to answer the question of 'what more need to be done'. This could be due to lack of comprehensive quantification of vulnerabilities and risks and partly the absence of reliable projected climate change impacts. In some cases, the adaptation initiatives could in fact increase the vulnerabilities of the local communities (what is called mal-adaptation) (e.g. as in the case of Bangladesh, promoting ground water use in Barind region without putting in place appropriate legal framework to limit over exploitation and introducing ground water recharging schemes could further enhance the local vulnerabilities).

1.3 Assessment of Adaptive Capacity

As a critical factor in determining the impacts of climate change, adaptive capacity is the potential or ability of a system in moderating the potential damages, taking advantage of the prospective opportunities or coping with the probable consequences (Smit and Pilifosova, 2001; IPCC, 2001; IPCC, 2007c; Vincent, 2007). This definition mainly aims to address the end-point vulnerability, where adaptations are designed or carried out in the face of future climate change and the vulnerability in biophysical factors (Liverman, 2001; Brooks, 2003; O'Brien et al. 2004). This is also consistent with the characteristics of the first generation adaptation research as reviewed in Burton et al (2002). However, considering adaptive capacity as an end point is fraught with uncertainties (O'Brien et al., 2004; Adger and Vincent, 2005; Vincent, 2007). Such uncertainties may originate from external factors, including climate scenarios, climatic effects on sectors, and future socio-economic conditions, or internal drivers of whether the adaptive capacity assets will be drawn upon in time of need as per the projections (Mitchell and Hulme, 1999; O'Brien et al., 2004; Vincent, 2007). As climate change may alter in a different way than expected over time, the predefined adaptation measures, technological ones in particular, may become inappropriate. Furthermore, with the social and economic factors, in addition to the biophysical factors, being increasingly included in the adaptation assessment (Tol and Fankhauser, 1998; Sygna et al., 2004), enhancing the adaptive capacity of the present systems' ability to deal with and respond to stressors as well as to secure livelihood is gaining greater attention (Burton et al., 2002; O'Brien et al., 2004a). Such approach, sometimes known to as starting-point approach, assesses the way the conditions or risks due to current and past exposures and sensitivities are dealt with, including the factors and processes that facilitate or constrain the choices (Smit and Wandel, 2006). Besides being a practical means of coping with changes and uncertainties in climate (Smit and Pilifosova, 2001), this approach also promotes sustainable development (Goklany, 1995; Burton, 1997; Munasinghe, 2000; Smit et al., 2000) and facilitates cheaper adaptation strategies that target the poor and vulnerable groups more effectively than many larger scale, technological or infrastructural adaptation measures (Orindi and Eriksen, 2005).

The capacity to adapt varies from the level of the country down to the individual (Sygna et al., 2004; Brooks et al., 2005; Vincent, 2007). Globally some assessments of country-level adaptive capacity have been undertaken with the view to assisting international decision-making around investments in adaptations under the United Nations Framework Convention on Climate Change (UNFCCC) mechanisms (Moss et al., 2000; Haddad, 2005; Brooks et al., 2005). At the national level, assessing the adaptive capacity of different systems and groups allows greater comprehension of their vulnerability, including the processes that trigger and aggravate it, so that the decision making is grounded on knowledge and information in such a way that the available resources are mobilised to target the most vulnerable areas and groups of people effectively. Adaptive capacity is influenced by a number of factors, including economic wealth; technology; access to resources; institutional capacities and decision-making process; human and social capitals; accessibility to risk spreading processes; the public's perceived attribution of the source of stress; and others (Yohe and Tol, 2002; Brien et al., 2004; Brooks et al., 2005; Haddad, 2005; Pelling and High, 2005).

The management of water resources are influenced by hydrological cycle and water use. As one of the many pressures on freshwater systems, anthropogenic climate change affects freshwater quantity and quality (e.g., water availability as well as floods and droughts) as well as impacts the use of water. Significant changes in water use or the hydrological cycle (affecting water supply and floods) require adaptation in the management of water resources (Kundzewicz et al., 2007). If not properly addressed, the implications of climate change on water, including drought-related stresses, flood events, water quality problems, and growing water demands, could impact across many sectors of the economy, society and the environment (Arnell et al., 2001).

Adaptation options in the water sector include supply-side management through increase of capacity (e.g., building reservoirs or structural flood defenses), changing in operating rules for existing structures and systems; and demand-side management by managing demand and changing institutional practices (Arnell et al., 2001). While changing to meet altered conditions and new ways of managing water are autonomous adaptations which are not deliberately designed to adjust with climate change, there are also planned adaptations that take climate change specifically into account to evaluate risks and response options (Kundzewicz et al., 2007). Arnell et al. (2001) reviewed a range of institutional, technological, regulatory, cultural, financial and governance factors affecting the adaptive capacity of water sector to climate change.

1.4 National Circumstances

1.4.1 India

Both agriculture and water sectors are negatively affected by the impacts of climate change, particularly in the developing nation like India. Further, the frequency and intensity of extreme events like cyclones, floods and drought are already increased in the last half of the 20th century, and likely to rise in the foreseeable future. The households in India, particularly those depending on agriculture for their basic livelihoods, are at high due to a wide range of impacts of the climate change. Adaptation options are crucial for them to deal with the unmitigated climatic impacts. It is also observed that vulnerable farmers in India are taking up a various adaptation measures to withstand against past events that occurred due to climate change; however, the extent of management differs both spatially and temporally. A better understanding of current adaptation mechanisms, i.e. both at farm and policy-level, assists for successful implementation of adaptation options for farming communities in India. In this context, the present study has two specific objectives: 1) assess effectiveness of specific farm level adaptation options through developing adaptation metrics, and 2) identify options and barriers of implementing specific farm level

adaptation strategies at both agriculture and water sectors. For empirical assessment, the state of Tamil Nadu is selected as the case study.

Tamil Nadu, a southernmost state of India, is situated along the coast with the Indian Ocean in the south and the Bay of Bengal on the east; it covers a coastal length of around 1076 km which is the second largest sea coast of India. It lies between 8°5'-13°35'N latitude and 76o15'-80o20'E longitude, and encompasses an area of 1.3 lakh km2 (Government of Tamil Nadu, hereafter GoTN, 2011); it is the eleventh largest State in India by area. It has a sub-temperate to temperate climate, with temperature ranges from 22°C to 36°C and normal rainfall of 911.6 mm (GoTN, 2011). Traditionally, Tamil Nadu is divided into five physiographic divisions, e.g. mountainous area, forest, arid zone, fertile region and coastal area (GoTN, 2003). Since agriculture is the predominant form of economic activity in Tamil Nadu (e.g. 49.22 percent of total labour force depended on agriculture as of 2001 census), the climate change affect livelihoods of the majority of households. Further, agriculture is the largest consumer of water resources in Tamil Nadu (e.g. 75 percent: Palanisami et al., 2011). Thus, the variability of water supply under the given climate change scenarios (see Mall et al., 2006) has largely influenced the agriculture sector.

1.4.2 Japan

Japan being a developed country and the signatory of UNFCCC Kyoto Protocol, it has obligation of reducing greenhouse gas emissions by 6% compared to the base year of 1990. In addition to this emphasis, there is an apparent understanding within Japan that Japan's perceived threat from climate change in agriculture and allied sectors could be easily managed (IGES, 2011). To this extent, several research programs have already been taken up within Japan to understand climate change impacts and to implement actions on the ground. These actions are dispersed across different ministries disguised under different names without being named as 'climate change adaptation'. This gives an impression that Japan is yet to travel a long distance to design and implement a clear climate change adaptation policy in terms of being clearly stated in its relevant national and provincial policy documents.

It has been widely regarded that policies and institutions that are adaptive in nature are better able to deal with the dynamic issues such as environmental degradation and climate change adaptation. However, verifying the veracity of this hypothesis is difficult often due to absence of long experience in climate change adaptation in most countries in general and with developed countries in particular. Hence, it is necessary to reviews how various agriculture related policies have evolved over the years along with the evolving issues that they are designed to address and tries to answer questions such as how adaptive policies and institutions in Japan are, how adaptive policies and institutions relate to the effectiveness of policies and problem solving, and what are the political, institutional, economic and social enabling factors that may lead to effective policies.

1.4.3 Malaysia

Several studies had been undertaken in Malaysia in the last two decades with the main focus on the potential impacts of climate change and the adaptation strategies. Despite the uncertainties of the timing and magnitude of climate change impacts, these studies were either driven by the belief that developing country like Malaysia would be hit greater by the change in climate or in response to the commitment under the UNFCCC. Two such national studies were carried out in the 1990s' to address the potential climate change impacts on several key resource and economic sectors, including water and agriculture sectors. The studies are the Climate Change in Asia: Malaysia Country Report in 1994 (ADB, 1994) and the Malaysia Initial National Communication (INC) that was submitted to the UNFCCC in 2000 (MOSTE, 2000). Both were undertaken through multilateral funding supports. The former one was initiated in 1992 while the latter was carried out in the second half of the 1990s'. They are the earliest national level assessment that took place during the decade, with the main

focus on the impacts of and adaptation to climate change, and covered more than merely one particular sector.

Both studies adopted the impact assessment approach that evaluates the potential effects of the projected climate change scenarios on the water sector. The climatic stimuli were developed based on the assumed 2xCO2 case, before being applied on the sector for evaluating its exposure and sensitivity in the assessments of the vulnerability to the potential impacts (Fussel and Klein, 2006). Limited (if not none at all) consideration, however, was given on the sector's adaptive capacity with regard to its current or future ability to cope with future climate change. The inadequacy in such detailed analysis may be attributable to the projected future scenarios of climate change that remain greatly uncertain as well as the assessment of adaptive capacity only emerged as a critical focus of attention as observed in the IPCC Third Assessment Report (Ahmad et al., 2001).

Due to high greenhouse gas emissions, the temperature is projected to rise by 0.3◦C to 4.5◦C in Malaysia. Warmer temperature will cause to a rise in sea level about 95cm over hundred-year period. The changes in rainfall may fluctuate from about −30% to +30%. This change will reduce crop yield and prone to drought in many areas so that cultivation of some crops such as rubber, oil palm and cocoa will not possible (NRS, 2001). NRS (2001) projection shows more than 0.4% changes of rainfall by 2020 and 1% by 2060 will cause to decline the earning of farmers under a certain level of temperature. Moreover, NAHRIM (2006) projection shows maximum monthly precipitation will increases up to 51% over Pahang, Kelantan and Terengganu, while minimum precipitation decrease between 32%to 61%for all over Peninsular Malaysia. At the same time, annual rainfall will increase up to 10% in Kelantan, Terengganu, Pahang and North West Coast, and decrease up to 5% in Selangor and Johor by 2050. This variation of climate factors will cause the agricultural system vulnerable in Malaysia. As poor people are mostly engaged in agricultural activities, the poverty rate will increase more in the agriculture sector based on the projected variation of rainfall and temperature. Moreover, climate change will likely to exacerbate inequalities due to the uneven distribution of the burden of damage, and remedy actions. Under these circumstances, adaptation policy is very crucial for the agricultural sustainability as well as the livelihood sustainability in Malaysia.

The adaptation options considered for the water sectors are mainly related to supply-side management (Tan et al., 2010). Moreover, the INC emphasises water resource management development programmes that advocate supply management over the demand management approach. Besides the typical engineering or structural measures, there are also planning, institutional, regulatory and behavioural responses being recommended. The measures generally target physical or natural factors, except those awareness and education, and regulatory and institutional approaches that focus more on human system. Although the suggested responses may not be driven directly towards enhancing adaptive capacity, they would, if implemented, improve the ability to either moderate the potential damages or cope with the probable consequences of the projected change in future climate.

1.4.4 Vietnam

Vietnam's climate, complex topography and long coastline make the country particularly vulnerable to natural disasters (ADB, 2009).Most analysis and scenarios (ADB, 2009; MONRE, 2008; MONRE, 2009; UNEP and Danida, 2005) suggest that climate change will exacerbate vulnerability, particularly in coastal regions and influence most economic sectors, regions, and communities in Vietnam. The ongoing research by the authors suggest a number of barriers to implementing climate change adaptation exits, including (a) uncertainty in the climate change scenarios; (b) weak planning, institutional set-up and coordination for responding to challenges of climate change; (c) limited awareness and poor data to support planning and implementation; and (d) weak capacity to

undertake climate change impact analysis and identification of cost effective adaptation measures.

2. Methodology

This study is based on literature review, consultation workshop, and interviews conducted with personnel at national and local level government agencies, research institutes, academic, NGOs and extension agencies. Reviewed literatures include the reports and documents published by the national/local governments and research institutes, peer reviewed journals, academic remarks, and other technical books.

2.1 Identifying Barriers to Climate Change Adaptation

2.1.1 National level assessment

At the national level, assessment for all countries were conducted mainly based on review of national documents, particularly those official reports prepared for the United Nations agencies. Preliminary results were presented at national and regional workshops for solicitation of inputs and later reviewed through peer-review exercises in preparing for journal publication.

2.1.2 Local level assessment

A survey was conducted in January to March 2011 for analysing farm-level adaptation measures in India. The focus was to understand the adaptation measures adopted by farmers and to determine the constraints and barriers in practicing them. Seven prominent adaptation measures that are most commonly practiced among the farmers were selected, including micro-irrigation, rainwater harvesting, resistant crop, use of bio-fertilisers, crop insurance, income diversification and community based efforts. A purposive sampling method was followed to select 146 farmers in the selected five districts of Tamil Nadu. The barriers of these adaptation measures were evaluated through the analytical hierarchy process (AHP) using four criteria: effective awareness (i.e. farmers have information that given adaptation mechanisms are reducing level of vulnerability), economically viable (i.e. ease in accessing finance), individual and institutional compatibility (i.e. nature of complexity and compatibility with existing institutions, farm and household specific characteristics), and flexibility and independent benefits (i.e. actions that generate benefits independent of climate change: no-regret adaptation) (Dolan et al., 2001) (see Table 2.1). The order of priority for the criteria was established as effective awareness followed by economically viability, individual and institutional compatibility, and flexibility and independent benefits. This study developed a permutation of how these criteria can be satisfied. Every adaptation measure is graded by which and how many criteria it satisfies. Each of these rows represents a possibility, and in any consideration, satisfying the criterion (√) is obviously given a higher score than not satisfying that same criterion (X). Row 1 satisfies all the criteria, and so that is given the highest score, i.e. 10. The scores are assigned based on an arrangement reflecting the order of priority.

This assessment followed four steps to evaluate score for each adaptation measure. First, each respondent was given a score based on how, according to him/ her, the measure satisfies the above criteria. For example, in case of improved irrigation systems, if respondent 1 reports that all four criteria satisfied for him, then the measure is allotted a score of 10 against that respondent which reflects that he/she is fully satisfied with all the chosen criteria. In a similar fashion scores were allotted for each respondent based on the AHP table. Secondly, the sum of individual scores of respondents for that particular measure was calculated as the actual sum. Thirdly, it is assumed that in an ideal case where all criteria satisfy for all the respondents, the ideal sum would be [10 X Total numbers of respondents]. Finally, the effectiveness score for each adaptation option was calculated as the ratio of actual sum and ideal sum.

Table 2.1: AHP score for adaptation measures

Row No.	Criteria for Evaluating Adaptation Measures				Score
	Effective awareness	Economically viable	Individual & institutional compatibility	Flexibility & independent benefits	
1	√	√	√	√	10
2	√	√	√	X	9
3	√	√	X	√	8
4	√	√	X	X	7
5	√	X	√	√	6
6	√	X	√	X	5
7	√	X	X	√	4
8	√	Effective awareness and also implemented			3
9	√	Effective awareness but not implemented			2
10	X	Not effectiveness			1

Apart from the farmer level assessment the study also attempted to look at specific policy-level influence on adaptation measures. In doing so, a variety of policy measures were looked at and assigned priorities. Agricultural insurance and micro-irrigation are two measures which are found to be wide spread and made good headway. Hence, information pertaining to these two measures were gathered and analyzed.

In Japan, interviews were conducted in two case study locations, i.e. Niigata and Miyazaki prefectures (Figure 2.1) in 2010. These locations were selected based on the publications and announcements of the MAFF and MOE of Japan. Presence of climate change adaptation relevant initiatives in agriculture sector was the criteria. Interviews were conducted with the Agricultural Production Section and Research Management Office of Niigata Prefectural Government, the Niigata Agricultural Research Institute, Global Warming Research Centre for Agriculture and Fishery of Miyazaki, Prefecture Agricultural Experiment Station and the Miyazaki Prefecture Central Agricultural Development and Extension Centre.

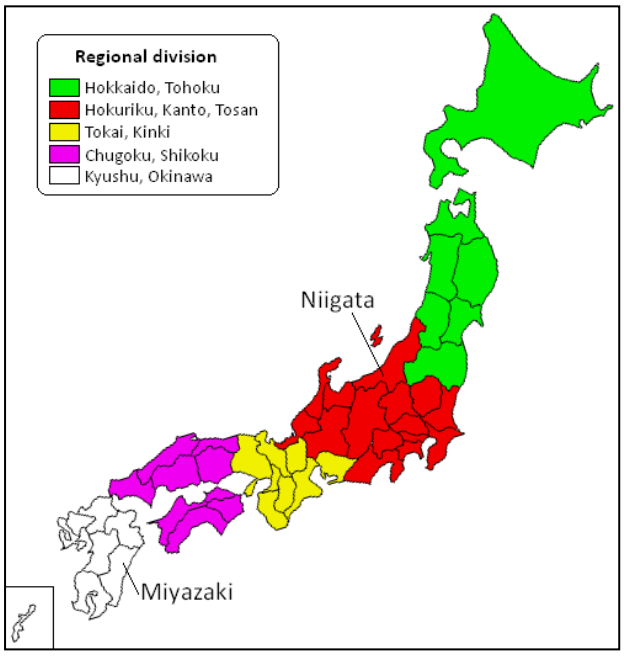

Figure 2.1: Location of Niigata and Miyazaki (Source: developed from Aoki, 2006)

2.2 Measuring Progress in Mainstreaming Climate Change Adaptation

Measuring progress in mainstreaming climate change adaptation into institutional processes was carried out using two frameworks. These include a modified Tearfund Framework and adaptive capacity assessment framework. Both frameworks were tested at the local level.

2.2.1 Modified Tearfund Framework

A questionnaire survey designed based on modified Tearfund Framework. The Framework (Figure 2.2) was initially developed to measure the progress in mainstreaming disaster risk reduction into institutional processes. It was modified for characterising climate change adaptation in terms of institutional processes and reflecting the same into the framework.

In Japan, the survey was conducted along with a consultation workshop in Tokyo. Based on the modified framework, a questionnaire was developed and distributed to several governmental agencies involved in climate change adaptation in Japan (Appendix 6). The questionnaire results were tabulated and analysed for trends and reasons.

	Level I	Level II	Level III	Level IV
	No capacity/recognition	Recognizes, has resources	Plans and tools available	Tools used, CB programs, inst. links
Policies & Strategies				
Geographical planning				
Project cycle management				
External relations				
Institutional capacity				

Poor mainstreaming ⟷ **Full mainstreaming**

Figure 2.2: Tearfund Framework for measuring the mainstreaming of disaster risk reduction into institutional processes.

2.2.2 Adaptive capacity assessment framework

The assessment framework for analysing the adaptive capacity of water institutions to climate change was developed by iteratively performing the following two steps: literature review and peer-review by experts during different project meetings. First, the existing literature on water related issues that are linked to adaptive capacity were reviewed. This is to identify the most important criteria for assessing institutions. Second, similar criteria were categorised to ensure distinction among each and not overlapping. Then, the results attained were presented and discussed during project meetings. Accordingly the criteria and indicators were modified based on the expert input, complemented by further review of relevant literature. The review of the literature indicates that a number of the proposed elements of adaptive capacity could be categorised together under six criteria. Each of the criteria comprises two indicators.

2.3 Assessing Characteristics of Adaptive Policies

Adaptive policy is defined as those policies that have changed with changing circumstances/triggers/ problems that these policies are developed to address (Prabhakar et al., 2011). Using this definition, the adaptive policies and actions were identified through a three step process. The first step identifies an issue that has long history of presence and gone through considerable policy intervention. The second step enlists policies introduced to address the issue over the year. The third step assesses how the policies changed over the years in response to changing stimuli and judges state of the issue along the course. The three-step approach can be performed through the literature review, expert consultations and questionnaire survey.

The case study was conducted in Japan in two important sectors relevant for climate change adaptation i.e. agriculture and disaster risk management (Figure 2.3). Comparison was done on how different agencies respond to perceived threat through interventions that can either be specific policies (as in case of agriculture sector) or specific amendments in a response plan (as in case of disaster risk management). The published literature and tracked specific changes in policies and processes in response to identified stimulus were gleaned through. After prioritisation, the policies were assessed on effectiveness in achieving set objective to compare if the policy that has undergone continuous change evolves as an effective policy in achieving its objective.

In agriculture sector, the changes in land use and agriculture labor have been identified as important and persistent issues in Japan. In disaster risk management, we identified the case of typhoon that hit the Shikoku region of Japan in 2004 for identifying possible changes introduced soon after the typhoon. We have chosen the Saijo city for the reason that it was severely affected by Typhoon 21 and 23 which made landfall on Shikoku region during 29-30th September 2004. The Saijo city is located in the north of Ehime Prefecture in Japan. Ehime Prefecture is on the Shikoku Island of Japan, located on the side of the Pacific Ocean. The new Saijo city was formed by merging Saijo, Toyo city, Tanbara town and Komatsu town from Shuso County in 2004. The population in Saijo city has declined from the year 2000 while the population continued to grow in other cities. Saijo city also has more percentage of people with age 65 and above with relatively more number of single-person households.

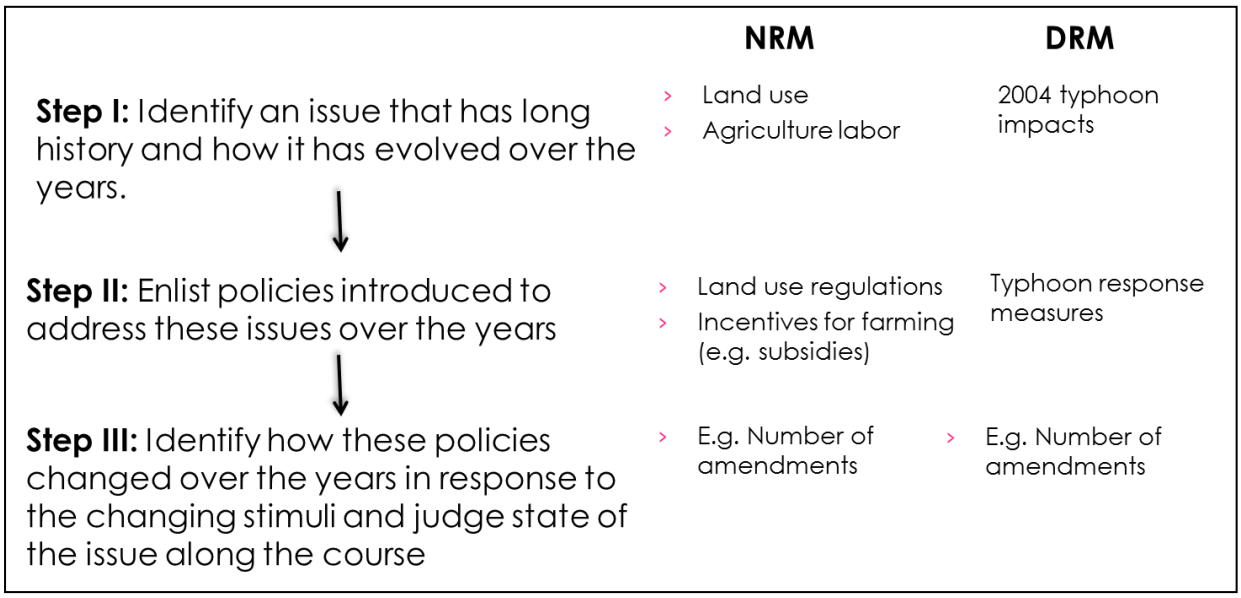

Figure 2.3: Process for identifying adaptive policies and actions in two cases in Japan

A consultation meeting was conducted on 28 June 2011 in Tokyo, Japan. The meeting was aimed to understand how dynamic policies and institutions are in Japan in formulating and implementing policies. The participants included various stakeholders involve in policy research and government in agriculture and allied sectors. The issued deliberated covered the policy environment in agriculture and allied sectors in Japan, how dynamic it is, and reasons behind the effectiveness of policies. The specific subjects discussed were historical analysis of agricultural policies in Japan, declining number of farmers in Japan and evolution of related policies, historical analysis of interventions to deal with floods and droughts in Japan, and fiscal policy support in Japan.

For answering the overarching question of how adaptive policies are in Japan, a sub-set of questions were addressed (Appendix 6). These questions include the following:

- When the policies were introduced to address the perceived problem?
- How frequently the policies were amended to address changing circumstances?
- How effective are the policies introduced?
- How the effectiveness is related to when and how frequently policies were introduced?

2.4 Creating an Adaptation Research and Policy Network in the Region

A network focusing on needs for adaptation research and policy in the Asia Pacific region was targeted at the initial stage. The network aims to foster effective participation of key organisations in member countries and the region. It should be created in a way that incentives such as learning opportunities through exchange of researchers and joint research will be expanded. The network would be linked to the existing networks.

2.5 Disseminating Project Outcomes and Enhancing Knowledge on Adaptation

Dissemination of policy-relevant information focusing on best case studies of mainstreaming adaptation, and adaptation metrics was a key component of the Project. Policy makers at national and regional levels were involved at different stages of the Project to improve the policy relevance of research recommendations and to modify research direction if necessary. In addition, the Project findings were disseminated through project reports, peer reviewed articles, relevant events in the region and at international level, and the web portal at regular intervals.

3. Results & Discussion

3.1 Barriers to Climate Change Adaptation

3.1.1 Barriers in developing countries

There are several factors affecting adaptation in countries at the national level. The constraints are wide-ranging and may differ in specific to country circumstances, encompassing methodological issues, biophysical limitations, socio-economic factors, technological barriers, and institutional and technical aspects. Some of such constraints, pointed out by Glantz (2001), include spatial and temporal uncertainties associated with forecasts of regional climate, low level of awareness among decision makers of the local and regional impacts of El Nino, limited national capacities in climate monitoring and forecasting, and lack of co-ordination in the formulation of responses.

Uncertainties of climate modelling

Modelling of climate change is a complex activity. Despite progressively improving knowledge accumulated through research over the years, the understanding of the precise magnitude of human-induced climate change is still limited by various sources of uncertainties. This can be attributed to a number of reasons, including imperfect knowledge and/or representation of physical

processes, limitations due to the numerical approximation of the model's equations, simplifications and assumptions in the models and/or approaches, internal model variability, and inter-model or inter-method differences in the simulation of climate response to given forcing (Cruz et al., 2007; ADB, 2009b). In addition to the methodological factors, availability of and/or access to reliable time series data are also limiting more robust modelling process. Uncertainties accumulate in model-based assessments from the methodologies for establishment of socio-economic scenarios, environmental scenarios, climate scenarios and climate impact assessment (Challinor et al., 2005).

Biophysical limitations

The adaptive capacity of a system has its limits due either to internal properties or external factors. Some ecosystems, habitats and species may have narrow ranges of biogeographic adaptability that constraints the options and effectiveness of adaptation, while in other cases impacts of climate change may over-stretch the ability of some ecosystems to adapt without dramatic changes in their functions and resilience (Cruz et al., 2007).

Economic constraints

Adaptive capacity is uneven within a country, with the more affluent components being generally better able to respond, while the greatest impacts may fall on those currently least able to adapt effectively. Poverty limits effective adaptation as the poor individuals and groups within the country usually have a low adaptive capacity due to limited access to information, technology and other capital assets (Cruz et al., 2007). When combined with other limitations, poverty also constrains the adaptation in other sectors (Sodhi et al., 2004).

Technological barriers

Identifying the role of technology in adaptation to climate change correctly is critical to ensure actions are able to reduce vulnerability to the impacts of climate change successfully. This warrants technology fits into the process of adaptation. Klein et al. (2006) elaborate the roles of technology within the four-stage process of adaptation, which are information development, planning and design, implementation, and monitoring and evaluation. Nevertheless, the technology transfer process could be inhibited by many different factors. Table 3.1 categorises such barriers that also have effect in the context of climate change (UNFCCC, 1998). van Aalst (2006) summarises several barriers to the transfer of technologies for adaptation:

- Uncertainty about the location, rate and magnitude of impacts is considerable, which hampers effective anticipatory adaptation and complicates early-stage private-sector intervention;
- Adaptation as such is often not considered a development objective. Cross-linkages with other sectors can be instrumental in improving access to public and private financing;
- Technologies for adaptation will often be initiated for site-specific reasons and keeping local conditions in mind. However, design and implementation can be structured by taking into account lessons learnt from similar situations elsewhere; and
- The direct benefits of adaptation, such as crops suited to more arid conditions, are primarily local, as opposed to the direct benefits of mitigation, such as avoided emissions, which are global.

Availability of information and knowledge

Effective adaptation requires sufficient information and knowledge on vulnerability to and impacts of climate change (SBI, 2005a). This poses challenges to Southeast Asian countries as systems for monitoring and research on climate and responses of natural and human systems to climate are yet the priority areas in governments' developmental plans. Furthermore, studies on the interconnections between adaptation and mitigation options, costs and benefits of adaptation, and trade-offs between various courses of actions are also lacking. As a result, it is difficult to enhance

public perception of the risks and dangers associated with climate change as well as to undertake the best and cost-effective adaptation option (Cruz et al., 2007).

Table 3.1: Barriers to technology transfer process

Category	Barriers
Institutional	Lack of legal and regulatory frameworks, limited institutional capacity and excessive bureaucratic procedures.
Political	Instability, interventions in domestic markets, corruption and lack of civil society.
Technological	Lack of infrastructure, lack of technical standards and institutions for supporting the standards, low technical capabilities of firms and lack of a technology knowledge base.
Economic	Instability, inflation, poor macroeconomic conditions and disturbed and/or non-transparent markets.
Information	Lack of technical and financial information and of a demonstrated track record for many environmentally-sound technologies.
Financial	Uncertainty about the effects of an investment, lack of investment capital and financing instruments, limited financial return (primarily local rather than global benefits), and difficulty to create ownership of the results.
Cultural	Consumer preferences and social biases.
General	Intellectual property protection and unclear arbitration procedures.

Inadequate legal and institutional framework

Cruz et al. (2007) noted that the inadequacy in existing legal and institutional framework in most Asian countries to facilitate integrated response to climate change, and if political and institutional landscape is changing in response to climate change, it is slow and could limit future adaptation. In countries already faced with other pressing and urgent domestic concerns, attention may be drawn away from the dangers of climate change and the need to implement adaptation.

Improving and relating future climate and socio-economic scenarios

The SRES scenarios developed by the IPCC were mainly aimed to support climate projection activities. The scenarios of greenhouse gases emission are strongly related to socio-economic change, environmental change, land-use change and technological advancement. In order to facilitate assessment of the most plausible impacts of climate change in future studies, it is necessary to design future social development scenarios by various models, which will input to the projection of future regional and local changes in climate and its variability (Cruz et al., 2007; ADB, 2009b). The need is recognised and works are already under way in the IPCC process (Moss et al., 2008).

Challenges of abrupt or unexpected climate change

One of the greatest concerns emerges from possible 'surprises' in the future as adaptive capacity will be under great challenge due to abrupt or unexpected changes in climate, leading to increase in vulnerability to significant impacts (Preston et al., 2006). Such abrupt and catastrophic climatic change may include a shutdown of the 'ocean conveyor belt' in less than a decade and collapse of ice sheet over a couple of centuries if polar water temperatures warm by a few degrees. In addition to studying change of climate in gradual manner, it is necessary to also shift the research to also cover rapid or abrupt change even if it cannot be predicted with a high degree of confidence (Cruz et al., 2007).

3.1.2 Barriers in Japan

If one only looks for the term 'adaptation to climate change', such policies in Japan would be extremely limited. Table 3.2 lists basic projects, strategies, and plans that are either directly addressing climate change adaptation or have adaptation benefits. Ministries such as Ministry of the Environment (MOE), Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Education, Culture, Sports, Science and Technology (MEXT), Ministry of Land, Infrastructure and Transport (MLIT), and Ministry of Health, Labour and Welfare (MHLW) seems to be actively involved in the present adaptation policies.

It is clear from Table 3.2 that the Japanese government has put special emphasis on research and technology development especially for predicting future climate and assessing the potential impacts. These approaches are essential for setting basis for comprehensive plans and effective project implementation. However, as OECD's environmental performance review of Japan pointed out for its recommendation, comprehensive national legally binding adaptation strategy is yet to be established in Japan (OECD, 2010), whereas practical adaptation measures in Japan are mostly implemented by the prefectural governments.

Several past developmental initiatives in the agriculture sector with adaptation benefits already exist in Japan which includes development of irrigation with huge support from public works (Council of Food, Agriculture and Rural Area Policies, 2006). New crop varieties and farming practices have been developed over the years to cope with changing natural environment and changing farming and consumer markets. For example, Hokkaido region was believed to be too cold for growing rice in the 19th Century. Rice production was the least priority for their agricultural development during that time. However, in order to respond to the demand for rice, crop varieties and cultivation techniques were improved significantly after mid-20th Century with the effort of local practitioners. Now the rice yield and rice quality in Hokkaido is ranked as one of the highest in the nation (Hokkaido Agricultural Policy Department, 2009).

In terms of specific responses to climate change, the MAFF has established 'Global Warming Taskforce' with clear emphasis on greenhouse gas mitigation in October 2009. The main objectives for the taskforce are to reduce GHGs emissions from agricultural activities, to absorb GHGs emissions from effective forest and land management, and to reduce GHGs emissions by facilitating biomass energy and renewable energies (MAFF, 2010a).

Adaptation strategies stated in chapter three of 'Ministry of Agriculture, Forestry, and Fisheries Comprehensive Strategy for the Climate Change (decided in June 2007 and revised in July 2008)' indicate promotion of adaptation through training and sharing present technologies, developing, demonstrating, introducing, and reviewing technologies. The MAFF has conducted climate change impact assessment in collaboration with counterparts in each prefecture to facilitate the technical assistance for agricultural production. Impacts on major crops (symptoms such as chalky rice grain) and possible adaptation measures proposed by the national and prefectural agricultural research institutes were compiled. Development of heat and disease tolerant agricultural crops has been initiated at national and prefectural level research centres. In the case of rice production, Nikomaru, the high temperature resistant rice variety developed by National Agriculture and Food Research Organisation is already promoted around Kyusyu area (MAFF, 2008). No direct national regulations were established for climate change adaptation by MAFF. Most approaches focused on research and related capacity building. Finally, adaptation policy measures are not so apparent in the form of incentives and regulations or approaches to mainstream adaptation.

Table 3.2: Major adaptation initiatives in various sectors in Japan

Sectors	Initiatives
Cross Cutting	▪ Climate Change Symposium 2007 (Cabinet Office) ▪ Reinforcement of weather and climate data observation using GOSAT (JMA) ▪ Comprehensive research for global warming 2005-2009 and report on Wise adaptation 2008 (MOE) ▪ Establishment of data integration and analysis system (MEXT) ▪ Kakushin Project for future forecast of climate change 2007-2011 (MEXT) ▪ Direction of climate change adaptation (MOE 2010)
Agriculture and water	▪ Annual climate change Impact report by product item (Climate change adaptation report by item 2007) (MAFF) ▪ Technology development and impact assessment of global warming for agriculture and fishery sectors 2002-2005 (MAFF) ▪ Water shortage information portal from 2002 (MLIT, MHLW, MAFF, and JMA) ▪ Interim report on integrated water resource management addressing climate change and other risks 2008 (MLIT) ▪ Comprehensive strategy for the climate change 2008 (MAFF) ▪ Vision of aqueduct 2004 (MHLW)
Ecosystems	▪ Project of monitoring site 1000 from 2003 (MOE) ▪ Comprehension of high risk mountainous disaster area and research on proactive measurements for mountainous ▪ Understanding high risk mountainous disaster area (FA) ▪ Third strategy on biodiversity 2007 ▪ Comprehensive strategy for the climate change 2008 (MAFF)
Disaster management	▪ Research on advanced technology in risk assessment and observation of severe weather 2009-2013 (MLIT and JMA) ▪ Abnormal climate report 2005 (JMA) ▪ Review on water disaster risk assessment method 2008 and How-to information on designing Hazard Map 2005 (MLIT) ▪ Disaster Risk Information Platform 2008- (MEXT) ▪ Research on land slide and wind/water disaster occurrence prediction by Multi-parameter Radar 2007- (MEXT) ▪ Plan for climate change adaptation in water disaster management sectors 2008, Recommendation in relation to the landslides in midterm vision 2007, and Urban and Rural Transport Strategies 2005 (MLIT) ▪ Strategy for the 21st century environmental nation 2007 (MOE)
Health	▪ Research on global health issues including 'annual research on health impact by climate change from 2000' and 'water management to cope with climate change 2009'(MHLW)

Sources: Council of Science and Technology Policy, 2010 and Pacific Consultants Co LTD., 2010.

Acronyms: MEXT: Ministry of Education, Culture, Sports, Science and Technology; MLIT: Ministry of Land, Infrastructure and Transport (JMA: Japan Meteorology Agency); MHLW: Ministry of Health, Labour and Welfare; MAFF: Ministry of Agriculture, Forestry and Fisheries (FA: Forestry Agency); and MOE: Ministry of the Environment.

3.1.3 Local level barriers

Case 1: Tamil Nadu, India

Figure 3.1 shows the distribution of respondents who have adopted specific adaptation measures. The highest percentage of farmers adopting any adaptation measures is less than 35 percent,

indicating that a vast majority of the farmers have not adopted most of options. It appears that there is still lack of information and awareness among the farmers about availability (discovery-stage lag) and effectiveness of undertaking different adaptation measures (evaluation-stage lag). Among them, 30 percents of the respondents have adopted community based efforts, crop insurance and resistant crops, whereas only 5 percent of the farmers have taken up micro-irrigation. Apart from this, 20 to 25 percent of farmers are adopting use of bio-fertilizers and income diversification, and in addition, 15 percent of farmers have implemented rain water harvesting.

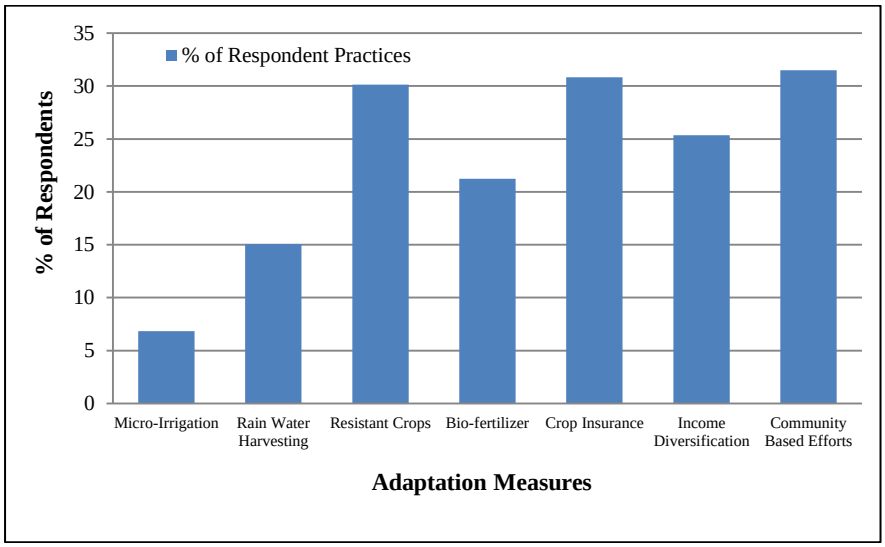

Figure 3.1: Percentage of respondents practicing specific adaptation measures

Table 3.3 shows the proportion of farmers reporting barriers to implement specific adaptation measures. The barriers were prioritised based on the logic that the barrier which has the least proportion must be the most limiting, and hence must be given highest priority while evaluating adaptation measures. The average values of four barriers are in range of 0.089 to 0.267. This suggests that we need to focus on all four barriers in order to increase adaptive capacity of farmers. Moreover, economically viability appears to be the most significant barrier among the four criteria, and effectiveness awareness is the least significant. Additionally, individual and institutional compatibility, and flexibility and independent benefits have occupied second and third place respectively.

Table 3.4 shows effectiveness score and priority rank for specific adaptation measures, identifying the best adaptation measure among those implemented. It is evident that the use of bio-fertilizer has scored the highest in terms of effectiveness. It must be noted that on a scale of 0 to 1, even the use of bio-fertilizer has scored only 0.304 (which roughly indicates that it is 30.4% effective), which is still a very low score. However, since it is the highest scoring among the other measures, it may be concluded that, of the seven adaptation measures, it is the most effective.

From Figures 3.2 and 3.3, it is observed that the performance of the agricultural insurance is increasing in the Tamil Nadu state, but a large percentage of farmers in delta zone are undertaking agricultural insurance (Table 3.5). As per the farmers' perception, lack of awareness is the major barriers for adopting agricultural insurance; because of this, a large percentage of Loanee farmers are adopting this measure as compared to the non-Loanee farmers. It is also not a no-regret adaptation option. In the context of micro-irrigation, the GoTN has given 100 percent subsidy for marginal and small farmers and more than 50 percent subsidy for large farmers. From the Table 3.6, it is understood that the performance of the micro-irrigation is increasing since its implementation in

the state (i.e. from 2007-08). However, this measure is more suitable for the horticulture crops (see Figure 3.4). Though the GoTN appears to be providing subsidy to implement micro-irrigation, farmers are facing problems in availing subsidy and technical help for repairs during operational period. In addition, micro-irrigation is only suitable for commercial and horticulture crops (Figure 3.4).

Table 3.3: Barriers of implementing specific Adaptation Measures

Sl. No.	Adaptation Measures	Effective awareness	Economically viable	Individual & Institutional compatibility	Flexibility & independent benefits
1	Micro-Irrigation	0.096	0.068	0.041	0.068
2	Rain Water Harvesting	0.219	0.021	0.155	0.155
3	Resistant Crops	0.315	0.000	0.291	0.312
4	Bio-fertilizer	0.219	0.210	0.203	0.217
5	Crop Insurance	0.418	0.317	0.014	0.007
6	Income Diversification	0.253	0.000	0.262	0.262
7	Community Based Efforts	0.349	0.007	0.312	0.319
8	Average	0.267	0.089	0.183	0.192
9	Priority Rank	IV	I	II	III

Table 3.4: Effectiveness Score and Priority Rank for Specific Adaptation Measures

Sl. No.	Adaptation Measures	Effectiveness Score	Rank
1	Micro-Irrigation	0.158	7
2	Rain-Water Harvesting	0.191	6
3	Resistant Crops	0.248	4
4	Bio-fertilizer	0.304	1
5	Crop Insurance	0.299	2
6	Income Diversification	0.227	5
7	Community Based Efforts	0.260	3

Table 3.5: Agro-climatic zone wise status of agricultural insurance in Tamil Nadu

Sl. No.	District	Farmers covered	Area (ha)	Average Area (ha)
1	Western Zone	9793 (2.1)	9623 (1.41)	0.98
2	Southern Zone	99061 (21.2)	144181 (21.18)	1.46
3	North Eastern Zone	123164 (26.36)	139865 (20.55)	1.14
4	North Western Zone	15028 (3.22)	18861 (2.77)	1.26
5	Delta Zone	215879 (46.2)	364867 (53.61)	1.69
6	High Rainfall Zone	3573 (0.76)	2282 (0.34)	0.64
7	Hilly and Tribal Zone	749 (0.16)	954 (0.14)	1.27
8	Total (Tamil Nadu)	467247 (100)	680633 (100)	1.46

Source: Data collected from AIC, Chennai
Note: figures in the parantheses indicate percentage figure

Table 3.6: Trend of Micro-Irrigation in Tamil Nadu

Sl. No.	Year	Area (in ha)
1	2007-08	7819
2	2008-09	11597
3	2009-10	18008
4	2010-11	26153
5	2011-12	27550

Source: Data collected from TANHODA, Government of Tamil Nadu, Chennai

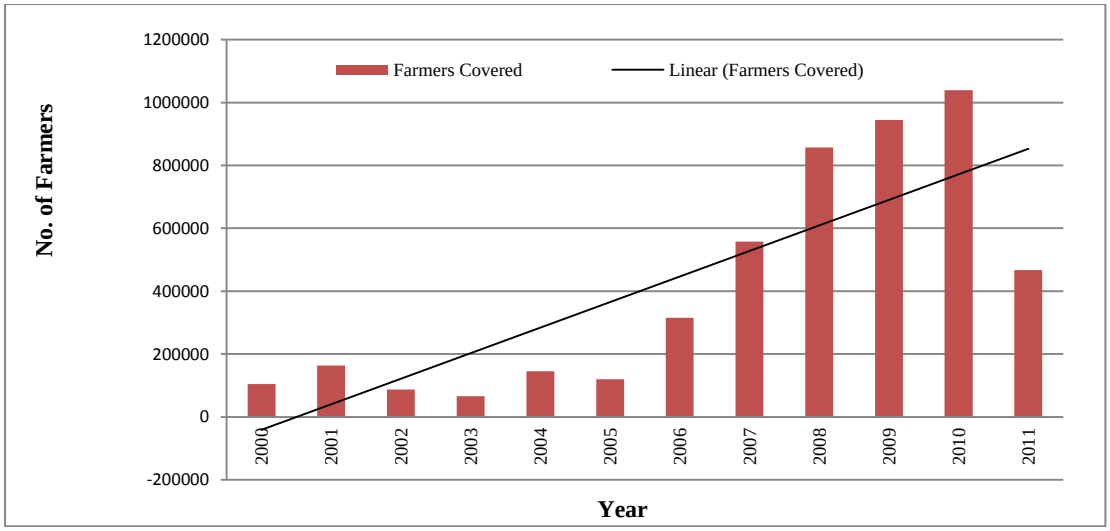

Figure 3.2: Farmers covered under agricultural insurance in Tamil Nadu

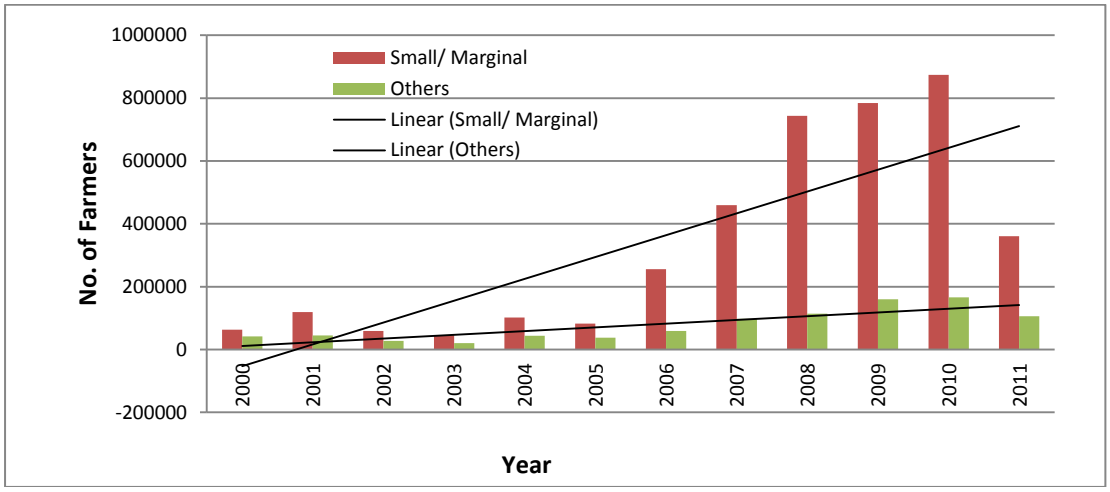

Figure 3.3: Classification of farmers covered under agricultural insurance in Tamil Nadu

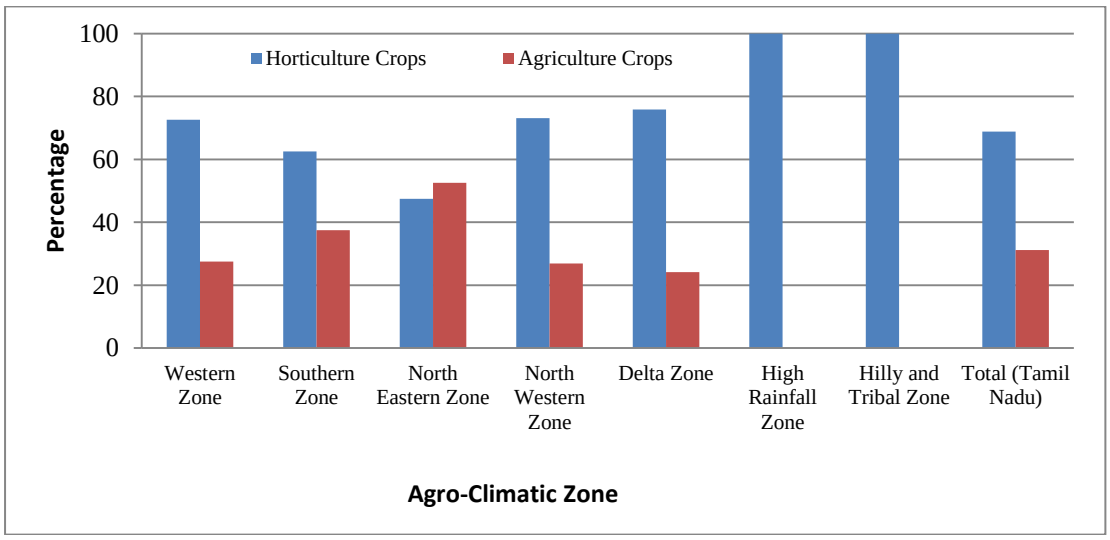

Figure 3.4: Crops covered under Micro-Irrigation in Tamil Nadu

Case 2: Niigata and Miyazaki prefectures, Japan

Climate-related issues are handled by multiple divisions in Niigata and Miyazaki prefectures, most importantly by the social and environmental divisions that deal with livelihoods, health, and water management and not by the agricultural division. In some prefectures, climate change measures in agricultural sector is not major while in other prefectural agricultural divisions/offices are responding to such needs as a priority depending on the awareness, understanding, resources available, and willingness of the prefecture as well as the severity of the climatic impacts that these prefectures have been facing.

Niigata Prefecture

The Global Environment Countermeasure Office in Environmental Planning Division of Residents' Life Environment Department is in charge of the climate change issues and they have developed 'Niigata Global Warming Regional Countermeasure Promotion Plan 2009 (Niigataken chikyu ondanka taisaku chiiki suishin keikaku, 2009)' (Niigata Prefecture 2009a). This plan focuses on mitigation (reduction and absorption of the GHGs emissions) and only single paragraph out of 76 pages states about adaptation.

The Agriculture, Forestry and Fishery Department issued the 'Agriculture and fishery vision 2006 (Nourin Suisan Vision, 2006)' (Niigata Prefecture 2006) based on the Niigata prefecture's overall basic development plan towards 2020 namely 'Dream developing policy plan 2006 (Yume Okoshi Seisaku Plan, 2006; revised in 2009)' (Niigata Prefecture 2009b). Only a few components considering climate change have been included in the vision: environmental protection through soil, air and water purification and sustainable forest management.

The development of a new rice variety Cho-Koshihikari was started in April 2010 to secure the prefecture's brand rice as a project of the Agriculture, Forestry, and Fisheries Department in Niigata prefecture. The prefecture aims to create a heat-tolerant and late-maturing rice variety which is as tasty as that of the existing Niigata-brand mid-maturing rice variety Koshihikari or the early-maturing variety Koshiibuki. The project is fully funded by the prefectural government (approximately 60 per cent of the total project costs), the Japan Agricultural Cooperatives (JA) group, and a part of revenues from rice seed sales. Development of this rice variety will diversify the rice varieties planted in the region and reduce the damage risk from the fluctuation of climate during the critical rice cultivation period.

Retrospectively, the development of the early-maturing rice variety, Koshiibuki, was also initiated to deal with changing climatic conditions after the prefecture experienced cool weather in 1993, drought and heat in 1994, and hot night temperatures in 1999— 55 per cent of total rice production failed to be graded as the first class quality in 1999. Even before the wide acknowledgement of climate change, research had been conducted to cope with the fluctuating temperatures. With their continuous efforts, in 2001, Niigata prefecture started commercial production of Koshiibuki, the rice variety that is tolerant to the hot temperature during the grain filling period with comparable quality and taste of Koshihikari.

In addition, the prefectural government provides guidance to farmers through extension services. It recommends that farmers fix the planting date on 10th of May (about 7 to 10 days later than the conventional date) in order to delay the rice spike emergence period. They also recommended farmers to plant Koshihikari for 70 per cent of their rice paddy and other varieties for 30 per cent to reduce yield and quality decline from epidemics and widespread crop loss due to monoculture. The latter recommendation is not received appealing by farmers because of high market value of Koshihikari even though they can reduce the risks from the dependency on a single variety. Hence,

the prefecture has to widen its genetic base of high-quality rice varieties so that farmers can cultivate different genotypes while benefiting from the same or similar high quality rice that the prefecture is known for.

Miyazaki Prefecture

The Environmental Administration Division of Environment and Forest Department are in charge of the prefectural climate change policies. 'Miyazaki global warming countermeasure implementation plan (Miyazaki chikyu ondanka taisaku jikko keikaku)' was issued in 2000. Similar to the Niigata prefecture, most activities promoted by the Environmental Administration division focuses on mitigation.

The Agricultural and Fishery Administration Department recently issued three major plans to promote research on the global warming, to showcase the global warming adaptive agricultural management, and to develop mitigation technologies including bio-energy such as poultry manure power plant (Global Warming Research Center for Agriculture and Fishery, 2008). In 2008, the prefecture individually established the Global Warming Research Center for Agriculture and Fishery under the supervision of Agricultural and Fishery Administration Department. This Center is one of a very few research institute specifically established for the purpose of studying global warming for agriculture at the prefectural level in Japan. By implementing pilot model projects for climate change, the Research Center is supporting the implementation of Production Area Structural Reform Plan to Cope with Global Warming in Miyazaki Prefecture (Miyazakiken chikyu ondanka taio sanchi kozo kaikaku keikaku)' for the Agricultural and Fishery Administration Department. The government officials interviewed believe that global warming could open new opportunities for producing alternative crops such as tropical fruits and diversifying agricultural products of the Miyazaki prefecture. Few months after the interview, Miyazaki prefecture announced to test-grow Lychee and Jujube to vitalize high quality local products. Warmer temperature may also reduce the fuel consumption of greenhouse mangoes.

Since Miyazaki is located in southern Japan, its climate is warmer than many other prefectures and hence the development of heat resistant rice variety has been initiated. The prefecture is growing two major rice varieties: Koshihikari (early-maturing variety planted in February, 3000 ha in the prefecture) and Hinohikari (mid-maturing variety, 1000 ha). Quality of both rice varieties were affected by the changing climate in the form of increase in chalky grain, pest, virus, and invasive species (Personal communication with Central Miyazaki Agricultural Extension Center). Koshihikari, is susceptible to rice blast and wind, and its flowering coincides with the high typhoon rainfall. The new early-maturing variety currently being developed (called Miyazaki No.45) will have a shorter stem and hence resistant to lodging. The development of this variety is supported by the prefecture and is in the field experimental stage to be ready for adoption in few years. Funded by the national government, Hinohikari was developed by the Agricultural Research Institute in Miyazaki prefecture for producing good flavoured rice even under warm climate such as in Kyushu region (MAFF, 2009).

From the above cases, it is clear that the initiatives by the prefectural governments were mainly driven to maintain the supply of high quality rice (Niigata) or to diversify the income sources of farmers (Miyazaki prefecture) which also benefit from the consideration of climate change adaptation. In fact, the prefectures such as Miyazaki are proactive enough to gain benefit from the climate change by redesigning the cropping patterns. However, some policy constraints do limit the extent these prefectures could make progress. The release of new rice varieties through conventional plant breeding techniques could take years since the National government only permits the use of the rice genetic engineering technologies for the laboratory research and not for the commercial use due to issues related to consumer acceptance (MAFF, 2010b). In addition, the

changing cropping pattern entails massive capacity building efforts to train farmers on new agronomic practices for new crops that farmers are not comfortable with.

Some prefectures have spontaneously acted in response to the observed long term climatic impacts by conducting research and promoting activities on the ground such as breading heat tolerant high-quality rice varieties, which have adaptation relevance to the projected impacts such as warming related yield losses in paddy. Some initiatives such as Global Warming Research Center for agricultural sector established in Miyazaki prefecture can provide even greater long-term benefits by facilitating the adaptation projects based on the information from downscaled climatic models.

The national government provided direction through reports such as 'Direction of Climate Change Adaptation (MOE, 2010)', 'Wise Adaptation (MOE, 2008)' and 'Climate change adaptation report by item (MAFF, 2007)' to facilitate decision making at the prefectural level. The National government also supports research in the field of climate change forecast and impact and vulnerability assessment and to a limited extent identification of adaptation technologies and practices.

Case 3: Selangor River Basin, Malaysia

The Selangor River Basin is located in the State of Selangor with an area of 2,200 km2 (Figure 5.5). It is the third largest river basin in Selangor after Langat River Basin and Bernam River Basin. The river basin was selected as it is the most important water resource in Selangor State, providing over 60% of the water used in Klang Valley (the most developed corridor in the Peninsular Malaysia). The main challenge here is the increasing demand for water as a result of rapid population growth and brisk economic development, coupled by the rainfall decrease, monthly river flow decrease and water supply decrease (NRE, 2011). For the whole Selangor, the projected increase in demand for raw water is expected to stretch the concern on water stress in the state.

The NC2 report pointed out that water resources may not be the main concern in the country as projection shows adequate level for the period of 2025-2050 (NRE, 2011). Nevertheless, water availability may still be vulnerable in future climatic conditions. Urban areas in particular may be expected to experience disruption of water supply during extreme drought events. Water shortages would require more draw-down from water supply reservoirs, which in turn could deplete water reserves in reservoirs. The existing facilities that draw water resources from the Selangor River Basin, including Sg. Selangor Dam, Tenggi Dam and downstream catchment between Sg. Selangor Dam to Batang Berjuntai Intake Point, may be impacted negatively. It was projected that 28 out of the total 240 months may face water supply deficit situations, ranging from 3 to 214 million cubic metres (NAHRIM, 2009). The water deficit months occur when rainfall is projected lower than the historical level.

In line with the National Policy on Climate Change, the National Physical Plan 2 (NPP2) approved in 2010 has incorporated a response to climate change under its policy NPP27: "The spatial planning framework shall incorporate mitigation and adaptation measures against the impacts of climate change" with the emphasis on risk assessment and vulnerability mapping, development away from areas vulnerable to rising sea levels/storm surges, protection of mangrove and the maintenance of key ecosystem processes. This plan is anticipated to be translated and refined in the next tier of development plan, i.e. State Structure Plan and District Local Plans. Selangor River Basin is administered by 3 local authorities: Selayang Municipal Council, Kuala Selangor District Council and Hulu Selangor District Council.

An assessment was done to evaluate how far current spatial planning has responded to climate change adaptation and mitigation, either explicitly or implicitly, in the Selangor River Basin (Chee et al., 2011). The assessment revealed that the National Physical Plan 2 (NPP2) and State Structure Plan

had the best performance. The State Structure Plan (RSN) has successfully translated climate change elements from the NPP2 and strengthened it, particularly for water resources management. However, spatial plans in the Selangor River Basin generally do not present a satisfactory performance for climate change integration. Climate change elements have not been translated and refined in the next tier of development at the basin level i.e. at the 3 local authority levels of Selayang Municipal Council, Kuala Selangor District Council and Hulu Selangor District Council. The findings require serious attention from the policy makers as local plans play the most important role in guiding development in the local area. Other challenges have also been identified from the assessment. These include issues of harmonising administration between ecological boundaries and administration boundaries, information gap to guide policy documents, stakeholder participation in the planning process, interaction between multi levels of government and planning priority of the planning institution. Planning guidance is required for future reviews of spatial planning policies to address all the challenges.

Climate change responses to-date have been implemented in a disjointed manner with emphasis mainly in the federal government level. Adaptation actions will have to be implemented at all levels. However, this will be a very challenging task at the state and local levels because land, forests, water and other resources come under the purview of the state government. State governments and local authorities are generally constrained by limited knowledge, capacity and resources. Urban areas under the management of local authorities pose the biggest challenge as many are unaware of not only climate change adaptation issues, but also of existing hazards that may undermine development in the near term.

Building capacity to implement adaptation responses is critical particularly at the local level, in view of increasing indication that some impacts of climate change can no longer be avoided. The challenge ahead is to support adaptation to future climate change while also explicitly responding to the needs of the present day. The ability to cope with changes in climate can be enhanced through starting point adaptation).

Immediate focus should be on the land use planning system at the local authority level, to build capacity for the preparation of structure plans and local plans that are climate resilient. These plans take into account several aspects that can promote climate resilient development. Examples include economic needs, population density, existing land use and other factors associated with the development process as well as environmental aspects such as conservation of wetlands and catchments as well as other ecosystems that provide risk reduction as an ecological service. Conservation efforts will contribute to natural carbon sequestration and this would constitute as a mitigation measure. Initiatives for assessing such potentials should be carried out with participation of local authorities in ascertaining potential vulnerability in the exposure to climate change as well as identifying adaptation approaches.

Drawing on the starting-point approach, a framework for assessing the adaptive capacity of the water institutions in responding to climate change has been developed (Tan et al., 2011). The framework encompasses a number of the proposed elements of adaptive capacity that are categorised together under six criteria, represented by twelve indicators (Table 3.7). The framework has been used to develop a survey form (Appendix 6) targeting water institutions managing Selangor River. The form had been tested and the survey is currently being implemented.

Table 3.7: The adaptive capacity assessment framework

Criteria	Indicator	Representation	Potential Elements
Information & Knowledge	Availability of scientific knowledge	Institutional knowledge of the current vulnerabilities and potential impacts of climate change.	▪ Perform research with in-house personnel. ▪ Collect/Assess data on current vulnerabilities and potential impacts of climate change. ▪ Apply scientific information in problem evaluation and decision making. ▪ Update data repository and/or knowledge management system.
	Access to scientific knowledge	Access to scientific knowledge and effective communication with experts, including scientific results.	▪ Identify relevant sources and establish communication to obtain external data/ knowledge/information. ▪ Use data from external sources for assessment and planning processes. ▪ Maintain directory of expertise.
Institutional & Governance	Regulatory & Institutional arrangement	Governance structure that facilitate rapid and innovative decision-making as well as effective actions by the institution.	▪ Recognise the need for adaptation to a changing climate. ▪ Institutionalise adaptation in the mandate and decision-making processes. ▪ Adopt formalised procedure(s) to consider a wide range of alternatives for adaptation. ▪ Adopt decision criteria to prioritise adaptation.
	Coordination & collaboration	Cooperation with various stakeholders outside the institution's hierarchy and access to networks at various scales.	▪ Maintain access to networks at various levels (federal/state/local). ▪ Engage and build consensus among stakeholders.
Human Capital	Leadership	Recognition by higher governance level and proactive and take ownership of adaptation.	▪ Top level of the institution advocates adaptation to climate change. ▪ Take ownership of the processes of climate change impact assessment and strategic adaptation planning. ▪ Proactively influence the decision- and policy-making on adaptation both within and outside the institution.
	Availability of technical expertise	Availability of in-house human resources with relevant technical skills, knowledge and experience.	▪ Retain staff capable of working with complex data and making assessment. ▪ Use of appropriate tools to assess options for adapting to a changing climate conditions. ▪ Provide opportunities for training and continuous learning.
Economic Resources	Financial resources	Availability of or access to sufficient income or the ability to generate resources to support policy measures and financial incentives for adaptation.	▪ Allocation of financial resources for adaptation to climate change. ▪ Approach financial needs for adaptation in a strategic manner. ▪ Assess availability of resources in adaptation process. ▪ Appropriate use of financial resources.
	Risk spreading mechanism	Ability to access and subscribe to relevant mechanism to spread or	▪ Recognise the need to address climate change risks. ▪ Identify appropriate risk spreading

		reduce the risks of climate change.	mechanisms (e.g. insurance, relief fund, guarantee fund, etc). ▪ Adopt mechanisms in distributing the costs of climate-related losses.
Technology & Infrastructure	Technology for adaptation	New technologies or revival of old ones in response to new conditions under uncertain future climate conditions.	▪ Keep abreast of technological options for adaptation. ▪ Support R&D programmes for development of technological adaptation. ▪ Revive existing technologies in response to new climate conditions. ▪ Develop/Adopt new technologies in response to new climate conditions. ▪ Adopt proper framework for assessment of and access to technology. ▪ Consider management solutions along with technology fixes.
	Resilience of infrastructure	Existing infrastructure and future investments integrate climate change factor and are climate-proved.	▪ Revise/Update guideline on infrastructure using the latest climate information. ▪ Integrate climate change risks assessment in planning new infrastructure. ▪ Incorporate climate change adaptation elements in infrastructural development. ▪ Assess existing infrastructure on risks to climate change. ▪ Rehabilitate/Upgrade existing infrastructure against climate change risks.
Adaptability	Flexibility	Openness towards uncertainties patterns and ability to update or adjust in a non-stationary climate.	▪ Operations automatically update or adjust to accommodate new climate information or conditions. ▪ Integrate uncertainty in climate change into adaptation planning and decision making. ▪ Improve functional and capacity flexibility to meet future needs.
	Continuous improvement	Ability to find innovative solutions and make changes to policies, processes, practices and behaviour that will lead to better performance.	▪ Maintain system for monitoring performance on a continual basis. ▪ Implement self-correcting features to trigger timely institutional adjustments. ▪ Undertake interventions in response to poor performance as the climate changes. ▪ Perform ex post analysis of policies and projects. ▪ Establish resources in aid of finding innovative solutions.

Case 4: Red and Mekong River Delta, Vietnam

Adaptations in Red River Delta

Based on the adaptation frame and considering the specific conditions of Red River Delta, the adaptations in water resources have been proposed. These measures include developing

multi-functions reservoir systems; upgrading, building, adding salt preventing constructions in coastal areas; reinforcing, improving embankment and dyke systems; enhancement of afforestation; reasonable and effective use of water; and international cooperation.

- Developing multi-functions reservoir systems: The construction of reservoirs, that ensure flood regulation and appropriate water allocation, can meet the requirements of downstream flood defense in the flood season and water supply in the dry season. This is a traditional measure, but still effective under climate change conditions. There are a number of large reservoirs in Red River basin, namely Son La, Hoa Binh, Tuyen Quang and Thac Ba, and a number are under construction such as Ban Chat and Huoi Quang. In addition, there are many medium and small-scale reservoirs used for agriculture. These reservoirs can be more effective through their optimal operation.
- Upgrading, building, adding salt preventing constructions in coastal areas: The construction of salinity barriers at the river mouths of Hoa, Do Han and Tra Ly Rivers can moderate salt intrusion in the dry season, and to maintain essential fresh water for primarily domestic and agricultural demands.
- Reinforcing, improving embankment and dyke systems: Improvement to sea and river dyke systems in the provinces of Hai Phong, Nam Dinh, Thai Binh and Ninh Binh can prevent high flood and sea water intrusion. The existing sea dike systems in the area of Red River Delta are still low and not strong enough to cope with strong typhoons from level 10. Therefore, Reinforcing and improving embankment and dyke systems needs to be implemented in the near future as part of the natural disaster prevention and mitigation program.
- Enhancement of afforestation: Priority should be given to poor forest or bared areas to protect the soil and retain water flows in the flood season. It is necessary to strengthen the protection of existing forests, especially primeval forests and surface humus layer, acting as a large reservoir to adjust and retain flood flows in the rainy season, and strengthen for the dry season.
- Reasonable and effective use of water: Reasonable and effective uses of water are recommended for three main using aspects in RRD: agriculture, industry, and domestic. Firstly, RRD is a main area for rice cultivation in the north, which requires a huge amount of water. Therefore, efficient use of water is necessary with priorities adaptations are (i) to continue concreting irrigation channels to minimize water loss, and (ii) to apply advanced water techniques such as drip irrigation. This is very efficient but requires big investment and high technology, so it may be used for specialized concentrated production areas. Secondly, water use in industry is significant. In the near future (by 2020), Vietnam is expected to be an industrial country with strong development of large industry zones, and therefore industry is expected to be the biggest water user. In company with development, industry might be the main cause of water pollution and quality degradation. Therefore, the following measures need to be applied in order to use water efficiently: Give priorities to reuse of water; treat wastewater from production enterprises to meet the new standards before disposing into environment; and enforce regulations, severely punishing those who do not meet treatment standards. Finally, water for domestic should be in high quality with two main solutions are to improve the quality of the pipeline system to avoid leakage as well as to monitor regularly the pipeline to avoid illegal extraction of water.
- International cooperation: International cooperation in the Red River system focuses on strengthening cooperation with China in management and protection of water resources in the upstream areas of Da, Thao and Lo rivers, and reasonable sharing water resources in exploitation and use. It is necessary to have basic agreements on water resources protection in each relevant country, as well as the benefit balance derived from water use for users located at upstream (Chinese part) and downstream (Vietnamese part) areas.

In the Red River Delta, there are several adaptation measures for the agriculture sector. These measures are as follows:

- Water management: Building reservoirs in upstream areas to reduce flood during the rainy season as well as to store, stable water supply for dry season. Simultaneously, upgrading river dyke systems in downstream areas. Building sewer systems and dams to prevent intrusion of sea level rise and mangrove upgrade and improve the bottom drain and sea dykes in estuaries and coastal provinces such as Nam Dinh and Thai Binh;
- Changes of the structure of plants, animals: For plants, seed structure should be changed in consistent with climate change by increasing short-term seeds, or the rice seeds that can stand salt, drought, heat and flooding, with high resistance to pests and diseases.
- Rotation crops structural changes: In areas where have not enough water for rice irrigating, rice will be transferred to the cultivation of crops such as corn, peanuts, soybeans and other vegetables those need less water than rice.
- Converting to aquaculture: In coastal areas where have been exposed to salt, an effective way for adaptation is to replace cultivation by aquaculture.
- For livestock: To create by cross- breeding and to breed animals with high resistant ability to heat and diseases or animals such as cattle, horses, goats, ostriches that their feed is waste from seafood products or from agricultural products. In some areas, water-bird and wild animals such as turtles, tortoises, crocodiles, pythons, snakes, porcupine can be reared to replace ordinary animals.
- Investment in new construction, upgrading and modernization of irrigation such as lakes, dams, pumping stations, drainages: The RRD will be upgraded and new built 272 reservoirs, 572 pumping stations to provide water for 398,000 ha of agricultural land. For the targets of 1,162,160ha, it needs 398 upgrade pump stations, sewer standards and building 143 new works.
- Protection and planting of mangroves: This is a belt of coastal protection against the effects of storms and sea level rise. It also works to protect sea dikes and ensure the development of biological diversity of plants and animals under the forest. Hundreds ha of mangroves have planted along the coast of Nam Dinh, Thai Binh, Quang Ninh and Hai Phong provinces every year. It is expected that by 2015, Hai Phong will bring the total mangrove area to 6.800ha (27.7% of the beach) where as Quang Ninh will grow 750 ha of mangroves to create a "green belt" of mangroves in the future.

Adaptations in Mekong River Delta

Based on the adaptation frame and considering the specific conditions of Mekong River Delta, the adaptations in water resources have been proposed. These measures include completing and reinforcing the approved water conservation projects; construction of sea dyke; salinity prevention; use of fresh water storage measures; environmental protection; and international cooperation.

- Completing and reinforcing the approved water conservation projects: This measure mainly aims to: (i) avoid flooding and/or increase the flood drain speed; (ii) build and complete the residential areas near the flooded areas and flood control dykes in An Giang, Dong Thap and Long An; (iii) widen drainage canals to west sea (Thailand bay) and to Tien river.
- Construction of sea dyke: Programming and gradually building dykes along East and West coastal areas to prevent salt contamination in case the sea level rises.
- Salinity prevention: Preventing salinity intrusion in the dry season need to be implemented, and should include the building of salinity barrier sluices at effective places.
- Use of fresh water storage measures: Devices such as large jars or pots should be used to store and save rainwater in the wet season for dry season using. The measure has proved to be efficient in coastal areas (Ben Tre, Bac Lieu, Soc Trang, and Ca Mau) where fresh water from the river is limited in the dry season because of tidal influences.

- Environmental protection: Environmental protection, including treatment and disposal of wastewater from industrial parks should be monitored regularly and strict punishment should be applied to polluters.
- International cooperation: International cooperation includes promotion of activities on water resources within the Mekong River Commission. Cooperation focus on sharing of water resources in dry season among riparian countries and construct reservoirs in various locations (within territories of Laos and Cambodia) to store water in flood season for later use in dry season (in downstream).

Similar to adaptation with climate change in the Red River Delta, adaptation in the agriculture sector in the Mekong River Delta should also be focused on water management, investment in new construction, upgrading and modernization of irrigation. The specific adaptations are proposed as follows:

- Changes of crop patterns and livestock: Changes of crops and livestock should be based on planning of land use under the condition of sea level rise. For areas unaffected by tide and salinity, plants and livestock that do not require large amount of water should be applied. In contrast, in areas that recently affected by tide and salinity, the crops and aquaculture should be distributed reasonably and priority for plants and animals that can adapt to brackish and salt water. Also, mangrove forest at coastal estuaries (Ben Tre, Hau Giang and Ca Mau) should be protected and enlarged.
- Rehabilitation and development of rice varieties that have ability to face to salinity, droughts, heat and floods as well as have high resistance to pests and diseases. Currently, the new rice varieties that are resistant to high salinity as OM6976, OM6677, OM5464, OM5629, OM5166 have been planted in provinces of Soc Trang, Kien Giang, Bac Lieu, Ben Tre.19 The rice which can be beard alkaline soil, drought tolerant will be planted in Dong Thap, Tra Vinh and Hau Giang provinces. Moreover, the rice which can grow in submerged conditions will be planted in Hau Giang province.
- Improving propagandizing, training of human resources and enhancing international cooperation: Propagandizing to improve community awareness through education and raise awareness and responsibilities of society about climate change. Human resource training is implemented at all levels, sectors and persons involved (managers, planning, program officers, project and professional staff) in order to develop human abilities to cope with climate change. Finally, agriculture promotes scientific research and international cooperation on climate change, especially within Mekong countries.

3.2 Progress in Mainstreaming Climate Change Adaptation

At the global negotiation under the UNFCCC, mitigation and adaptation have been identified as equally important measures to deal with climate change. However, the progress on adaptation is much slower than mitigation, partly owing to the lack of the appropriate metrics. For mitigation, a major advance was made with clear targets for the Kyoto Protocol in 1997, which was possible because there was a clear metric of the actions, “the greenhouse gas emissions”. In addition to the lack of the metrics, adaptation is more complicated than mitigation for the following reasons. First, it is locally oriented so that necessary local actions can substantially vary, which makes difficult to generate standard actions. Second, it is complex interaction of biophysical and socio-economic elements, which necessitates for adaptation to be made at a system level. This creates a condition that an adaptation option can have different impacts and outcomes at different time and location scales. This section of research makes a case on the need for adaptation metrics through elaborating on aspects such as criteria for selecting adaptation metrics and the types of metrics available thus far, particularly relevant for the agriculture sector are discussed. The main purpose is to highlight the challenges involved in developing an adaptation metrics.

Mainstreaming climate change considerations in agriculture and water sectors means that the developmental plans and programs in these sectors are aware about the imminent risks of climate change and that suitable countermeasures are planned. There is very limited comprehensive research carried on assessing the status of mainstreaming adaptation principles and practices in agriculture and water sectors globally and in the Asia Pacific regions. A meta analysis of adaptation initiatives by World Resources Institute suggest that the mainstreaming adaptation in development can happen in three stages i.e. serendipitous adaptation (where adaptation is an accidental rather than designed outcome of development), climate proofing of development (where adaptation is a planned intervention however the main focus is on development) and discrete adaptation (where adaptation is the sole intended outcome of the intervention) (McGray et al., 2007). On this scale, the current level of adaptation in agriculture and water sectors in Asia Pacific region can best be placed between serendipitous adaptation and climate-proofing of development since there are very few adaptation only initiatives taken up so far.

Determinants of adaptive capacity (e.g., economic resources, technology, information etc., Figure 3.5) are variable at a local scale as well as at national scale (Yohe and Tol 2002). Hence, metrics have to be flexible enough to be applicable to various conditions and location related aspects. In addition, the adaptation metrics need to be able to measure adaption at any given point of time so that it can provide a means to compare the level of adaptation reached in different locations, regions, societies, and nations. The establishment of the adaptation metrics can help decision makers to identify and prioritise appropriate adaption actions, and to fund these actions, minimizing the risk of mal-adaptation.

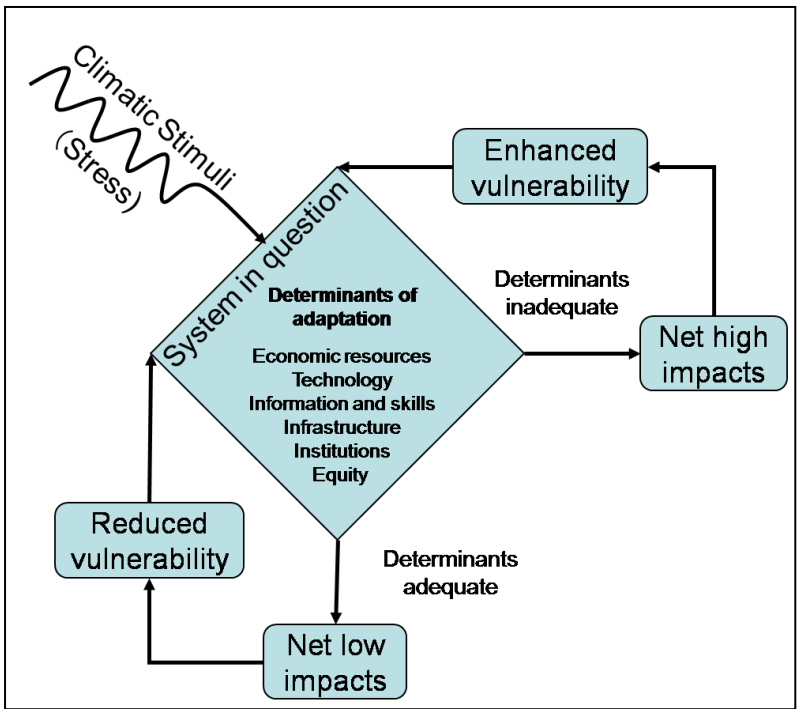

Figure 3.5: The determinants of adaption and their link with the system vulnerability (Prabhakar and Srinivasan, 2011).

3.2.1 Criteria to select appropriate indicators

There are a few criteria for adaptation metrics to be effective. The metrics has to be measurable and cost effective. As adaption can vary in time and space, adaptation metrics have to be scalable spatially and temporally (Prabhakar and Srinivasan, 2011). And, it should be comparable in a wide range of opportunities. Reflecting the context specific nature of adaption, the adaptation

metrics should be specific to the system being measured, and it has to be sensitive to the degree of change in adaptation. Table 3.8 lists several methodologies for choosing adaptation metrics in the agriculture sector. As adaptation metrics are a relatively new concept, it is necessary to develop new methodologies that are simple and be able to be used at the operational level.

Table 3.8: Methods for choosing adaptation metrics in agriculture.

Methodology	**Geographical scope**	**Sources**
Benefit-cost analysis	L, N, R	Tubiello and Rosenzweing, 2008
Cost-effectiveness analysis	L, N, R	Rosenqweig and Tubiello, 2006
Multi-criteria analysis	L, N, R	Dolan et al., 2001
Expert consultation (workshops)	L, N, R	Rosenzweig and Tubiello, 2007
Dynamic crop models	L, N, R	Tubiello and Rosenzweig, 2008
Modeling relationship between stressor and outcome variables	L	Luers et al., 2003
GIS based index based on normalization and aggregation of determinants	Sub-national	Swanson et al., 2007
Historical trend analysis and constructing conceptual models	Sub-national	Allison and Hobbs, 2004

Note: L, N, and R represent local, national, and regional levels respectively

3.2.2 Types of adaptation metrics

Many options can be considered for effective adaptation metrics. It can be qualitative and quantitative depending on costs and time resources. In some cases, it has to be indirect metrics using proxies when direct measures are not possible (Srinivasan and Prabhakar, 2009). The metrics can be utilized to prioritise adaption policy and measure options before adaptation options are taken, or the metrics can be applied to evaluate the effectiveness of the implemented adaption actions. Although various adaptation metrics have been proposed as listed in Table 3.9, some difficulties to form appropriate adaptation metrics have been noticed. Firstly, many of those metrics are single metric because policy makers usually prefer single composite index representing the entire sector with a single number. However, that approach often fails to provide an overall picture of adaption in agriculture sector. Secondly, although composite indices (for example Gross Domestic Product and Human Development Index) have been suggested as possible metrics for adaptation metrics, the composite indices can grossly average out and even nullifies the impacts at the sectoral and sub-national level. In addition, the use of the composite indices as adaptation metrics is criticized as either primitive or too unattainable as in the case of HDI. Therefore, some researchers have tried to come up with new composite indices for adaptation metrics such as “Index of usefulness of practices for adaptation to climate change (IUPA)” developed by Claudio Szlafsztein, Federal University of Para, Brazil (Szlafsztein, 2008). The index is calculated by integrating both qualitative and quantitative parameters into a single number. However, it is found to be rather difficult to choose appropriate weighting coefficients for individual parameters.

3.2.3 Measuring progress in mainstreaming into institutional processes

The survey for measuring progress in mainstreaming climate change adaptation into institutional processes was conducted in Japan. The background on responses obtained was listed in Table 3.10. All the results were combined into government agencies, educational agencies and donor agencies for the reason that the respondents chose to keep their responses anonymous. Though

questionnaire was sent to more than 40 institutions in Japan, very few responses were obtained for the reason that most questionnaire recipients found it inconvenient to rate their own institution. While other institutions which have agreed to respond have chosen to keep anonymous for the same reason.

Table 3.9. Adaptation metrics from existing studies

Metrics	**Description on availability and limitation**	**Sources**
Mean and variability of yield and production, income, aggregate of value added	Measured and computed metrics. Available at local, national, regional and international levels in many countries. The aggregate of value added may need to be computed at the local level as such statistics will not be readily available.	Tubiello and Rosenzweig, 2008
Nutrition index	Computed metric (sum of local production and net imports divided by total food demand). Can be computed at national regional level.	Tubiello and Rosenzweig, 2008
Yield estimates (remotely sensed), yield variability, highest relative yield/yield percentile	Estimates could help in filling the gaps in the existing yield data, validating the measured yield data etc. Accuracy could be an issue when resolution of remote sensing is low.	Luers et al., 2003
Agricultural export, farm income, out-migration from farming, emergency payments	Agricultural exports and out-migration of farming are mostly applicable at the macro-economic level, while data on rest of the metrics could be sparingly available.	Venema, 2006
Sources of income, livestock number, source of fertilizer	It was not clear on how many sources of income is considered as optimal, and also the number of cattle. However, it is suggested that the higher the sources of income, with more diversification into non-farm sources, the higher the adaptive capacity.	Brooks and Adger, 2005

Table 3.10: Responses obtained from different organizations for the survey.

Nature of agency	**Number**	**Name (if chosen to disclose the name)**	**Nature of agency**	**Total staff strength (range)**	**Total Budget (USD)**
Development agencies	2	Chose not to disclose the name	A quasi-government and a non-governmental Agency	100 - 10000	>1000,000
Governmental agencies	5	Mie Prefecture, Kawasaki Prefecture, Shiga Prefecture, Japan Water Agency, and Higashi Osaka City	City governments, prefectural governments and government agencies	1000-10000	>1000,000
Educational	2	Anonymous and Kyoto University	Universities	1000-10000	>1000,000

3.2.4 Mainstreaming climate change adaptation in Japan

The survey has revealed that the current level of mainstreaming climate change adaptation into institutional processes vastly differ between kinds of institutions studied (Figure 3.6). The numbers indicate the level of mainstreaming assessed on the scale of 1-4 where 1 indicates little or no understanding on the subject, 2 indicates recognition for the need to mainstream, 3 indicates engagement to a certain extent in active mainstreaming of climate change concerns and 4 indicates full mainstreaming where the organization allocates considerable resources and implements climate change adaptation in various activities it carries out.

From the above institutional groupings, it is clear that donor agencies in Japan have rated themselves as fully mainstreaming climate change considerations into their business activities while the government agencies rate poorly with educational institutions falling in between. In general, governments rated better in terms of policy relative to other aspects of evaluation whereas educational institutions rated themselves at level three for planning and strategy. The reasons for poor mainstreaming as identified by the respondents are as follows:

- The staff could identify the entry point for climate change actions (e.g. strategic plans at the city and prefectural level) but felt that the poor knowledge of staff on incorporating climate change aspects into planning is a major hindrance. In some prefectures, though the environment departments are well aware about climate change aspects, other departments don't have necessary knowledge and skills to deal with this subject.
- Lack of collaboration and cooperation among city and prefectural governments.
- Some prefectures expressed concerns related to limited budget hindering the progress in climate change adaptation.
- Agencies such as Japan Water Agency are conducting detailed evaluation of climate change adaptation needs and have plans to introduce capacity building of staff soon after the evaluation. One important limitation that this agency is finding is lack of data to assess climate change risks to water infrastructure in Japan.
- In other prefectures, some of the responding staff indicated the presence of mandate related issues with the staff. Lack of specific terms of reference in the job profile is indicative that these prefectures have not yet reached the level of operationalizing the climate change adaptation.
- In case of universities, limited budget and lack of agenda in some graduate schools is the reason behind limited research in climate change adaptation though most relevant graduate schools have ongoing research on other aspects of climate change. These universities do not have specific departments to address exclusively climate change.

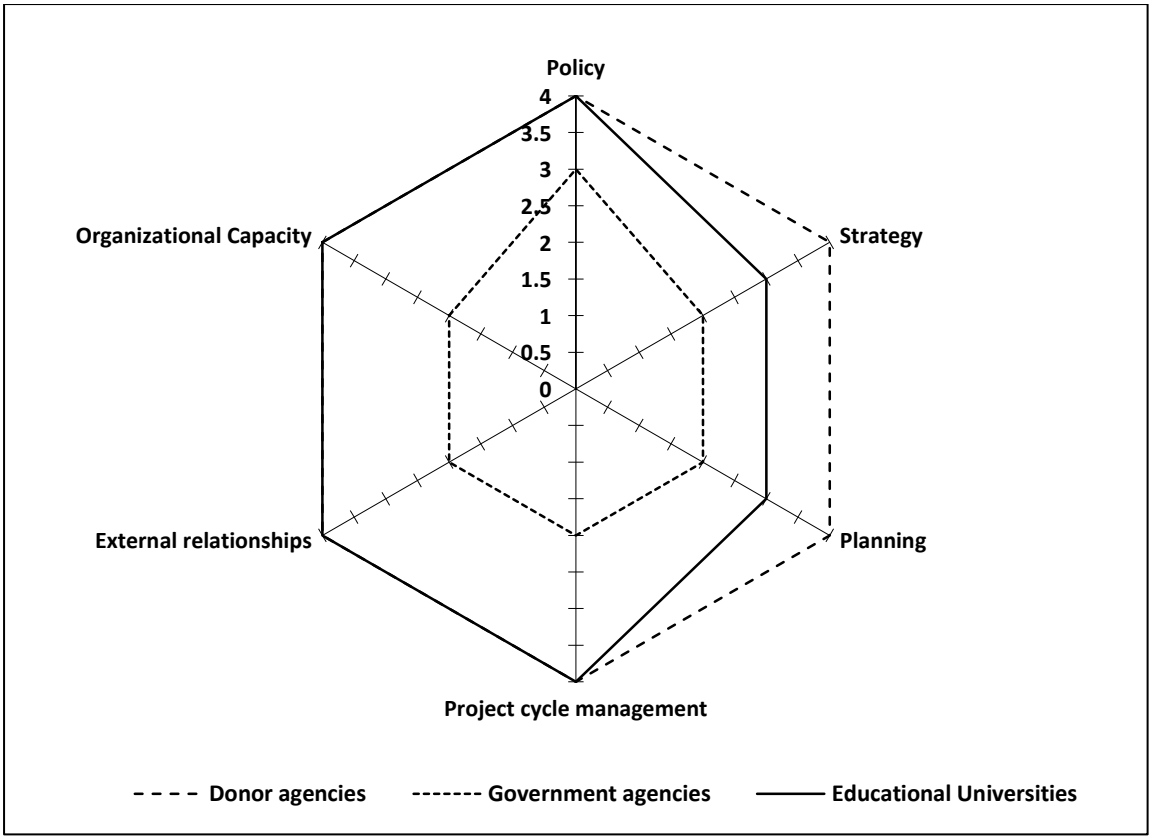

Figure 3.6: Level of mainstreaming climate change adaptation into institutional processes in Japan.

3.3 Characteristics of Adaptive Policies

The case study was conducted on the agriculture sector and disaster risk management in Japan, which are two critical sectors for climate change adaptation. The ways different agencies respond to perceived threat through interventions were compared. These interventions are either through specific policies as in case of agriculture sector or through specific amendments in a response plan as in case of disaster risk management. Results from the questionnaire survey and literature review are discussed in the following sections.

3.3.1 Agriculture sector

Identifying specific policy issue in agriculture sector

Since the number of policy issues and related experience is vast in the agriculture sector, we conducted a questionnaire survey to identify and prioritize important issues in the sector. Most respondents indicated decline in number of farmers as a main policy issue for agriculture in Japan (33%) and they opined that the Agriculture Basic Law or any law that supports farmers and group farming as an important policy intervention for Japan (see Figure 3.7 and Table 3.11). As second most important policy issue, most respondents ranked declining global competitiveness of Japanese agricultural produce (22%) followed by increasing income gap between rural and urban areas in Japan (19%).

Respondents were asked to rate specific policies for their timeliness, adaptiveness, effectiveness and strategic on the scale of 1-5 where 1 is least timely and 5 is most timely. Those who said declining number of farmers is an important policy issue in Japan have rated the related policies as least timely, least to moderately affective, and least to moderately adaptive, and least to moderately

strategic in nature (Table 3.12). Overall, the respondents were not satisfied on the effectiveness of policies introduced in Japan. This very much corroborates with the discussion in this section wherein introduction of different policies didn't lead to positive changes in the trend of number of farmers and land used for agricultural purposes. In the subsequent iterations, the survey will elicit from respondents on the institutional, social and economic reasons behind the poor rating of policies on above indicators.

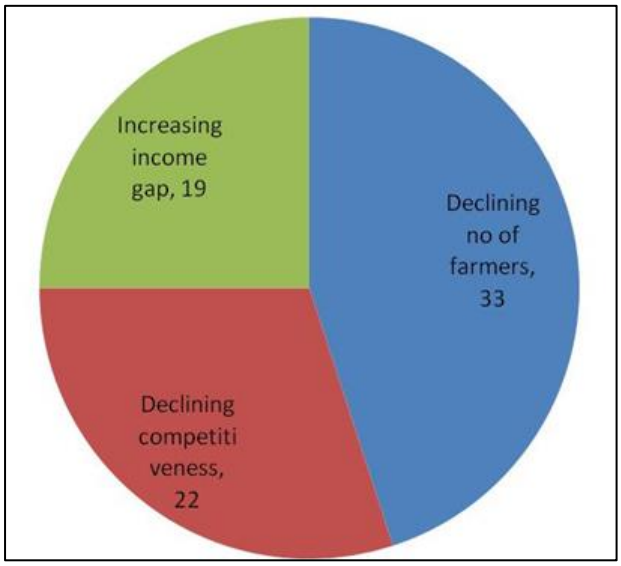

Figure 3.7: Top three important agriculture policy issues in Japan (n =27)

Table 3.11: Important issues identified and policies suggested by the respondents in the first round of Delphi Survey. (n=27)

Rank category	**Important issue hindering agriculture in Japan**	**Important policies for overcoming these issues**
First	Declining number of farmers	▪ Agricultural basic law ▪ Support for new farmers and group farming ▪ Agriculture land act ▪ Promoting strengthening of management foundations
Second	Declining global competitiveness of Japanese agriculture	▪ Rationalisation of owned farm lands ▪ Promoting "6th industrialization" ▪ Trade protection ▪ Fund for price stabilisation of agro-crops
Third	Increasing income gap between rural and urban areas	▪ Direct subsidy to mountainous areas ▪ Compensation for farmers' household income ▪ Agriculture protection policy ▪ Establishing system based on retail market act

Table 3.12: Ranking of policies on the scale of timeliness, adaptiveness, effectiveness and being strategic.

Policy (combined into two groups)	**Criteria ranking (average across each group)**			
	Timely	**Adaptive**	**Effective**	**Strategic**
Policies targeting top 3 issues	Moderately timely	Less adaptive	Less effective	Less strategic
All policies identified by all respondents	Moderately timely	Well adaptive	Effective	Less strategic

When the policies were introduced?

In order to answer this question, historical analysis of various agriculture and allied policies in Japan was conducted from the available literature and findings are presented in this section (see Tables 3.13 – 3.17). The logic behind this analysis was to identify a policy as 'dynamic' if it undergoes continuous change in its course of development and implementation over the years as a result of known external pressures operating in agriculture and allied sectors.

Tables 3.11 – 3.16 present a list of important driving forces that operated during various phases of agriculture policy development and policies that have been implemented in Japan in the past seven decades (modified and updated from Ohara and Soda, 1994). The agricultural policy development in Japan can be broadly divided into six broad time periods i.e.

- Postwar reconstruction period (1940s-1950s);
- Post-Agricultural Basic Act (1960s);
- Low economic growth period (1970s to early 1980s);
- Globalisation period (mid 1980s to early 1990s);
- Structural reform of agricultural and rural policies period (most of 1990s); and
- Realignment of agricultural and rural policies to global trends.

Driving forces for policies introduced during these periods vary greatly. During the postwar reconstruction period (Table 3.13), the driving forces for policies were labor flow, dominance of landlords, reconstruction of economy, and decline in farming population in rural areas. Government had to address these issues early by introducing policies such as Staple Food Control Act (1942), Agricultural Cooperatives Act (1947), Agricultural Land Act (1952), Act for promotion of mechanization (1953), and New Rural Construction (1956). All these acts very much correspond to the issues identified during that period. Same follows for most of the driving forces mentioned in subsequent tables (Tables 3.14 – 3.18).

From the Tables 3.11 – 3.16, one would conclude that agricultural policy environment in Japan can be characterised either as reactive or adaptive. Reactive for the reason that mostly the policies were made in response to emerging issues but mostly well within a decade period within which these policies were identified and implemented with a reasonable period of identifying the issues by the policy formulating institutions and stakeholders. However, this conclusion should be read with a caution since there is no way for this research to identify 'when' a particular issue or driving force has come into existence since most agricultural policy issues have no clear beginning and end point but rather seamlessly emerge with time. By nature due to unknown reasons, agricultural policy issues may remain 'under the carpet' until they surface after crossing a threshold and identification of this period from literature is often difficult and not something that this research could do. Nevertheless, from this review, it can be broadly concluded that agricultural policies in Japan were made in immediate response to the issue once it came to the notice of the policy makers in the country. This addresses the question of how soon a policy was made and brought into effect in Japan.

Table 3.13: Major agricultural issues faced by Japan and major policy interventions addressing the issues during postwar reconstruction period (updated from Ohara and Soda, 1994).

Aspects of policy	Driving issues*	Characteristics
1942 Staple Food Control Act 1947 Enact of Agricultural Cooperatives Act 1948 Agricultural Improvement Promotion Act 1949 Land Improvement Act 1951 Japan and US sign Mutual Security Treaty 1952 Agricultural Land Act 1953 Act on Promotion of Agricultural Mechanization 1954 Japan and US sign Agricultural Surplus-Commodity Agreement 1956 New rural construction; Act on Subsidies for Agricultural Improvement 1960 Japan Association of Corporate Executives announce opinions on Japanese agriculture, scheme of doubling national income	- labor out flow into other industries - farmland dominance by land lords - reconstruction needed for subsistence farming framework - Decline in farming population in rural areas	Agriculture and community: land-owned farmers; integration of agriculture, the community and farmers; vibrant agriculture; a very hopeful period Farming as an occupation: agriculture as a living and as a family business, diversified business (self-support and sell), natural energy dependant farming Farm land: family property, means for the earning Farming community: uniform and self-sufficient (rural) area; traditional system area; the countryside Agrarian labor: family business, tough and hard working farmers

* collected from several sources published during/addressing this period

Table 3.14: Major agricultural issues faced by Japan and major policy interventions addressing the issues during post-Agricultural Basic Act (updated and modified from Ohara and Soda, 1994).

Aspects of policy	Driving issues*	Characteristics
1961 Agricultural Basic Act 1962 Agricultural structural improvement project starts; Consumption of rice starts to decrease 1963 Free trade of bananas and other items 1964 Forestry Basic Act 1967 Record high rice yield of 14 million 4500 thousand tons 1970 Rice Paddy Reduction Policy starts, Amendment of Land Reform Act 1972 'Reconstruction of Japan' written by Kakuei Tanaka (to be prime minister a month after this publication); Establishment of Japan Agricultural Cooperatives	- labor out flow into other industries - full-time farmers decrease - part-time farmers increase - soil natural capability decrease due to over usage of chemical fertilizers and pesticides - income disparity between the rural and urban community - farming population decline in rural areas	Agriculture and community: agriculture as a part of the; national economy; deepening as the side-business; mechanization; more usage of chemicals; modernization of lifestyle; disparity between rural and urban areas is narrower Farming as an occupation: viable farming business (request approval as an independent industry), collaborative farming, monoculture, regional specialization, scale expansion, capital investment, freedom of choice for farming continuation, outflow of labor into other industries Farm land: As a means for the earning, role as insurance Farming community: for supply of industrial labor; urbanization of rural areas, depopulation, production area formulation, riddance from poverty Agrarian labor: Agricultural labor, people with skills

* collected from several sources published during/addressing this period

Table 3.15: Major agricultural issues faced by Japan and major policy interventions addressing the issues during low-economic growth period (updated and modified from Ohara and Soda, 1994).

Aspects of policy	Driving issues*	Characteristics
1973 Oil crisis 1974 National Land use Planning Act, Act Concerning Agricultural Land 1978 Restructuring paddy fields usage measures 1980 Agricultural Land Use Promotion Act; Act on Promotion of Improvement of Agricultural Management Foundation 1981 'Initiative for agricultural self-sustainability research published by the National Institute for Research Advancement (NIRA) 1982 National rice cultivating managers committee is set up	- labor out flow into other industries - full-time farmers decrease - part-time farmers increase - income disparity between the rural and urban community - farming population decline in rural areas - environmental pollution issues	Agriculture and community: adjustment of production; loss of prospects for the future; environmental pollution issues; readjustment of farming; organic farming Farming as an occupation: Single generation farming, development of company-like farming, production of what sells, development of organic farming and fresh from the farm campaign Farm land: Used for transplantation, property management Farming community: Urbanization; aging of the farming community; declining population Agrarian labor: Representational farmers, farmers with up-to-date information

* collected from several sources published during/addressing this period

Table 3.16: Major agricultural issues faced by Japan and major policy interventions addressing the issues during globalization period (updated and modified from Ohara and Soda, 1994).

Aspects of policy	Driving issues*	Characteristics
1985 Brides from the Philippines come to Asahimachi town 1986 Coordination of economic framework for international collaboration workshop report (Maekawa report) is released 1987 Multi-polar Pattern National Land Formation agreed in The Fourth Comprehensive National Development Plan 1988 Embracement of GATT arbitration proposal for the 12 farm products 1991 Implementation of Taxation as home lot, Free trade of rice issue 1992 MAFF announces 'A new way to Food, Agriculture and Rural policy'	- Income disparity between the rural and urban community - Full-time farmers decrease - Part-time farmers increase - Cultivated land abandonment - Farming population decline in rural areas	Agriculture and community: Further progress in globalization and liberalization; resignation farming but at the same time hopeful for future farming Farming as an occupation: Diversification of farmers, resignation farming, renaissance of choosing agriculture as a living, new entry of farming corporations Farm land: Social effect, conscience development for public utilization of farm land; means to enjoy life and the living; landscape formation, environment conservation Farming community: Stimulation of intercommunion of urban and rural areas Agrarian labor: Local agriculture successor, emergence of urban citizens, U-turns

* collected from several sources published during/addressing this period

Table 3.17: Major agricultural issues faced by Japan and major policy interventions addressing the issues during structural reforms of agriculture and rural policies period (compiled by authors from various sources).

Aspects of policy	Driving issues*	Characteristics
1993 The Heisei Rice Riots 1995 MAFF environment-sound agriculture implementation headquarters; National association of environment for sound agriculture implementation committee; Act on Stabilization of Supply, Demand and Prices of Staple Food; Repeal of Staple Food Control Act; Minimum access system of rice begin; Act on Special Measures concerning Incentive Loan Program for Youths to Become Farmers 1997 Outline for New Rice Policy 1998 Outline for Agricultural Policy Reform 1999 Food, Agriculture and Rural Areas Basic Act; Act on Promoting the Introduction of Sustainable Agricultural Production Practices 2000 Hilly and mountainous area direct payment system 2001 Establishment of Research Group for Management Policies in Agriculture September 11 attacks	- farmland usage change (farmland liquidation) - full-time farmers decrease - part-time farmers increase - cultivated land abandonment - aging of the whole farming society	Agriculture and community: Environmentally Friendly Farming, increase of farming organizations, direct income compensation Farming as an occupation: farming corporation labor, no more an occupation for farm or nonfarm origin but for all kinds of people Farm land: cultivated land is transferring into the hands of large-scale farm households Farming community: increase of urbanization of rural areas Agrarian labor: overall aging, quality degradation of agrarian labor, U-turns

* collected from several sources published during/addressing this period

Table 3.18: Major agricultural issues faced by Japan and major policy interventions addressing the issues during realignment of agriculture to global trends period (compiled by authors from various sources).

Aspects of policy	Driving issues*	Characteristics
2002 Management Policy for Promoting Structural Reform of Agriculture Report; New Rice Policy 2004 Amendment of Food Control Act 2006 Production of main crops decrease due to extreme weather around the world; Restriction of genetically modified crops in local governments 2007 IPCC AR4; Concern over climate change impact on agriculture increase; Measures and Policies for the Improvement of Conservation of Rural Land; Comprehensive Strategy on countermeasures against global warming 2008 Rise in crop prices; Tainted rice scam 2009 Agricultural damage to lack of sunlight and low temperature Regime Change 2010 Trans-Pacific Partnership (TPP); Witness record heat; Introduction of income compensation system for individual rice farming households	- Change in farmland usage (farmland liquidation) - excess production of rice - full-time farmers decrease - part-time farmers increase - abandonment of cultivated land - aging of the whole farming society - food security - adaptation to Climate Change?	Agriculture and community: large-scale farm households, increase in Full-Time Farm Households, reconsideration of agricultural identity Farming as an occupation: increase of farmers from other industries origin Farm land: Increase in abandonment of cultivated land area in to other industrial use, concern on mobility of farm land Farming community: diversify into related businesses, high demand for nursing care in agricultural community Agrarian labor: even more aging, increase in new outcome farmers

* collected from several sources published during/addressing this period

How frequent policies were amended?

To answer the question of how frequent policies have undergone change over the period (amended or repealed), following the changing circumstances or driving forces, the number of amendments and repeals some major acts have undergone were looked at. Table 3.19 provides a list of amendments that some major policies have undergone over their implementation period. It is clear from the table that some policies have undergone very frequent changes, as much as every year during their implementation (e.g. Agricultural cooperatives act, agricultural land act and food, agriculture and rural areas basic act), while others have remained more or less same (e.g. agricultural improvement promotion act, act on subsidies for agricultural improvement). From this analysis, few basic conclusions can be drawn:

- The high frequency of changes may have something to do with the importance of the areas these policies aim to address,
- Possible lack of consensus within government and institutions responsible for their formulation and implementation,
- Inability of earlier versions of policies to address/stem the issue,
- Lack of clear understanding among institutions and governments on how to address the problem, and
- Dynamic nature of environment within which various governments and institutions are expected to formulate and implement policies.

Table 3.19: Amendments in major agriculture and related policies in Japan (Compiled from various government sources)

No	Policy/Act	Number of Amendments	Duration in which the amendments carried out	Frequency (changes per year)
1	Staple food control act	27	1943-1994	0.5
2	Agriculture cooperatives act	83	1948-2010	1.3
3	Agricultural improvement promotion act	16	1950-2004	0.3
4	Land improvement act	55	1951-2011	0.9
5	Agricultural land act	66	1953-2010	1.2
6	Act on promotion of agricultural mechanization	13	1962-2006	0.3
7	Act on subsidies for agricultural improvement	16	1961-2010	0.3
8	Agricultural policy	3	1978-1999	0.1
9	Act on promotion of improvement of agricultural management infrastructure	19	1989-2010	0.9
10	Act on stabilization of supply, demand and prices of staple food	9	2000-2010	0.9
11	Act on special measures concerning incentive loan program for youths to become farmers	11	1995-2010	0.7
12	Food, agriculture and rural areas basic act	10	2000-2010	1.0
13	Act on promoting the introduction of sustainable agricultural production practices	3	2002-2010	0.4
14	Act on special measures for promotion of independence for underpopulated areas	9*	2000-2011	0.8
15	Policy for delivering subsidies to the farmers for stabilization of agriculture	1	2009	0.0

* with another amendment scheduled in 2016

How effective the policies are?

While the questions of how soon a policy was introduced and how frequent it was modified to keep abreast with the changing circumstance are important, what is even more important is that the policy delivers the intended outcomes. For identifying the effectiveness of policies, the policies were overlaid on the time series diagrams of various indicators which reflect the effectiveness of a policy for a better visual representation.

Number of farmers

Declining number of farmers has been a major cause of concern for Japan as it is leading to heavy reliance on imported food burdening national economy. Various specific policies and amendments were introduced to control the outflow of farmers from agriculture to non-agriculture sectors. Figure 3.8 depicts major policies introduced and their effectiveness on the trend of number farmers (full time and part time). It is clear from the figure that policies introduced over the years have failed to control the outflow of farmers as reflected from continuous decline in number of farmers in the country.

Land use changes

A factor that is closely associated with the changing number of farmers is the associated decline in area (acreage) under farming. As in former case, several policies were introduced to control the change in land use from agriculture to non-agriculture purposes though some initial leverage was given for deliberate movement of land to non-agricultural purposes for promoting industrialization during the early years of economic growth in Japan. Figure 3.9 show the trend of total population, agriculture production, usage rate of cultivated land, and number of farmers. The main policy introduced to control the rate of land use change from agriculture to non-agriculture use was the Amendment of land reform act (1970) and other related policies. None of these policies could able to stop or control the reduction of agricultural land over the time.

Figure 3.10 shows further details of land use changes within cultivated land in Japan. It is clear from the chart that the introduction of land reforms act in 1970 didn't had any positive change on the land use change from agriculture (both paddy and other field crops) to non-agriculture use.

From these examples of trend in farming population and land use changes, it is clear that related policies have failed to control the unintended changes in Japan. More interestingly, these are the policies that have undergone most amendments since they were introduced (e.g. agriculture land act which has undergone 66 amendments, Table 10). It can be safely concluded from these observations that the indicators such as 'how soon policies were introduced' and 'how frequent policies were amended' may not necessarily lead to effectiveness in policy outcomes.

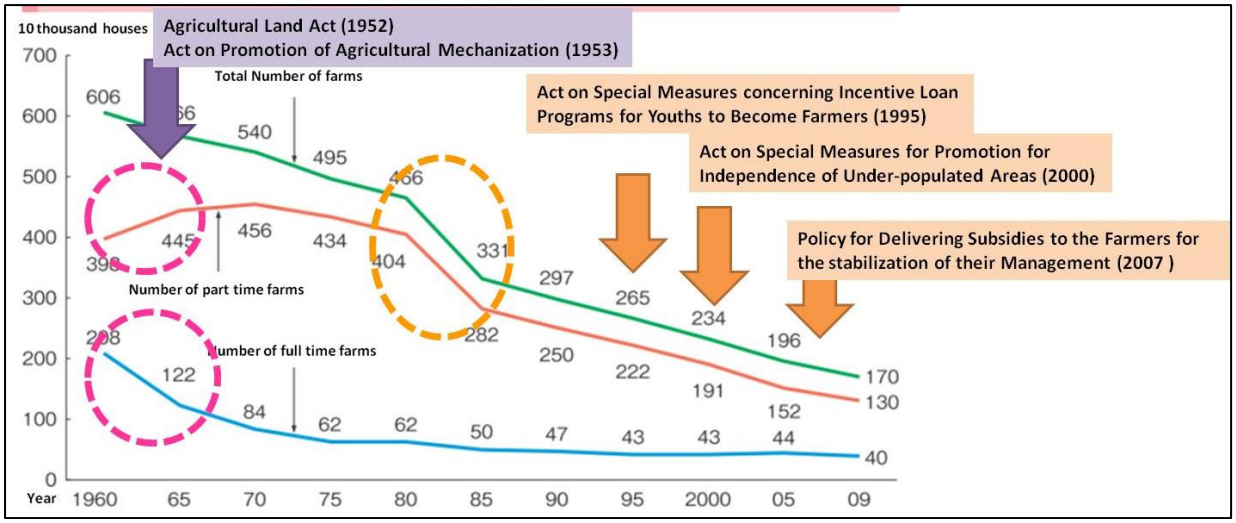

Figure 3.8: Trend of number of farmers in Japan over the past five decades and various policies introduced to stem the decline in number of farmers (Data source: MAFF, 2011a).

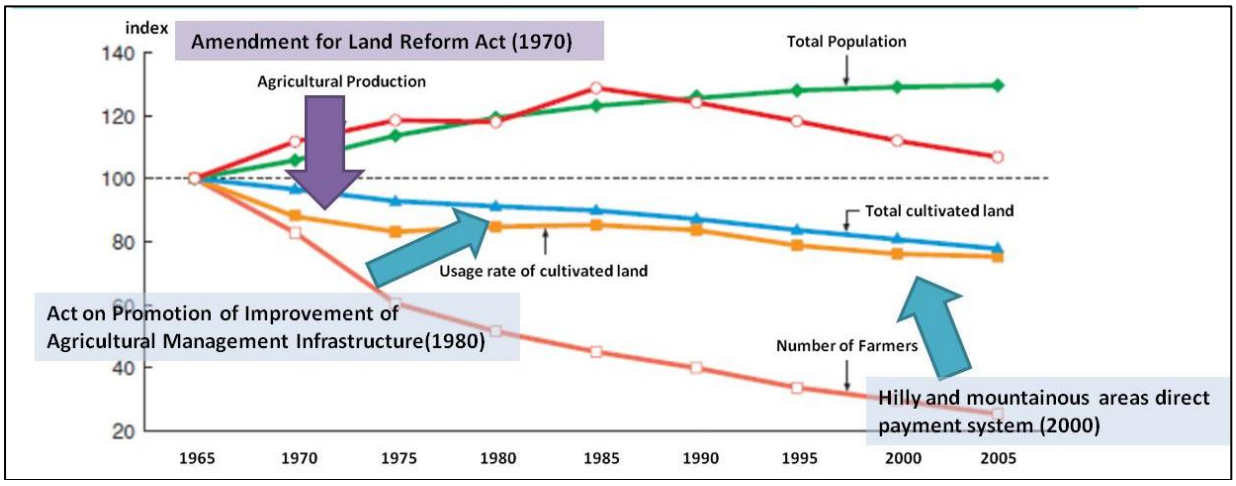

Figure 3.9: Land use changes and various policies introduced to control the land use change (Data source: MAFF, 2011b).

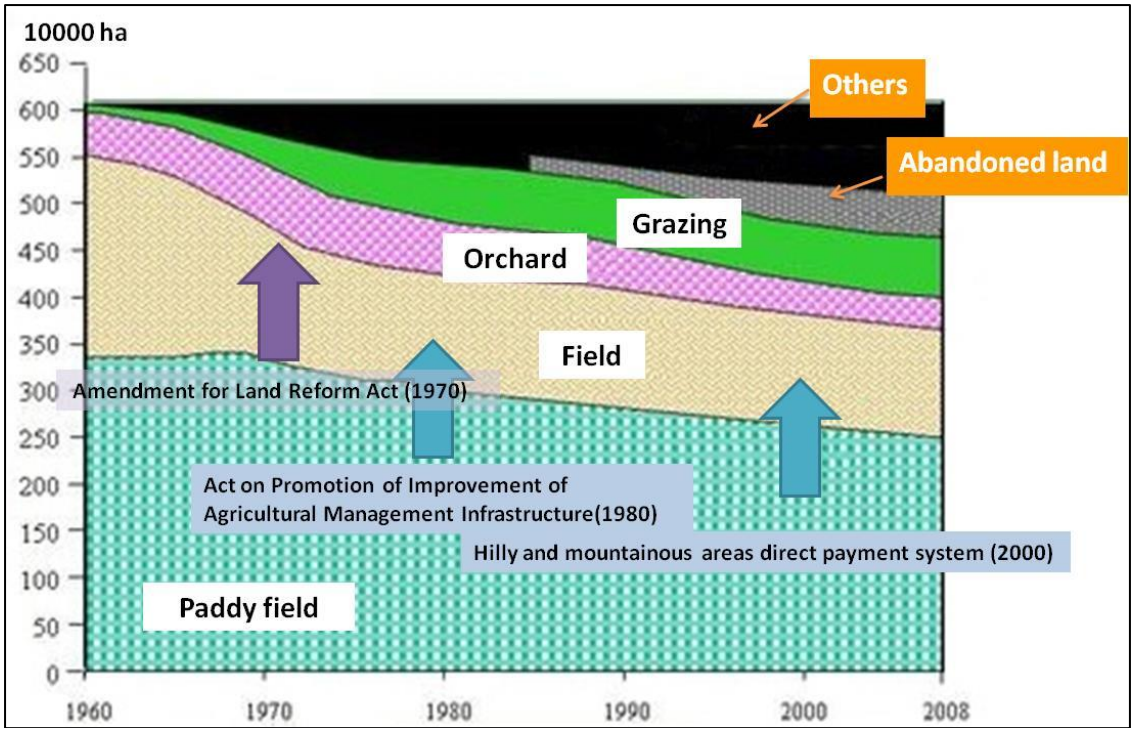

Figure 3.10: Trend of land use changes within agricultural land in Japan and various policies introduced (Data source: MAFF, 2009).

3.3.2 Disaster risk reduction: Response to 2004 typhoon in Shikoku region

The typhoon of 2004 that struck the Shikoku region of Japan is the most severe typhoon known in the recorded history of Shikoku region (Figure 3.11). The typhoon killed 5 people, injured 2 and affected thousands of houses through inundation in the city. A typhoon of this nature was unknown in the history of the city, and the local DRM system was caught unawares. The typhoon has exposed the weaknesses of the city disaster risk management planning, and problems such as the meager income of the city government due to poorly developed industries, outward migration of young people, and an aged population were exposed by the extreme event. In addition, the highly undulated landscape of the city caused heavy downpours to produce flash floods along the Kamo River that runs through the city, creating heavy landslides along the slopes. The impacts of Typhoons 21 and 23 made the city government think differently, and initiate a host of disaster risk management activities.

Amendments in the city disaster management plan

In response to 2004 typhoon, the city has made several amendments to the city disaster management plan. The number and the year of introduction of amendments are presented in Table 3.20. Most amendments were introduced in the same year of experiencing the typhoon or soon thereafter which is in contrast to the situation observed in the case of agriculture where the amendments to policies have been made continuously with little or no effect on the issue being addressed.

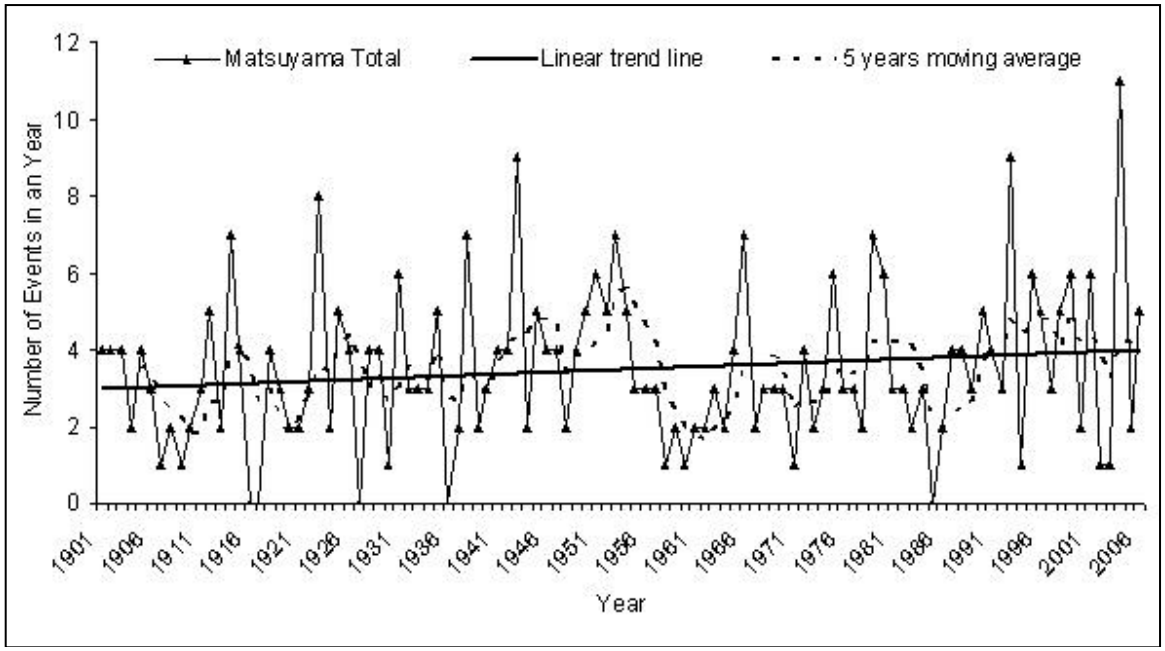

Figure 3.11: Long term trend of heavy precipitation (>50mm/day) events recorded at Matsuyama Observatory, Ehime Prefecture in the Shikoku region of Japan (Source: Using data obtained from Japan Meteorological Agency)

Table 3.20: Responses to typhoon (Amendments to DRM plan) by Saijo city government (modified from Prabhakar et al., 2012).

No	Area of Disaster Management Plan Amended	No of Specific Amendments	Year of Amendment
1	Hazard, risk and vulnerability assessment	9	2004, 05, 06 & 07
2	Redundancy	2	2004 and 06
3	Rescue and evacuation	6	2005 and 07
4	Relief management	2	2005 and 06
5	Forecasting climatic events	6	2005 and 07
6	Dissemination of early warning	1	2006
7	Quick damage assessment	2	2006 and 07
8	Linkage with other stakeholders	4	2006 and 07

3.4 Adaptation Research and Policy Network for the Asia-Pacific Region

The Project had initially set out to identify, assess and develop linkages with existing networks including directory of institutions, projects, researchers and policy-makers on adaptation in the region. A preliminary list of existing networks was ascertained during the First Project Meeting: Climate Action Network (CAN), UNEP Regional Adaptation Network, SEI-SIDA Asia-Pacific Knowledge Platform, Linking Climate Adaptation (LCA) Network, Asia-Pacific Forum for Environment and Development (APFED), and Asia-Pacific Regional Network of Policy Research Institute for Environmental and Sustainable Development (NetRes).

Subsequent to the meeting, a cursory review was done to identify networks and institutions that operate at a regional level. Linkages were later made with several networks. These include Asian University Network on Environment and Disaster Management (AUEDM), the University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR), UNESCO Network on

Communication and Information (ORBICOM). Linkages were also made with a number of prominent universities in the research on climate change adaptation, including Asian Institute of Technology, Nanyang Technology University and Kyoto University.

During the Third Project Meeting, it was decided that ARPNAP, constituting the APN Project Partners as a cohesive unit, would initially play an active role in APAN and AUEDM. The activities of the project will be shared with APAN at its upcoming steering committee meeting scheduled on 10 March 2012 in Bangkok, Thailand. A similar plan is proposed for the upcoming AUEDM steering committee meeting. Through participation in APAN and AUEDM, ARPNAP will pursue the following:-

- Network effectively with other adaptation and sustainable development networks in Asia and beyond.
- Create a platform to support young researchers and post-graduate students to pursue research on adaptation.
- Encourage promising students by organising annual research workshops on adaptation and recognising their research through small awards.
- Promote effective linkages between researchers and policymakers with a view to convince the latter of the importance of adaptation planning at various levels - community, local, national, regional and international.
- Proactively assist the governments to access newly available adaptation funds and where possible, utilise regional funds to maintain the relationship of APN Project Partners beyond the duration of the project.
- Encourage and provide platforms for researchers and practitioners in the region to publish their findings in peer-reviewed and indexed journals.

3.5 Dissemination of Project Outcomes and Knowledge on Adaptation

The Project adopted two approaches in disseminating research findings of the Project to a wider audience in order to enhance knowledge of adaptation in Asia. These included research-policy dialogues and publications. The following sections summarises the activities undertaken and results achieved.

3.5.1 Policy-Research Dialogues and Events

The Project held a total of six meetings. Four meetings were held in Malaysia and one each in Bangkok, Thailand and Incheon, Republic of Korea, respectively. The meetings were mainly carried out in conjunction with other events that UKM jointly organised. Therefore it provided opportunities for Project Partners to share respective research findings with stakeholders, who are essentially policy-makers and researchers in the region. The following briefly summarises the meetings:

- The First Project Meeting (Project Planning Meeting) was held on 11 August 2009 in Kuala Lumpur, Malaysia, which outlined a detailed list of tasks for each Project objectives and planning of future activities. Prior to the meeting, a capacity building workshop on 10 August 2009 was attended by over 40 Malaysian policy-makers and researchers. At the initial stage, the Project has been expanded its partnership, with funding from UKM, to include country participation from Cambodia, the Philippines and Indonesia as well as the Asian Development Bank.
- The Second APN Project Meeting 2010 was held on 26 June 2010 in Port Dickson, Malaysia. It was held in conjunction with the Workshop on Scenarios Concerning Climate Change Adaptation in Asia and the Pacific by Year 2030, jointly organised by ORBICOM, Network of UNESCO Chairs in Communication and Universiti Kebangsaan Malaysia. The APN Project Partners also supported the Workshop, in particular for reviewing the Background Paper for East and Southeast Asia prepared by LESTARI/SEADPRI-UKM and also for providing inputs for the experts' survey on knowledge drivers for climate change adaptation in the Asia Pacific. APN Project Partners were invited to consider having a joint APN Project workshop with ORBICOM, to identify knowledge

drivers for climate change adaptation in the agriculture and water sectors in the near future.

- The Project had its Third Meeting on 16 November 2011. The meeting was held in conjunction with the National Symposium on Climate Change Adaptation and the MyCLIMATE Forum on Climate Change, jointly organised by the Ministry of Natural Resources and Environment, Universiti Kebangsaan Malaysia (LESTARI & SEADPRI-UKM) and APN, with local collaborators and APN Project Partners. The APN Project Partners shared respective research outcomes on local adaptation with Malaysian policy makers, practitioners and researchers.
- The Fourth APN Project Meeting was held on 11 March 2012 in conjunction with the Second Asia Pacific Adaptation Forum 2012, held on 12 & 13 March 2012 in Bangkok, Thailand. The Project Partners updated the research progress and discussed the plan for the final year.
- The Fifth APN Project Meeting was held on 6 November 2012. The meeting was organised in conjunction with the Workshop on Natural Disasters and Climate Change in Asia, held on 5 to 7 November in Bangi, Malaysia. The main purpose of the meeting was to plan the final stage of work in achieving the project objectives. It decided to disseminate the final project outcomes in another regional policy-science dialogue. The event targeted was the Asia Pacific Adaptation Forum from 18 to 20 March 2013 in Korea. The main theme of the Forum, Mainstreaming Adaptation into Development, fits the project objectives.
- The Sixth APN Project Meeting is scheduled to be held in conjunction with the Third Asia-Pacific Climate Change Adaptation Forum on 18-20 March 2013 in Incheon, Republic of Korea. The Project Partners is expected to discuss the final report, share respective research outcomes and outline the final financial report. The meeting would also provide an opportunity to discuss/explore the possibilities for a future collaboration.

In addition to the above, the Project Members also contributed in other events. The presentations were made by the Project Members in sharing the results of research findings to a wider audience at the national (Table 3.21) and international (Table 3.22) platforms.

Table 3.21: List of presentations delivered by the Project Members in respective country

No.	Presentations
	India
1.	Arivudai Nambi, A. Chennai to Copenhagen: Defining Priorities. Preparatory Meeting for COP-15 - Agenda for Chennai. British High Commission, Chennai. 15 November 2009.
2.	Arivudai Nambi, A. Workshop on Economics of Climate Change Adaptation. Madras School of Economics, MSSRF and South Asian Network for Dvelepment and Environmental Economics, Chennai. 12-13 February 2010.
3.	Arivudai Nambi, A. Workshop on Science and Policy for Climate Change – What should we do now? Indian Institute of Technology, Chennai. 17 February 2010.
4.	Arivudai Nambi, A. The Experience Sharing Workshop on Climate Change Action in Semi-Arid Areas. Development Alternatives and SDC, Bundelkhand. 27-28 April 2010.
5.	Arivudai Nambi, A. Visioning Workshop, Climate Change Community and the Knowledge Mela. UNDP, New Delhi. 29-30 April 2010.
6.	Arivudai Nambi, A. and T.N. Balasubramanian. "Vulnerability and adaptation to climate change: towards enriching National missions on climate change – key lessons and experiences from semi-arid areas". SDC and mSSRF. India habitat Centre, New Delhi. 10 June 2010.
7.	Arivudai Nambi, A. "Climate change and agriculture". Symposium on Our Lives, Our Climate – Climate Change and its Impact. Goethe-Institute, max mueller Bhavan, Chennai. 22 June 2010.
8.	Arivudai Nambi, A. Development of methodology for Vulnerability and Risk Assessment of MoEF-GTZ Project on CCA-RAI. Centre for Climate Change Research and Adaptation Research, Chennai. 29 September 2010.
9.	Arivudai Nambi, A. National Policy Dialogue on Climate Change Actions. New Delhi. 12 November 2010.

10.	Arivuudai Nambi, A. "Living with climate change: Lessons from community-based adaptation in water". International Conference cum Workshop on Water Partnerships towards meeting the Climate Challenge, Centre of Excellence for Change (CEC) and UNICEF India. Chennai. 6-7 January 2011.
11.	Arivudai Nambi, A. Food, Agriculture and Rural markets Systems (FARMS) Consultation on Climate Change Adaptation. India-USAID / FARMS, New Delhi. 18-19 October 2011.
12.	Arivudai Nambi, A. "National mission on Sustainable Agriculture - National Action Plan of India and Missions: Reflections on water, forests, agriculture and energy". Invited Lecture, National Roundtable: Climate Change and State Responses: Review of Key Policies and Action. India International Centre, New Delhi. 2-3 November 2011.
13.	Arivudai Nambi, A. Participated in the National Workshop on "Reducing Vulnerabilities to Climate Change and Disaster Risk through Integrated Water Management". AusAID-UNDP, New Delhi. 17 December 2012.
14.	Arivudai Nambi, A. Joint World Bank – MSE Workshop on Diagnostic Tools and Instruments for Assessing Environmental Challenges: Computable General Equilibrium Modeling and other Approaches. Madras School of Economics, Chennai. 19-20 December, 2012.
	Japan
15.	Prabhakar, SVRK; R, Mashimo; S. Hayashi and I. Tsurita. 2011. Adaptive Policies and Measuring Mainstreaming Climate Change Adaptation into Institutional Processes: Some Experiences from Japan. In Adaptive Policies and Measuring Mainstreaming Climate Change Adaptation into Institutional Processes: IGES Consultation Meeting. 28th June 2011. Hayama, Japan.
16.	Tsurita, Izumi; Prabhakar, SVRK; Sano, Daisuke and Hayashi, Shinano. 2011. Does Japan need to think about adaptation within its own agriculture sector? A case study of initiatives in rice production. In 8th International Conference of NAPSIPAG 2011, 17. Kathmandu, Nepal. NAPSIPAG.
17.	Tsurita, Izumi; Prabhakar, SVRK and Hayashi, Shinano. 2011. Climate change adaptation in Japan: Development of Vulnerability and Adaptation Indices for the Asia Pacific Region: identification of win-win adaptation options and adaptation metrics through an integrated decision making framework. In Pacific Regional Meteorological Services Directors Training Workshop.
18.	Prabhakar, SVRK and Misa Aoki. 2013. Do Adaptive Policies Mean Effective Policies? Implications for Climate Change Adaptation and Disaster Risk Reduction. In Earth System Governance Tokyo Conference, Tokyo, Japan. Earth System Governance and Tokyo University.
	Malaysia
19.	Tan, C.T., Pereira, J.J., Mazlin, M., Ibrahim, K. & Nadzri, Y. 2010. Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector in Malaysia. In Workshop on "Mainstreaming Adaptation to Climate Change in Agricultural and Water Sectors", by LESTARI-UKM, 10 August 2009, Kuala Lumpur, Malaysia.
20.	Chee Ping Ngang, Pereira, J.J, Datin Halimaton Saadiah Hashim, 2011. Spatial planning response to climate change: case study of the Selangor River Basin, Malaysia. Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.
21.	Mamunur Rashid, Rawshan Ara Begum, Pereira, J.J., Sarah Aziz and Mazlin Bin Mokhtar, 2011. Perspective on national security and adaptive capacity in the context of climate change in Malaysia. Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.
22.	Md. Azizul Baria, Rawshan Ara Begum, Abdul Hamid Jaafar, Raja Datuk Zaharaton Raja Zainal Abidin, Pereira, J.J., 2011. Water use by people function of their consumption pattern in Malaysia. Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.

23.	Tan, C.T., Pereira J.J., Mazlin, M., Komoo, I. & Nadzri, Y. 2011. Adaptive capacity of water institutions to climate change: an assessment framework. LESTARI Postgraduate Colloquium 2011, Bangi, Malaysia, 21-23 November 2011.
24.	Pereira, J.J. 2012. Vulnerability and Adaptation to Extreme Weather and Climate Change. National Conference On Extreme Weather and Climate Change: Understanding Science and R&D Capacity Needs. Malaysian Meteorological Department, 8-9 October 2012.
25.	Pereira, J.J. 2012. Natural Hazards and The Changing Climate. JPS Technical Talk, 19 October 2012, Ampang, Malaysia. Drainage and Irrigation Department and Malaysian Hydrological Society.
26.	Pereira, J.J. 2012. Disaster Prevention and Climate Change Adaptation: Highlights of IPCC-SREX. Workshop on Natural Hazards and Climate Change Adaptation. Langkawi, Kedah, 9 November 2012. JMG, SEADPRI-UKM, GTK.
27.	Pereira, J.J. 2012. Issues related to Climate Change Impacts related to Geo-Hazards. Strategic Consultative Lab 6 (SCL6) on Climate Change Impact on Water Resources: Water-related Hazard and Risk Management Capacity. Palace of the Golden Horses, Seri Kembangan 12 December 2012. Academy of Science Malaysia.
	Vietnam
28.	Thang, N.V. 2010. On the development of climate change scenarios for Viet Nam. Proceedings of the Fifth Conference of Asia Pacific Association of Hydrology and Water Resources. APHW Conference in Hanoi, Vietnam, 8-9 November 2010.
29.	Thang, N.V. 2010. Assessments of climate change impacts on climate resources. Proceedings of the Fifth Conference of Asia Pacific Association of Hydrology and Water Resources. APHW Conference in Hanoi, Vietnam, 8-9 November 2010.
30.	Thang, N.V. 2011. Mainstreaming Adaptation to Climate Change in Development Activities in Vietnam. National Consultation Workshop on "National Strategy on Climate Change", 18th March 2011, Ho Chi Minh, Vietnam. Ministry of Natural Resources and Environment & United Nations Development Programme.
31.	Thang, N.V. 2011. Climate Change Scenario and Sea Level Rise for Vietnam. Workshop on "Update and Sharing Global and Vietnam Climate Change Information to the Media in the South of Vietnam", 22 October 2011, Cantho, Vietnam. Ministry of Natural Resources and Environment & United Nations Development Programme.

Table 3.21: List of presentations delivered by the Project Members in international platforms

No.	Presentations
	2009
1.	LESTARI-UKM: Collaborative Research on Climate Change. In Workshop on 'Environmental Science Research Field Study', by Royal University of Phnom Penh and The United Nations University, 25 July 2009, Phnom Penh, Cambodia.
2.	Arivudai Nambi, A. Asia Pacific Network Meeting. Impacts of Climate Change on Agriculture and Water in Asia Region. University of Kebangsaan, Kuala Lumpur, Malaysia. 10-12 August 2009.
3.	Arivudai Nambi, A. Facilitating Adaptation: Critical Factors at the Local Level. Side-Event on Local Adaptation to Climate Change COP-15 Meeting. UNFCCC, Copenhagen, Denmark. 10-18 December 2009.
	2010
4.	Tan, C.T. & Pereira, J.J. 2010. Background Paper on Climate Change Adaptation in the Asia Pacific: Southeast Asia & Pacific East as well as China & East Asia. In Knowledge for Development Workshop on Scenarios Concerning Climate Change Adaptation in Asia and the Pacific by Year 2030, by Orbicom the Network of UNESCO Chairs in Communication, 26-28 June 2010, Port Dickson, Malaysia.

5.	Arivudai Nambi, A. Scenario Planning Workshop Concerning Knowledge and Innovation in Climate Change Adaptation, Malaysia. 26-28 June 2010.
6.	Arivudai Nambi, A. Member of Official Indian Delegation to the UN Framework Convention on Climate Change (UNFCCC) – Conference of Parties (COP)-16, Cancun, Mexico. December 2010.
	2011
7.	Prabhakar, SVRK; R. Mashimo; M. Aoki; Tsurita, Izumi and Hayashi, Shinano. 2011. How adaptive policies are in Japan and can adaptive policies mean effective policies? Some Implications for Governing Climate Change Adaptation. In 8th International Conference of NAPSIPAG 2011, 17. Kathmandu, Nepal. NAPSIPAG.
	2012
8.	Arivudai Nambi, A. Panelist for the session on Community Based Adaptation Second Asia-Pacific Climate Change Adaptation Forum. United Nations Conference Centre, Bangkok, Thailand. 12-13 March 2012.
9.	Prabhakar, SVRK. 2012. Opinions and Science in Bottom Up Approaches: Some insights from survey research. In Adaptation Futures: 2012 International Conference on Climate Adaptation, Arizona, USA. 29-31 May 2012. Arizona, USA.
10.	Prabhakar, SVRK; J.J. Pereira; A.A. Nambi; T.C. Tan; T.D. Trong and J. Pulhin. 2012. Strengthening Capacity for Policy Research on Mainstreaming Climate Change Adaptation. In Adaptation Futures: 2012 International Conference on Climate Adaptation, Arizona, USA. 29-31 May 2012. Arizona, USA.
11.	Pereira, J.J. 2012. Strengthening the capacity for policy research on mainstreaming adaptation to climate change in agriculture and water sectors in Southeast Asia. Science-Policy Dialogue on Challenges of Global Environmental Change in Southeast Asia, Bangkok, Thailand, 19-21 July 2012.
12.	Arivudai Nambi, A, Presented a paper on 'Metrics for Mainstreaming daptation in Agriculture & Water Sectors: Insights from Tamil Nadu, India', Workshop on Natural Disasters and Climate Change in Asia, Equatorial Hotel, Bangi, Malaysia. 5-7 November 2012.
13.	Prabhakar, SVRK and Misa Aoki. 2012 Does adaptive policies mean effective policies? Implications for climate change adaptation and disaster risk reduction. Seminar on Climate Change and Natural Disaster in Asia, 5-7 November 2012, Bangi, Malaysia.
14.	Pereira, J.J. 2012. Dealing with geohazards in a changing climate. Workshop on Natural Disasters and Climate Change in Asia. Hotel Equatorial Bangi, 5-7 November 2012. Anjuran SEADPRI-UKM, University of Cambridge, NRE & MKN.

3.5.2 Publications

At the Project Planning Meeting, the Project Partners agreed to produce a publication for any event held by the Project. The focus will now be on channelling the collection of papers to indexed journals, to be considered for a special thematic issue. The aim is to target authors of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR5).

Papers from the Inception Workshop were compiled and internally reviewed by selected Project Members. The papers were then be submitted to a peer reviewed journal, i.e. the Asian Journal on Environment and Disaster Management (AJEDM). The articles were finally accepted for publication as a special thematic issue of the journal: Volume 2, Issue 4 of 2010, "Climate Change Adaptation: Perspectives in the Asia Pacific"). The Special Issue is the first collection of 10 peer-reviewed papers from the two workshops organised by the Project. It represents findings of the project, documenting climate change adaptation perspectives in the Asia Pacific, and country experiences in the water and agriculture sectors. The target group comprises of practitioners and researchers. The list of papers and authors is shown in Table 3.23.

Table 3.23: List of papers and authors in AJEDM Special Issue 2010, Volume 2, Issue 4

No.	Papers	Authors
1.	Mainstreaming Climate Change Adaptation in the Asia Pacific: Current Status and Way Forward for the Agriculture and Water Sectors	S.V.R.K Prabhakar & Kyoto Matsumoto
2.	Climate Change Adaptation: An Overview of Southeast Asia	C.T. Tan, Pereira, J.J.
3.	Climate Change Adaptation: An Overview of Research in South Asia	Rajib Shaw
4.	Climate Change Adaptation: An Overview of Financing Mechanisms in the Agriculture and Water Sectors	Ancha Srinivasan & Abul Quasem Al-Amin
5.	Monitoring the Progress of Adaptation to Climate Change: The Use of Adaptation Metrics	S.V.R.K Prabhakar & Takuro Kobashi
6.	Mainstreaming Adaptation to Climate Change in the Agriculture and Water Sectors in India: An Overview of the Challenges	Arivudai A. Nambi & S.V.R.K Prabhakar
7.	Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector in Malaysia	C.T. Tan, Pereira, J.J., Mazlin M., Ibrahim K.
8.	Climate Change Adaptation Policy for Agricultural Livelihood in Malaysia	Alam,M.M., Chamhuri, & Al-Amin
9.	Climate Change Adaptation in Water and Agricultural Sectors in the Philippines	Pulhin J.M., R.J.J. Peras & M.A. Tapia
10.	Climate Change Adaptation in the Agriculture and Water Sectors: An Overview of Vietnam	Nguyen Van Thang & Tran Dinh Trong

In 2012, the Project contributed to another special issue of the AJEDM (Volume 4 Issue 3) jointly with its networked partner in Nanyang Technology University. The objective is to document the current status and challenges of climate change adaptation in the Southeast Asia including Mekong River Basin for identifying approach to strengthen regional adaptation agenda. The issue, themed as "Strengthening Regional Agenda on Climate Change Adaptation", was a collection of fifteen (15) papers based on research conducted in Southeast Asia. The first ten papers provide an inventory of the state of adaptation practice in the Mekong River Basin, discussing current and projected climate impacts and framework for identifying 'successful' adaptation projects in practice. A set of five case studies are used to present identified best adaptation practices. The other papers discuss the prevailing governance issues in managing adaptation efforts that provide an insight into approaches for strengthening the regional adaptation agenda. The list of papers and authors is shown in Table 3.24.

Table 3.24: List of papers and authors in AJEDM Special Issue 2012, Volume 4, Issue 3.

No.	Papers	Authors
1.	Climate change and adaptation in the Lower Mekong Basin	Lucas Neo
2.	Application of an operational framework for identifying successful adaptation projects in the Lower Mekong Basin	Li Ding
3.	Governance issues in climate change adaptation in the Lower Mekong Basin: Perspectives from practitioners	Lucas Neo
4.	Climate Change Impacts and Adaptation in the Water Resources and Agriculture in Vietnam: Case Studies in Mekong and Red River Deltas	Tran, T, Thang, N.V. & Tran Dinh Trong
5.	Developing multi-scale adaptation strategies: a case study for farming communities in Cambodia and Laos	Roth, C.R. & Clemens M Grünbühel
6.	Climate resilience in rural Cambodia: Adaptation mainstreaming, water resource management and agricultural practice	Lay Khim
7.	Baseline assessments, vulnerability analysis and finding sustainable livelihood options: Designing a climate change adaptation project in Ben Tre Province, Vietnam	Provash Mondal

8.	The conservation and development of the Kien Giang Biosphere Reserve	Sharon M. Brown
9.	Climate change adaptation through agro-social enterprise: Green Net's experiences in Thailand	Vitoon R. Panyakul
10.	Strengthening the Adaptation Agenda in the Mekong River Basin	Andreas Schaffer
11.	Climate Disasters and Climate Change in Vietnam: Tendency, Strategic Tasks, and Action Plans	Tran, T, Thang, N.V. & Tran Dinh Trong
12.	National Policy on Climate Change: Towards An Integrated and Balanced Approach for Adaptation and Mitigation in Malaysia	C.T. Tan, Pereira J.J., Lian Kok Fei
13.	Mitigation Co-Benefits of Adaptation and Actions in Agriculture: An Opportunity for Promoting Climate Smart Agriculture in Indonesia	S.V.R.K Prabhakar, S. Suryahadi, Irsal Las, Astu Unadi, Prihasto Setyanto
14.	A Decision Support System to Deal with Contemporary Issues of Climate Change Induced Vulnerability and Human Security in Peninsular Malaysia	Mohammad Imam Hasan Reza, Sharifah Munirah Alatas
15.	Climate Change Adaptation and Freshwater Resource in Malaysia: Creating A Culture of Intellectualism	Sharifah Munirah Alatas

4. Conclusions

The Project accomplished its aims in strengthening research capacity on mainstreaming climate change adaptation concerns into agricultural and water policies and networking for adaptation policy research in Asia. It contributed to the development of a sound scientific base for decision- and policy-making related to climate change adaptation in the region, particularly in the four participating countries. It also established and engaged in multiple platforms to enhance policy-science interface and disseminate research findings, build capacity, and strengthen network for adaptation policy research.

The technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels were assessed and approaches for addressing the barriers were identified. The assessment reveals the need for capacity building of local stakeholders for science-based adaptation. Topics such as downscaling of climate change projections and impacts would be useful for local level decision making. Through the research undertaken at the national and local levels, it is found that the communication and coordination between different administrative levels needs to be improved ideally with a greater role at the national level such that lessons learned at the local level could be shared effectively. The challenges surround policies and programs that are implemented in a coordinated and integrated manner to avoid duplication in different sectors and governments.

The priority issues in developing indicators to monitor mainstreaming of adaptation measures were identified and country-specific menu of indicators to track effectiveness of such measures were developed. The indicators are essential for prioritising adaptation, but the purpose (such as screening of adaptation projects) and context (such as to set adaptation goals or targets) must be established and communicated to stakeholder clearly. There are a number of principles that should be considered, including scalability, transferability, independence, comparability, and cost-effectiveness, but also it has to be flexible enough to accommodate changes as experiences accumulate. At the local level, engagement between policy makers and local communities is crucial in deciding the indicators. The challenges to initiate and monitor adaptation actions are often related to the long-term nature of climate change, difficulties to find cause-effect relations, lack of

attribution of climate change on the impacts of social change, lack of baseline data, and inadequate understanding of the complex social problems.

Case studies were conducted in evaluating effectiveness and to identify characteristics of selected policies that will enhance adaptive capacity. It is evident from the case studies that mere ability to respond to policy imperatives is not sufficient for a policy to be effective. It is also critical to base assumptions on which the policies were introduced and how clearly the threat has been perceived by the stakeholders engaged in the policy process.

The Project played a catalytic role in exchange of information between and among policy makers and researchers. Linkages have been established with several of the active networks and institutions that have on-going work on climate adaptation at the regional level. These include the Asia Pacific Adaptation Network (APAN), Asian University Network for Environmental and Disaster Management (AUEDM), University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR), Orbicom – Network of UNESCO Chairs in Communication, Asian Institute of Technology, Nanyang Technology University and Kyoto University. The Project Leader has been appointed as a Member of the Steering Committee of APAN administered by UNEP and also Vice-President for Research in AUEDM. ARPNAP, which constitutes the APN Project Partners as a cohesive unit, had used the networks as entry points to disseminate the project findings.

The Project established multiple channels in engaging stakeholders and for disseminating research findings. A Project website has been established and a leaflet was prepared for dissemination of information about the Project. While the Project conducted its dialogues, it also worked in synergy with other networks to jointly hold regional, national and local-level events. In addition to presentation in these sessions, the research findings were also peer-reviewed for publishing in academic journal. Among others, the study results were compiled in two Special Issues of the Asian Journal on Environment and Disaster Management in 2010 and 2012, respectively.

5. Future Directions

Several methodological frameworks and approaches have been developed and tested in specific cases by the respective Project Partners. Issues assessed included mainstreaming climate change adaptation into institutional processes and adaptive policies, effectiveness of specific adaptation measures and the barriers associated with it, and level of institutional capacity for climate change adaptation. While the study focus was on the water and agriculture sectors, the assessment on mainstreaming climate change adaptation can be extended to other inter-disciplinary research areas such as ecosystems based adaptation, climate smart agriculture and green growth and economy.

The frameworks could be further comprehensively improved and used to effectively rank and compare adaptation measures across a broad spectrum and provide critical feedback for mainstreaming adaptation into relevant policy areas. The value of these kinds of study is significant and will assume greater importance in the coming years as it would enable facilitating context specific adaptation measures which are technically relevant, economically viable, and beneficial at both individual and community level. If the focus of the study is fine tuned further it could also contribute to the understanding of specific costs for each of the adaptation measures that are in vogue and there by contribute immensely to the growing body of literature on economics of adaptation.

The study has clearly indicated that there is a great potential for developing tools that help evaluating climate change adaptation at project, program and institutional level. While it appears that the task of evaluating individual technologies (such as zero tillage) is relatively easier, the task is

more complicated and less understood when the evaluation would have to be scaled up beyond technologies, for example at the program, regional, sectoral and national levels. Isolating the effects from other development initiatives that have adaptation co-benefits is a challenge. While conducting mainstreaming evaluation surveys at institutions level, institutions often take such evaluations as intrusion into their matters especially such evaluations are done by an external agency. Hence, it is necessary to develop a methodology that takes into consideration the sensitivities of institutions and how this evaluation information is shared across different actors involved in climate change adaptation. In this context, who conducts evaluations, what is the use of such evaluations (how this information is used), and the implications of such evaluations. There will be less involvement if disclosure of such evaluations is to affect the credibility of institutions. On the contrary, institutions could render more attention to such evaluations if they perceive that evaluations could either effect their public credibility and their existence.

Addressing climate change impacts necessitates integrating knowledge of past experience and insights into future trends. Adaptation strategies require decisions that are valid for the future, decisions made based on future climate forecasts. However, such decision-makings are still hindered by challenges such as limited information on future impacts of climate change, and how to understand and use the available climate information in the processes, including the uncertainties involved in the available climate projections. Hence, there is a need for identifying win-win adaptation options that stand for the current climatic conditions, including climatic variability, and for the broad range of climate change scenarios in the future. Identifying these adaptation options is possible by understanding how these adaptation options will influence the underlying factors that make the system vulnerable to climate change impacts.

The Project generates results from bottom-up approaches that are useful for considering goals, nationally or sectorally, on climate change adaptation. Such adaptation goals may constitute an array of non-empirical aspirations for different sectors. Sector based goals and aspirations are critical for developing a meaningful roadmap at the national level. The potential impacts of climate change are area specific and essentially occurring at the local level. Many adaptation actions will, therefore, require specific spatial consideration and should take into account the different jurisdictions in the country's multi-level government structure.

References

ADB, 2009. The Economics of Climate Change in Southeast Asia: A Regional Review.

Adger, W.N., Brooks, N., Bentham, G., Agnew, M. and Eriksen, S. 2004. New indicators of vulnerability and adaptive capacity. Norwich: Tyndall Centre for Climate Change Research Technical Report 7.

Adger, W.N. and Vincent, K. 2005. Uncertainty in adaptive capacity. C.R. Geoscience 337: 399-410.

Ahmad, Q.K., Warrick, R.A., Downing, T.E., Nishioka, S., Parikh, K.S., Parmesan, C., Schneider, S.H., Toth, F. & Yohe, G. 2001. Methods and tools. In McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J. & White, K.S. (Eds). Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, 105-143.

Alam, M.M., Chamhuri Siwar & Abul Quasem Al-Amin. 2010. Climate Change Adaptation Policy for Agricultural Livelihood in Malaysia. Asian Journal on Environment and Disaster Management 2(4): 463-470.

Alam, M., Rahman, A., Rashid, M., Rabbani, G., Bhandary, P., Bhadwal, S., Lal, M. and Soejachmoen, M.H. 2007. Background paper: impacts, vulnerability and adaptation to climate change in Asia. United Nations Framework Convention on Climate Change.

Arnell, N.W. C. Liu, R. Compagnucci, L. da Cunha, K. Hanaki, C. Howe, G. Mailu, I Shiklomanov and E.

Stakhiv, 2001. Hydrology and water resources. Climate Change 2001: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, J.J. McCarthy, O.F. Canziani, N.A. Leary, D.J. Dokken andK.S.White, Eds., CambridgeUniversity Press, Cambridge, 191-234.

Berkhout, F., 2005, Rationales for adaptation in EU climate change policies. Climate Policy 5, 377-391.

Brenkert, A.L. and Malone, E.L. 2005. Modeling vulnerability and resilience to climate change: a case study of India and Indian states. Climatic Change 72: 57-102.

Brooks, N. 2003. Vulnerability, Risk and Adaptation: A Conceptual Framework. Working Paper 38, Tyndall Center for Climate Change Research, Norwich, UK.

Brooks, N., Adger, W.N. and Kelly, P.M. 2005. The determinants of vulnerability and adaptive capacity at the national level and the implications for adaptation. Global Environmental Change 15: 151-163.

Burton, I., Huq, S. Lim, B., Pilifosova, O., and Schipper, E.L. 2002. From impacts assessment to adaptation priorities: the shaping of adaptation policy. Climate Policy 2: 145-159.

Challinor,A., Wheeler, T., Sling, J. & Hemming, D. 2005. Quantification of physical and biological uncertainty in the simulation of the yield of a tropical crop using present day and doubled CO2 climates. Philosophical transactions of the Royal Society of London, 360, 2085-2094.

Chee, P.N., Pereira, J.J. & Halimaton Saadiah Hashim. 2011. Spatial planning response to climate change: case study of the Selangor River Basin, Malaysia. Research Paper presented at National Symposium on Climate Change Adaptation, 16-17 November, Putrajaya.

Chong, A.L. and Mathews, P. (Eds.). 2001. Malaysia: National response strategies to climate change. Kuala Lumpur, Ministry of Science, Technology and Environment.

Cruz, R.V., Harasawa, H., Lal, M., Wu, S., Anokhin, Y., Punsalmaa, B., Honda, Y., Jafari, M., Li, C. & Huu Ninh, N. 2007. Asia. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. & Hanson, C.E. UK: Cambridge University Press, 469-506.

Fusel, H.-M. and Klein, R.J.T. 2006. Climate change vulnerability assessments: an evolution of conceptual thinking. Climatic Change 75: 301-329.

Glantz, M.H. (Ed). 2001 Once Burned, Twice Shy? Lessons Learned from the 1997-98 El Niño. Tokyo: United Nations University.

Goklany, I.M. 2007. Integrated strategies to reduce vulnerability and advance adaptation, mitigation, and sustainable development. Mitigation and Adaptation Strategies for Global Change 12: 755-786.

Haddad, B.M. 2005. Ranking the adaptive capacity of nations to climate change when socio-political goals are explicit. Global Environmental Change 15: 165-176.

Huq S. and J. Ayers. 2008. Taking steps: Mainstreaming national adaptation. IIED Briefing, November 2008. International Institute for Environment and Development, UK, London.

IIED. 2008. Environmental mainstreaming. International Institute for Environment and Development, UK, London. Available at http://www.environmentalmainstreaming.org/ (Accessed 10 November 2009).

Intergovernmental Panel on Climate Change (IPCC). 2001. Climate Change 2001: Impacts, Adaptation and Vulnerability. Summary for Policy Makers. World Meteorological Organisation, Geneva.

IPCC, 2007a. Summary for Policymakers. In: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC, 2007b. Summary for Policymakers. In: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van

der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22.
IPCC. 2007c. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.
Kelly, P.M. and Adger, W.N. 2000. Theory and practice in assessing vulnerability to climate change and facilitating adaptation. Climatic Change 47: 325-352.
Klein, R.J.T. 2006. Mainstreaming adaptation to climate change into official development assistance. Promoting synergy or divertingmoney? GECHGS News, Spring 2006, pp 4–6.
Klein, R.J.T., Alam, M., Burton, I., Dougherty, W.W., Ebi, K.L., Fernandes, M., Huber-Lee, A., Rahman, A.A. & Swartz, C. 2006. Application of environmentally sound technologies for adaptation to climate change. Technical paper, FCCC/TP/2006/2, United Nations Framework Convention on Climate Change.
Kundzewicz, Z.W., L.J. Mata, N.W. Arnell, P. Döll, P. Kabat, B. Jiménez, K.A. Miller, T. Oki, Z. Sen and I.A. Shiklomanov. 2007: Freshwater resources and their management. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 173-210.
Leichenko, R.M. and O'Brien, K.L. 2002. The dynamics of rural vulnerability to global change: the case of South Africa. Mitigation and Adaptation Strategies for Global Change 7: 1-18.
Liverman, D. 2001. Vulnerability to global environmental change. In Global Environmental Risk, (eds.) J. X. Kasperson and R. E. Kasperson, Earthscan and United Nations University Press, London.
McGray, H. A. Hammill, R. Bradley, E. L. Schipper & J. Parry. 2007. Weathering the storm: Options for framing adaptation and development. World Resources Institute, Washington D.C.
Ministry of Natural Resources and Environment (NRE) 2011. Malaysia Second National Communication to the UNFCCC.
Ministry of Science, Technology and Environment (MOSTE), 2000. Malaysia Initial National Communication.
MONRE, 2008: National Target Program to respond to climate change (Full text). Ha Noi, Vietnam.
MONRE, 2009: Vietnam Second National Communication. Under the United Nations Framework Convention on Climate Change. Ha Noi, Vietnam.
Moss, R.H., Brenkert, A.L. and Malone, E.L. 2000. Vulnerability to climate change: a quantitative approach. US: Department of Energy.
Munasinghe, M., 2000: Development, equity and sustainabillity (DES) in the context of climate change. In: Climate Change and Its Linkages with Development, Equity and Sustainability: Proceedings of the IPCC Expert Meeting held in Colombo, Sri Lanka, 27–29 April, 1999 [Munasinghe, M. and R. Swart (eds.)]. LIFE, Colombo, Sri Lanka; RIVM, Bilthoven, The Netherlands; and World Bank, Washington, DC, USA, pp. 13–66.
Nambi, A.A. & Prabhakar, S.V.R.K. 2010. Mainstreaming Adaptation to Climate Change in the Agriculture and Water Sectors in India: An Overview of the Challenges. Asian Journal on Environment and Disaster Management 2(4): 443-452.
National Hydraulic Research Institute Malaysia (NAHRIM), 2006, Study of the impact of climate change on the hydrologic regime and water resources of Peninsular Malaysia – Final Report. NAHRIM, Malaysia.
NAHRIM. 2009. Preliminary impact assessment of climate change on irrigation and water supply scenario for selected areas in Malaysia. Study Report.
O'Brien, K., Eriksen, S., Schjolden, A. And Nygaard, L. 2004. What's in a word? Conflicting interpretations of vulnerability in climate change research. CICERO Working Paper 2004: 04. Norway: CICERO. pp 16.
Orindi, V.A. and Eriksen, S. 2005. Mainstreaming adaptation to climate change in the development

process in Uganda. Kenya: Acts Press.
Parry, M.L., O.F. Canziani, J.P. Palutikof and Co-authors. 2007. Technical Summary. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 23-78.
Pelling, M. and High, C. 2005. Understanding adaptation: what can social capital offer assessments of adaptive capacity? Global Environmental Change 15: 308-319.
Pereira, J.J. 2009. Strengthening capacity for policy research on mainstreaming adaptation to climate change in agriculture and water sectors. APN Newsletter 15(4): 26. Japan: APN Secretariat.
Prabhakar, S.V.R.K. 2007. Climate change implications for sustainable development: need for holistic and inclusive policies in agriculture, land, rural development, desertification, and drought. UNESCAP, Bangkok, Thailand.
Prabhakar, S.V.R.K. & Kyoto Matsumoto. 2010. Mainstreaming Climate Change Adaptation in the Asia Pacific: Current Status and Way Forward for the Agriculture and Water Sectors. Asian Journal on Environment and Disaster Management 2(4): 363-370.
Prabhakar, S.V.R.K. 2011. Climate Change Impacts in Japan and Southeast Asia: Implications for Crop Adaptation. In Crop Adaptation to Climate Change, edited by S. Yadav, B. Redden, J. L. Hatfield, H. Lotze-Campen and A. Hall. 30. USA. John Wiley.
Prabhakar, S.V.R.K. & Kobashi, T . 2010. Monitoring the Progress of Adaptation to Climate Change: The Use of Adaptation Metrics. Asian Journal on Environment and Disaster Management 2(4): 435-442.
Prabhakar, S.V.R.K., R. Mashimo, M. Aoki; Tsurita, I. & Hayashi, S. 2011. How adaptive policies are in Japan and can adaptive policies mean effective policies? Some Implications for Governing Climate Change Adaptation. In 8th International Conference of NAPSIPAG 2011, 17. Kathmandu, Nepal. NAPSIPAG.
Pulhin, J.M., Rose Jane J. Peras & Maricel A. Tapia. 2010. Climate Change Adaptation in Water and Agricultural Sectors in the Philippines. Asian Journal on Environment and Disaster Management 2(4): 471-484.
Reza, M.I.H. & Alatas, S.M. (2012). A Decision Support System to Deal with Contemporary Issues of Climate Change Induced Vulnerability and Human Security in Peninsular Malaysia. Asian Journal on Environment and Disaster Management 4(3).
Schipper, E.L., 2006. Conceptual history of adaptation in the UNFCCC process. RECIEL 15: 82–92.
Smit, B., Burton, I., Klein, R.J.T. and Wandel, J. 2000. An anatomy of adaptation to climate change and variability. Climatic Change 45: 223–251.
Smit, B. and Pilifosova, O. 2001. Adaptation to climate change in the context of sustainable development and equity. In McCarthy et al (Eds.) Climate Change 2001: Impacts, Adaptation, and Vulnerability. Cambridge University Press, Cambridge.
Smit, B. and Wandel, J. 2006. Adaptation, adaptive capacity and vulnerability. Global Environmental Change 16: 282-292.
Sodhi, N.S., Koh, L.P., Brook, B.W. & Ng, P.K.L. 2004. Southeast Asian biodiversity: an impending disaster. Trends in Ecology and Evolution 19: 654-660.
Srinivasan, A. & Al-Amin, A.Q. 2010. Climate Change Adaptation: An Overview of Financing Mechanisms in the Agriculture and Water Sectors. Asian Journal on Environment and Disaster Management 2(4): 427-434.
Sygna, L., Eriksen, S., O'Brien, K., and Naess, L.O. 2004. Climate change in Norway: Analysis of economic and social impacts and adaptation. CICERO Report 2004: 12. Norway: CICERO. pp 39.
Tan, C.T. & Pereira, J.J. 2010. Climate Change Adaptation: An Overview of Southeast Asia. Asian Journal on Environment and Disaster Management 2(4): 371-398.
Tan, C.T., Pereira, J.J., Mazlin, M., Ibrahim, K. & Nadzri, Y. 2010. Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector in Malaysia. Asian Journal on

Environment and Disaster Management 2(4): 453-462.
Tearfund. 2005. Mainstreaming disaster risk reduction. A tool for development organizations. Tearfund, UK.
Tol, R.S.J. and Fankhauser, S. 1998. On the representation of impact in integrated assessment models of climate change. Environmental Modeling and Assessment 3: 63-74.
Tran, T., Nguyen Van Thang and Tran Dinh Trong. 2010. Climate Change Adaptation in the Agriculture and Water Sectors: An Overview of Vietnam. Asian Journal on Environment and Disaster Management 2(4): 485-494.
Tran, T., Nguyen Van Thang and Tran Dinh Trong. (2012). Climate Change Impacts and Adaptation on the Water Resources and Agriculture in Vietnam: Case Studies in Mekong and Red River Deltas. Asian Journal on Environment and Disaster Management 4(3).
Tran, T., Nguyen Van Thang and Tran Dinh Trong. (2012). Climate Disasters and Climate Change in Vietnam: Tendency, Strategic Tasks, and Action Plans. Asian Journal on Environment and Disaster Management 4(3).
UNDP. 2004. UNDP Environmental mainstreaming strategy: A strategy for enhanced environmental soundness and sustainability in UNDP policies, programs, and operational processes. UNDP, New York.
United Nations Framework Convention on Climate Change (UNFCCC). 2006. Technical paper on terms of transfer of and know-how: barriers and opportunities related to transfer of technology. FCCC/TP/1998/1, United Nations Framework Convention on Climate Change.
UNEP and Danida, 2005: Climate Check in Vietnam. Final country report.
van Aalst, P. 2006. Innovative options for financing the development and transfer of technologies. Technical paper, FCCC/TP/2006/1, United Nations Framework Convention on Climate Change.
Vincent, K. 2007. Uncertainty in adaptive capacity and the importance of scale. Global Environmental Change 17: 12-24.
Yohe, G.W. 2001. Mitigative capacity – the mirror image of adaptive capacity on the emissions side – An editorial. Climatic Change 49: 247-262.
Yohe, G.W. and Tol, R.S.J. 2002. Indicators for social and economic coping capacity – moving toward a working definition of adaptive capacity. Global Environmental Change 12: 25-40.

Appendices

Appendix 1: Minutes of Project Meetings
Appendix 2: Conferences/Symposia/Workshops
Appendix 3: Funding sources outside the APN
Appendix 4: List of Young Scientists
Appendix 5: Glossary of terms
Appendix 6: Questionnaires
Appendix 7: Publications
Appendix 8: Photos

Appendix 1: Minutes of Project Meetings

1. First Project (Planning) Meeting, 11 August 2009, Kuala Lumpur, Malaysia.
2. Second Project Meeting, 26 June 2010, Port Dickson, Malaysia.
3. Third Project Meeting, 16 November 2011, Putrajaya, Malaysia.
4. Fourth Project Meeting, 11 March 2012, Bangkok, Thailand.
5. Fifth Project Meeting, 6 November 2012, Bangi, Malaysia.
6. Sixth (Final) Project Meeting, scheduled on 18-20 March 2013, Incheon, Republic of Korea.

APN Project: "Strengthening the Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture & Water Sectors"

PROJECT PLANNING MEETING

Date: 11 August 2009.
Time: 9.00 am – 4.00 pm.
Venue: Corus 2, Corus Hotel Kuala Lumpur, Malaysia.

Attendance:
1. Prof Dr. Joy Jacqueline Pereira, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM) – Chair
2. Mr. Nyda Chhihn, Royal University of Phnom Penh (RUPP), Cambodia
3. Dr. Ancha Srinivasan, Asian Development Bank (ADB)
4. Dr. Arivudai A Nambi, M. S. Swaminathan Resaerch Foundation (MSSRF), India
5. Dr. Krishna Suryanto Pribadi, Bandung Institute of Technology (ITB), Indonesia
6. Dr. S.V.R.K. Prabhakar, Institute for Global Environmental Strategies (IGES), Japan
7. Dr. Takuro Kobashi, Institute for Global Environmental Strategies (IGES), Japan
8. Prof. Dr. Juan M. Pulhin, University of the Philippines Los Baños (UPLB), Philippines
9. Dr. Nguyen Van Thang, Institute of Meteorology, Hydrology & Environment (IMHEN), Vietnam
10. Dr. Tran Dinh Trong, Institute of Meteorology, Hydrology & Environment (IMHEN), Vietnam
11. Datin Dr. Syarifah Munirah Syed Hussein, Universiti Kebangsaan Malaysia (UKM)
12. Dr. Abul Quasem Al-Amin, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)
13. Ms. Koh Fui Pin, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)
14. Mr. Mohd. Khairul Zain Ismail, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)
15. Mr. Tan Ching Tiong, Southeast Asia Disaster Prevention Research Institute, Universiti Kebangsaan Malaysia (SEADPRI-UKM)

Discussion Items:
1. Inception Workshop on 10 August 2009.
2. APN Project Proposal.
3. Financial Arrangement.
4. Other Matters.

MINUTES OF MEETING

1. Inception Workshop on 10 August 2009.

1.1 Prof. Pereira recapped the Inception Workshop held on 10 August 2009. LESTARI-UKM will collect feedbacks of selected Malaysian policy-makers about the workshop and the APN Project.

1.2 The meeting agreed to produce publication for any events held by the Project. For the Inception Workshop, LESTARI-UKM will coordinate with all speakers in preparing the publication based on the materials gathered from the workshop. Length of each paper is 5-10 pages (A4), including figures (limited to two only). LESTARI-UKM will draft discussion in each session. Deadline for submission of paper is 31 October 2009.

2. APN Project Proposal.

2.1 The meeting deliberated activities to be undertaken in achieving the Project objectives (Appendix A). While each institution is expected to carry out all activities, a preliminary list of lead coordinator and supporting institution were determined for each objectives as follows:

Objective	Lead Coordinator	Supporting Institution
Objective 1	LESTARI-UKM	IGES
Objective 2	IGES	MSSRF
Objective 3	IGES	IMHEN
Objective 4	LESTARI-UKM	IGES
Objective 5	LESTARI-UKM	IGES

The function of lead coordinator institute is to update rest of the institutions with the latest literature in the relevant area, to act as a resource for clarifying the methodological issues, and to coordinate the progress on that component. Supporting institutions would help backup whenever and wherever necessary.

2.2 The meeting agreed that each institution will first undertake Step 1 of Objective 1, Step 1 of Objective 2 and Step 1 of Objective 3, and consider methodology of all other steps. Deadline of the review exercise is 31 March 2010. The outcomes of this phase would have to be presented in the next meeting planned to be organised in April 2010 in Malaysia (actual dates to be finalised after consulting with all the partner institutions).

3. Financial Arrangement.

3.1 LESTARI-UKM will circulate the signed contract to MSSRF, IGES and IMHEN.

3.2 MSSRF, IGES and IMHEN will provide a letter to LESTARI-UKM on participation in the Project to facilitate disbursement of funds from LESTARI-UKM to the three respective partners. In case if a invoice is required, a request will be made by LESTARI-UKM to the partners.

3.3 LESTARI-UKM will inquire the APN Secretariat on disbursement of advance funding and guidance of financial reporting.

4. Other Matters.

4.1 LESTARI-UKM will inquire with the APN Secretariat on the requirements of the Project annual reporting, which is expected to due in July 2010.

4.2 The meeting agreed to plan and document modality for engaging policy-makers at planning stage and during dissemination of the Project outcomes (to draw on case studies).

4.3 The meeting agreed that a workshop to be held in Malaysia, tentatively in April 2010, to take stock of and consider further the proposed activities in Item 2.1 based on the outcome of Item 2.2. The workshop will attempt to invite Dr Darren A. Swanson, Senior Project Manager of the International Institute for Sustainable Development (IISD) to speak on its framework for characterising adaptive nature of selected policies.

4.4 The meeting recognised the need of resources for additional activities, including the Asia-Pacific Regional Policy Dialogue in 2012 and partnership with other institutions (such as University of California, San Diego, etc).

Appendix A: Proposed list of activities under each objectives of the Project

Objective 1: To assess technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels and propose countermeasures

a. Step 1: Assessment of national documents/reports
    - Country coverage: India, Japan, Malaysia, Vietnam (+ Bangladesh, Cambodia, Indonesia, Philippines, China, and others); and
    - Documents: national communications and other documents submitted to the UNFCCC, poverty reduction strategy papers (PRSPs), MDG progress reviews, and national sustainable development strategies (NSDS).
b. Step 2: Identification of critical barrier (primary and secondary)
    - Country coverage: India, Japan, Malaysia, Vietnam (+ Bangladesh, Cambodia, Indonesia, Philippines, China, and others);
    - Consultation with national policy-makers in identifying the barriers and on recommendations to counter the barriers;
    - Develop checklist of questions, initial survey, desktop study; and
    - Develop country-specific framework of primary and secondary barriers.
c. Step 3: Propose counter measures for overcoming barriers
    - Country coverage: India, Japan, Malaysia, Vietnam (+ Bangladesh, Cambodia, Indonesia, Philippines, China, and others);
    - Consultation with national policy-makers in identifying the barriers and on recommendations to counter the barriers;
    - Develop checklist of questions, initial survey, desktop study; and
    - Develop country-specific framework for counter measures.

Objective 2: To develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations

a. Step 1: Identification of country-specific menu of indicators (social, environmental, economic, including human security) to track effectiveness (reference: World Bank document; IGES questionnaire)
    - Priority issues: drought, flood, sea-level rise, typhoon/cyclone, hurricane, seasonal change, extreme swell/wave;
    - Adaptation of questionnaire to local conditions; and
    - Conduct policy consultation for responses on questionnaire.
b. Step 2: Assessment of priority adaptation investment in case study country
    - Portfolio of adaptation related projects in agriculture and water sectors;
    - Applicability of indicators for tracking progress of such projects (measurable, reportable and verifiable); and
    - Develop country-specific framework to prioritise indicators of adaptation effectiveness.
c. Step 3: Testing of adaptation metrics
    - Select specific study cases (2-4) in each country; and
    - Determine methodology for testing the adaptation metrics (multi-criteria analysis, and Analytic Hierarchy Process (AHP), etc).

Objective 3: To identify characteristics of selected policies that will enhance adaptive capacity

a. Step 1: Survey of key policies in agriculture and water sectors (regulatory, economic instruments, insurance, water conservation law, etc)
    - Documentation and prioritisation of effective policies in existing policy environment (without considering climate change).
b. Step 2: Assessment of the adaptive nature of the selected policies (2-4) using IISD framework
    - Identify key determinants of adaptive nature of selected policies in country context.
c. Step 3: Assessment of enabling factors and barriers for adaptive policies

Objective 4: To create a ARPNAP network linking adaptation research and policymakers in Asia

a. Step 1: Formalise institutional affiliation to ARPNAP
b. Step 2: Prepare a charter for the affiliation (sample from IGES: UNEP adaptation network)
    - Identify benefits of membership.
c. Step 3: Develop website and publicity materials in English
d. Step 4: Identify, assess and develop linkages with existing networks including directory of institutions, projects, researchers and policy-makers on adaptation
    - List of existing networks: CAN, UNEP Regional Adaptation Network, SEI-SIDA Asia-Pacific Knowledge Platform, LCA Linking Climate Adaptation, APFED, NetRes, and others; and
    - Affiliation to International Human Dimensions Programme on Global Environmental Change (IHDP): to add IHDP logo in ARPNAP website.

Objective 5: To disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications:

a. Peer-reviewed articles – ISI recognised (min 2 per institution)
b. Institutional publications (policy brief, working papers, etc)
c. Books, research monograph
d. Conference presentations, COP side event
e. Interim, annual, final and financial reports
f. Two-page article for APN upon request

PROJECT MEETING 2010

Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors (CRP2009-02NMY-Pereira)

26 June 2010, Port Dickson, Malaysia

ATTENDANCE

1. Prof Dr. Joy Jacqueline Pereira, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)
2. Dr. S.V.R.K. Prabhakar, Institute for Global Environmental Strategies (IGES), Japan
3. Dr. Arivudai A Nambi, M. S. Swaminathan Resaerch Foundation (MSSRF), India
4. Mr. Tran Dinh Trong, Institute of Meteorology, Hydrology & Environment (IMHEN), Vietnam
5. Prof. Dr. Juan M. Pulhin, University of the Philippines Los Baños (UPLB), Philippines
6. Mr. Nyda Chhihn, Royal University of Phnom Penh (RUPP), Cambodia
7. Mr. Tan Ching Tiong, Southeast Asia Disaster Prevention Research Institute, Universiti Kebangsaan Malaysia (SEADPRI-UKM)
8. Ms. Sharifah Diyana Syed Ismail, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)

AGENDA

1. Welcoming Remarks
2. Work Progress
3. Network Development
4. Publication
5. Finance
6. Future Plans
7. Other Matters

DISCUSSION

1. Welcoming Remarks

Prof. Dr. Joy Jacqueline Pereira warmly welcomed and thanked everyone for making time to attend the APN Project Meeting 2010, held in conjunction with the Workshop on Scenarios Concerning Climate Change Adaptation in Asia and the Pacific by Year 2030, jointly organised by ORBICOM, Network of UNESCO Chairs in Communication and Universiti Kebangsaan Malaysia (LESTARI-UKM & SEADPRI-UKM).

Prof. Pereira thanked the APN Project Partners and Affiliates for supporting the Workshop; in particular for reviewing the Background Paper for East and Southeast Asia prepared by LESTARI-UKM/SEADPRI-UKM and also for providing inputs for the experts survey on knowledge drivers for climate change adaptation in the Asia Pacific. APN Project Partners and Affiliates were invited to consider having a joint APN Project workshop with ORBICOM, to identify knowledge drivers for climate change adaptation in the agriculture and water sectors in the near future.

The meeting was informed that the Project Interim Report and the Progress Report for Year 1 was submitted to the APN Secretariat in January 2010 and February 2010, respectively. The Project has now been approved to receive funding for Year 2. The outcomes reported at this meeting will serve as a basis for preparing the Progress Report for Year 2.

The main purpose the APN Project Meeting 2010 is to further develop the establishment of the **A**daptation **R**esearch and **P**olicy **N**etwork for **A**sia and the **P**acific (ARPNAP) and review progress since the last meeting on 11 August 2009 in achieving the project objectives as listed below:-

1. To assess technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels and propose countermeasures.
2. To develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations.
3. To identify characteristics of selected policies that will enhance adaptive capacity.
4. To create a ARPNAP network linking adaptation research and policymakers in Asia.
5. To disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

2. Work Progress

LESTARI-UKM, Malaysia

Role: Project coordination, and implementation of activities in Malaysia, Networking in *Archipelagic Southeast Asia*. Lead Coordinator Institute for Objectives 1, 4 and 5 – provide update on the latest literature; act as a resource for clarifying the methodological issues; and coordinate progress.

Status: The research team held six meetings over the past year to mobilise and monitor progress. With respect to Objective 1, a review of national documents in the agriculture and water sectors has been completed. A preliminary report has been prepared and is now being reviewed internally. The report will be circulated to project partners by October 2010 [Tan C.T & Dr. Amin]. With respect to Objective 2, a literature review of concepts and criteria for developing climate change indicators has been completed. The menu of indicators has been identified and the framework is now under discussion. In developing the framework, a national-level workshop is being proposed to identify priorities with respect to climate change and national security. The project team has decided to adopt the Selangor Basin, Malaysia, which is an important area for food security, for the pilot study. Background information on the basin, i.e. its history of its land-use, demographics, socio-economic activities, is being collected using GIS and this will be followed by a local level consultation workshop on issues and priorities [Rashid & Rashidah]. With respect to Objective 3, the means of building capacity on understanding the adaptive nature of policies using the IISD framework is being grappled with [Joy Pereira & Dr. Munirah]. With respect to Objective 4, a quick review of several key networks has been conducted. The next stage of work will commence upon receiving

inputs from this meeting [Eli Diyana]. With respect to Objective 5, several linkages have been made (i.e. AUEDM, UN-CECAR, ORBICOM, etc.). A template will be developed to report networking and information dissemination activities. The report from LESTARI-UKM using this template will be circulated to Project Partners and Affiliates by August 2010 for comments, improvements and routine provision of information, thereafter [Eli Diyana]. SEADPRI-UKM, in conjunction with LESTARI-UKM & the Asian University Network for Environment and Disaster Management (AUEDM), is developing an Information Portal on stakeholder engagement and good practices in CCA and DRR. The Portal will also be leveraged to highlight the outputs of the APN Project [Khairul].

Institute for Global Environmental Strategies (IGES), Hayama, Japan.

Role: Partner and mentor institute to develop methodologies and build adaptation research and policy networks in Asia in general and East Asia in particular. Lead Coordinator Institute for Objectives 2 and 3 – provide update on the latest literature, act as a resource for clarifying the methodological issues, and coordinate progress.

Status:

Progress for the Year I:

1. Conducting an **expert consultation workshop** entitled 'Adaptation in Agriculture and Water Sectors in Japan and Its Relevance for Developing Countries in the Asia Pacific' as a part of the institute-wide conference 'International Forum for Sustainable Asia and the Pacific'. This expert consultation aims at obtaining lessons from the national level initiatives that could be of relevant for the developing countries in the region in terms of institutional, policy and technological fronts. A group of experts representing various technological, policy and institutional domains will present their views on current emphasis on adaptation in Japan and how it could be relevant to the developing countries in the Asia Pacific region. This is to explore the question what are the technical, institutional and policy barriers that Japan faced in promoting better agriculture and water management within Japan which would in turn give an indication of how Japan can strengthen the science-based adaptation in the Asia Pacific region. The workshop is scheduled for 13th July in Yokohama, Japan.
2. **Working paper** on 'How Japan Can Contribute to Climate Change Adaptation in Developing Countries in the Asia-Pacific? A Focus on Agriculture and Water Sectors' to be finalized. This paper provides a thorough review of the current state of adaptation related expertise available in Japan and assesses its relevance to the adaptation needs in the Asia Pacific region. The working paper is a living document for the next half a year during which the new findings and developments will be updated and finally published as an IGES publication.
3. **Book Chapter:** A book chapter on Climate Change Impacts in Japan and Southeast Asia: Implications for Crop Adaptation was published (in print) in a book to be published by Wiley and Blackwell (**suggested citation**: Prabhakar, SVRK. 2010/10. Climate Change Impacts in Japan and Southeast Asia: Implications for Crop

Adaptation. In Crop Adaptation to Climate Change, edited by S. Yadav, B. Redden, J. L. Hatfield, and H. Lotze-Campen. 30. USA. Wiley-Blackwell).

Activities planned for Year II (tentative):

4. **Working paper** on the relevance of multi-criteria decision making (MCDM) mechanism as a tool for prioritizing adaptation decisions in agriculture and water sectors. This working paper reviews the vast amount of literature available on MCDM and looks at the potential applications and limitations for using the same in adaptation in agriculture and water sectors. The working paper is a living document for the next one year during which the new findings and developments will be updated and finally published as an IGES publication.
5. **Working paper** on cost-benefit aspects of adaptation. Since cost-benefit ratio provides a very useful tool for prioritizing among a basket of options, this working paper digs down the pertinent literature in agriculture and water sectors and identifies the potential applications of this methodology in prioritizing adaptation actions and policy implications for the same. The working paper is a living document for the next one year during which the new findings and developments will be updated and finally published as an IGES publication.
6. **Survey of stakeholders** for identifying the gap between national level thinking in terms of prioritizing adaptation and reflection of the same on the ground needs in Japan. This survey would help answering the question on whether or not Japan national policies are doing sufficient to reflect on the ground adaptation needs in agriculture and water sectors. This would help addressing the research question of what kind of strengths Japan has in contributing to adaptation in the Asia Pacific region. Discussion with national level ministry of agriculture and prefectural governments has already been undertaken to identify the possible stakeholders and geographical and thematic focus of the survey. Tentatively, the high quality rice has been identified as an important issue that has adaptation implications for Japan.
7. **Research-policy dialogue:** A research-policy dialogue will be conducted to assess the level of mainstreaming adaptation in Japan at national level and Japan-led international activities such as ODA will be conducted. This dialogue will serve the purpose of measuring the progress in mainstreaming adaptation concerns at national level and help prioritize certain issues for further emphasis. Survey findings will be presented to the attending policy makers and efforts will be made to introduce the concept of adaptive policies to the policy makers and their response will be solicited.

MS Swaminathan Research Foundation (MSSRF), Chennai, Tamil Nadu, India.

Role: Project implementation in India and Networking in *South Asia*. Supporting Institution for Objective 2.

Status: The project activities are progressing well and will draw on the experience and outputs of completed study and other ongoing works and workshops at national level. Compilation of relevant key national documents, reports policy briefs and other secondary data was central to the project activities during this period. Some of the

ongoing work relates to analysis of gathered documents and conceptualization of appropriate indicators. Two relevant materials produced by MSSRF during this period looking into the insights of other projects, namely "Vulnerability Assessment and Enhancing Adaptive Capacity to Climate Change in Semi Arid Regions of India Programme" and "Community Level Adaptation to Climate Change and its Relevance to National Action Plan: A Road Map for Policy Development" will be helpful in understanding the mainstreaming processes relevant to India in the APN project context. In addition, an article entitled "Economics of Climate Change Adaptation in India" was published in the Economic and Political Weekly, Volume XLV, No. 18, in May 2010, which has immense significance to the ongoing work.

Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam.

Role: Project implementation in Vietnam and Networking in Mekong countries. Supporting Institution for Objective 3.

Status: With respect to Objective 1, ongoing activities are collecting data and documents for research; a review of climate change research in Vietnam including climate change status, climate change issues and challenges. With respect to Objective 2, a list of indicators has been discussed and will be finalised. Questionnaire of adaptation to climate change in agriculture and water sectors has been prepared in both Vietnamese and English. An elementary assessment of climate change impacts on water resources and agriculture for the whole country is ongoing. Two case studies from another project "Strengthening national capacities to respond to Climate Change in Vietnam, reducing vulnerability and controlling GHG emissions" were referred (case studies: Cantho and Binhthuan provinces).

University of the Philippines Los Baños (UPLB), the Philippines.

Role: APN Project Affiliate.

Status: Prof. Dr. Juan Pulhin informed the progress of his APN-funded project, entitled "Capacity Development on Integration of Science and Local Knowledge for Climate Change Impacts and Vulnerability Assessments". The project is being implemented in the province of Albay, Philippines which is one of the most vulnerable province in the Philippines as far as disasters are concerned. It is a collaborative undertaking of the UPLB College of Forestry and Natural Resources, the Province of Albay, and the University of Sunshine Coast in Australia, with Prof. Pulhin serving as the Project Leader. The project aims to build the capacity of local government officials and researchers in conducting integrated assessments of climate change impacts, vulnerability and adaptation using SIMClim model (a computer-based climate simulation model) while incorporating local knowledge in the process. The Albay provincial government has committed to apply the knowledge and skills it will acquire through the project in the preparation of its new comprehensive land use development plan to climate-proof all development initiatives in the province.

Royal University of Phnom Penh (RUPP), Cambodia.

Role: APN Project Affiliate.

Status: Mr. Nyda Chhihn informed that a two-year funding was secured under the EEPSEA Project to conduct cross-cutting vulnerability and adaptation study on the water and agriculture sectors. The study will employ indicator and risk mapping approach as well as cost-benefit analysis in determining the best adaptation options.

3. Network Development

In the context of ARPNAP and delivery of high profile project outputs, the meeting on 11 August 2009 recognised the resource need for additional activities including the Asia-Pacific Regional Policy Dialogue in 2012 and partnership with other institutions (such as University of California, San Diego, etc). Subsequent to this, linkages have been made with several networks (AUEDM, UN-CECAR, ORBICOM, etc.). A substantial review of networks has also been conducted by Stockholm Environment Institute (SEI) and the report will be circulated to Project Members and Affiliates. In addition, consultation with Dr. Ancha Srinivasan of the Asian Development Bank (ADB) has yielded the following inputs:-

- ARPNAP should build effective networks with other adaptation and sustainable development networks in Asia and beyond.
- ARPNAP, in collaboration with other like-minded networks, should create a platform to support young researchers and post-graduate students to pursue research on adaptation.
- ARPNAP can encourage promising students by organising annual research workshops on adaptation and recognising their research through small awards. ARPNAP can cooperate with ORBICOM and others in developing and testing tools for vulnerability and adaptation assessments and scenario planning. Policymakers should be involved in testing those tools.
- ARPNAP should make effective linkages between researchers and policymakers with a view to convince the latter of the importance of adaptation planning at various levels - community, local, national, regional and international.
- ARPNAP should proactively assist the governments to access newly available adaptation funds.

The meeting discussed the matter and agreed on the following items:

- LESTARI-UKM to draft a concept note of ARPNAP for consultation with Project Members and Affiliates.
- LESTARI-UKM to initiate formalisation of ARPNAP.
- LESTARI-UKM to establish linkage with the UNEP Adaptation Network and explore the setting up of a regional hub for bridging researchers and policy-makers.

4. Publication

The meeting has previously agreed to produce a publication for any event held by the Project. The focus will now be on channelling the collection of papers to indexed journals, to be considered for a special thematic issue. The aim is to target authors of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR5).

Papers from the Inception Workshop have been compiled and will be internally reviewed by selected Project Members (Dr. Prabhakar and Dr. Nambi). The papers will then be submitted to a peer reviewed journal. Discussion is now ongoing with the Chief Editor of the Asian Journal on Environment and Disaster Management (AJEDM), to seek a special thematic issue. A soft-launch of ARPNAP is also proposed in conjunction with the release of the published document.

5. Finance

The meeting was informed of the following developments since August 2009:-

- The advance funding (80% of Year 1 Budget) was received by LESTARI-UKM from the APN Secretariat in August 2009.
- Signing of contracts and disbursement of funds from LESTARI-UKM to IGES, MSSRF and IMHEN was completed by the fourth quarter of 2009. All institutions have confirmed receipt of funds.
- The budget was resubmitted in accordance with the APN Guidelines to the APN Secretariat. The budget-line for Years 1 and 2 have been approved. The budget-line for Year 3 will be reviewed after acceptance of the Progress Report for Year 2 in 2011.

The Financial Report for Year 1 shall be submitted within 30 days after the end of Year 1 contract i.e. by **4 September 2010**. The report should contain copies of receipts in a set format. The template has been sent to partners. Partner organisations are requested to submit their full expenses (with copies of receipts) by **10 August 2010** to get the balance due in Year 1 from the APN Secretariat. LESTARI-UKM will forward the APN's template for financial report to the Project members.

6. Future Plans

The proposed workshop planned in Malaysia by April 2010, to take stock of and consider further activities was postponed. As a result, the project did not benefit from the experience of Dr Darren A. Swanson, Senior Project Manager of the International Institute for Sustainable Development (IISD), who was identified to speak on the IISD framework for characterising the adaptive nature of selected policies. LESTARI-UKM will re-visit this idea of holding a workshop, possibly during the soft-launch of ARPNAP in early 2011.

Project Partners and Affiliates will be invited to present the findings of their research at the proposed Workshop. The research report of Partner Organisations would have to be prepared in advance, in the format of journal manuscripts. The guideline for authors

from a selected journal/ publisher will be distributed to Partner Organisations for this purpose by **30 September 2010**. The deadline for preparation of the first draft of manuscripts is **31 Dec 2010.**

7. Other Matters

The meeting was informed that Prof. Pereira and Prof. Pulhin have been selected as Coordinating Lead Authors for the upcoming IPCC-AR5. It was proposed that the Project Partners and Affiliates participate actively in the upcoming IPCC-AR5 related workshops and initiatives in the region. For this purpose, strong linkages will be developed with the IPCC and updates will be issued on a periodic basis to Project Partners and Affiliates. In conjunction with this, LESTARI-UKM will explore potential collaboration with the ASEAN Secretariat and other partners, and will keep Project Partners and Affiliates updated on the progress.

It was agreed that communication among the Project Partners and Affiliates should be further enhanced. The communication tools that can be used include email forum, tele-conferencing and others.

PROJECT MEETING 2011
Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors (CRP2010-02CMY-Pereira)
16 November 2011, Putrajaya, Malaysia

ATTENDANCE
1. Prof Dr. Joy Jacqueline Pereira, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)
2. Dr. S.V.R.K. Prabhakar, Institute for Global Environmental Strategies (IGES), Japan
3. Mr. Tran Dinh Trong, Institute of Meteorology, Hydrology & Environment (IMHEN), Vietnam
4. Mr. Tan Ching Tiong, Southeast Asia Disaster Prevention Research Institute, Universiti Kebangsaan Malaysia (SEADPRI-UKM)

ABSENT WITH APOLOGY
1. Dr. Arivudai A Nambi, M. S. Swaminathan Research Foundation (MSSRF), India

AGENDA
1. Welcoming Remarks
2. Work Progress
3. Network Development
4. Knowledge Dissemination and Publication
5. Finance
6. Future Plans
7. Other Matters

DISCUSSION

1. Welcoming Remarks
Prof. Dr. Joy Jacqueline Pereira warmly welcomed and thanked everyone for making time to attend the APN Project Meeting 2011. The meeting was held in conjunction with the National Symposium on Climate Change Adaptation and the MyCLIMATE Forum on Climate Change, jointly organised by the Ministry of Natural Resources and Environment, Universiti Kebangsaan Malaysia (LESTARI-UKM & SEADPRI-UKM) and APN, with local collaborators and APN Project Partners.

Prof. Pereira thanked the APN Project Partners for sharing their respective research outcomes on local adaptation with Malaysian policy makers, practitioners and researchers. She also conveyed the regrets of Dr. Nambi who could not attend due to a health emergency and thanked him for submitting a written report for the meeting despite the constraints of his situation.

The meeting was informed that the Project Financial Report for Year 1, Project Interim Report for Year 2 and Progress Report for Year 2 were submitted to the APN Secretariat in September 2010, January 2011 and February 2011, respectively. The Project had received funding for Year 2 and is currently preparing the Financial Report for Year 2.

The main purpose the APN Project Meeting 2011 is to review progress since the last meeting on 26 June 2010 in achieving the project objectives as listed below:-

1. To assess technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels and propose countermeasures.
2. To develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations.
3. To identify characteristics of selected policies that will enhance adaptive capacity.
4. To create a ARPNAP network linking adaptation research and policymakers in Asia.
5. To disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

2. Work Progress

The first three objectives of the project relate to research being conducted by all APN Project Partners in their respective countries. The progress on this is highlighted in the following sections.

LESTARI-UKM, Malaysia

Role: Project coordination, and implementation of activities in Malaysia, Networking in *Archipelagic Southeast Asia*.

Status: With respect to Objective 1, a review of national documents in the agriculture and water sectors has been completed. The research outcome was compiled as the articles that were published in the AJEDM journal. Inputs have been obtained through a series of consultations and findings are currently being synthesized. With respect to Objective 2, a literature review of concepts and criteria for developing climate change indicators has been completed. The menu of indicators has been identified and a policy framework is developed with linking impacts of climate change to national security and capacity. It also includes aspects that effective factors for adaptive capacity is the vital component of successful adaptation action in response to climate change consequences. The finding is expected to contribute in the planning process at local and national levels in response to climate change. The project team has decided to adopt the Selangor River Basin, Malaysia, which is an important area for food security, for the pilot study. Background information on the basin, i.e. its history of its land-use, demographics, socio-economic activities, is being collected using GIS. Arrangement is on-going for local level consultation on issues and priorities. With respect to Objective 3, a paper that presents the approach for characterising the capacity of water institutions in adapting to climate change was prepared and presented in the LESTARI Postgraduate Colloquium 2011. An assessment framework that comprises six criteria with a total of fifteen indicators is proposed for assessing adaptive capacity of water institution in the context of climate change. The framework includes criteria on Adaptability and Flexibility that comprises two indicators on Continuous Improvement and Investment for Innovation. The framework will be tested on Selangor River Basin as a case study.

Institute for Global Environmental Strategies (IGES), Hayama, Japan.

Role: Partner and mentor institute to develop methodologies and build adaptation research and policy networks in Asia in general and East Asia in particular.

Status: With respect to Objective 1, most of the research related to barriers to mainstreaming adaptation was finished in the year I. Subsequent to the year I work, the results from the field surveys conducted in Year I were published as a conference paper

Does Japan need to think about adaptation within its own agriculture sector? A case study of initiatives in rice production (Tsurita et al., 8th NAPSIPAG Conference, 2011). In addition, a policy dialogue was organized to understand the barriers related to emergency response post Tohoku disaster in relation to agriculture and food sector in Japan. The consultation proceedings are being prepared for sharing widely. Keeping in view the importance of DRR in the resilience of Japan, a research paper was published that reviews the existing DRR initiatives in Japan and how they relate to the climate change adaptation in Japan (Prabhakar et al., DOI 10.1080/17477891.2011.618821 Journal of Environmental Hazards, 2012). With respect to Objective 2, a paper on 'Monitoring and Evaluation of Progress in Adaptation to Climate Change: Advances, Challenges, and Way Forward' (Prabhakar et al., 5th International Conference on Community Based Adaptation, 2011) was submitted and is being under consideration with the editors. With respect to Objective 3, a consultation meeting was conducted on 28th June on 'Adaptive Policies and Measuring Mainstreaming Climate Change Adaptation into Institutional Processes: Some Experiences from Japan'. The event was attended by several policy makers and researchers in agriculture and water sectors. Various issues related to the nature of policy making in Japan and their implications for climate change adaptation were discussed. The proceedings of the dialogue are being prepared. In addition, a questionnaire survey is being conducted to identify institutional, economic and political factors that may help formulate adaptive policies is being conducted using Delphi survey technique. In the first iteration of the survey, so far, 20 responses were obtained. Benefiting from the policy dialogue, preliminary questionnaire survey results and literature review, a paper on 'How adaptive policies are in Japan and can adaptive policies mean effective policies? Some Implications for Governing Climate Change Adaptation' has been published at the 8th NAPSIPAG conference (Prabhakar et al., 8th NAPSIPAG Conference, 2011). A separate full paper will be published upon completion of the entire iterations of the Delphi Survey.

MS Swaminathan Research Foundation (MSSRF), Chennai, Tamil Nadu, India.

Role: Project implementation in India and Networking in *South Asia*.

Status: With respect to Objective 1, the project activities are progressing well as per the work plan. Based on the assessment of the national and state adaptation policies conducted during last year, a study design was formulated. The findings of the study were shared at the National Workshop on India's Second National Communication (SNC) to United Nations Framework Convention on Climate Change (UNFCCC) held on September 20, 2011. During this period, intensive field research was carried out in the state of Tamilnadu covering five districts (Kancheepuram, Ramanathapuram, Namakkal, Pudukottai and Dharmapuri) representing different agro-climatic zones to review the adaptation measures in practice and their effectiveness at the community level. MSSRF conducted two workshops/ training programmes for 'Community level climate risk management' for selected local government leaders (Panchayat) specifically focussing on adaptation during this period. With respect to Objective 2, an elaborate questionnaire was developed and about 150 farmers were interviewed (about 30 from each district) to understand the adaptation measures taken up the farming community. The study essentially focused on the perceptions of farmers on different climate related impacts, relevant adaptation practices (e.g. irrigation, climate resilient crop varieties, bio-fertilizer use, crop insurance and income diversification options), the effectiveness of such practices and the critical constraints experienced by them,

particularly in the context of water and agriculture. Both qualitative and quantitative methodologies were used. The adaptation measures were evaluated through the Analytical Hierarchy Process (AHP) using multiple criteria like (i) effectiveness (ii) economic efficiency (iii) farm implementability and independent benefits. The analysis helped in ranking the effectiveness of specific adaptation measures and associated barriers. A set of recommendations were developed based on the inference from the study. A Master's thesis "Climate Change Adaptation Metrics for Agriculture Sector in Tamilnadu" submitted to Anna University, Chennai was produced based on this study. A draft paper based on the study titled 'Climate Change Adaptation Metrics in Agriculture and Water Sectors: Insights from Tamil Nadu, India' is under preparation. With respect to Objective 3, Having focused on community perspectives during the first phase, the study would focus on understanding the implications of adaptation from the policy perspective, especially interacting with a variety of policy makers and other stakeholders involved in implementing adaptation related policy measures during the coming year. The approach would be to follow through 2 or 3 selective policy measures like (crop insurance, promotion of water saving irrigation technologies, etc) and how they have performed as a policy option. A state level consultation on adaptation related policy issues is envisaged during the coming year.

Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam.

Role: Project implementation in Vietnam and Networking in Mekong countries.

Status: With respect to Objective 1, a review of climate change research in Vietnam including climate change status, climate change issues and challenges was shared with the Capacity Building for Climate Change Project (CBCC at http://www.cbcc.org.vn/) and Vietnam's second National Communication to United Nationas Framwork Convention on Climate Change. With respect to Objective 2, Two sets of questionaire on: the impacts of climate change on Agriculture and water resourses and adaptation strategy was delivered to understand what impact on agriculture and water sectors at the servey area, who play a key role in climate change adaptation strategy, what are barriers on adaptation activities and what should be done/improved to adapt to climate change. An overview on elementary assessment of climate change impacts on water resources and agriculture for the whole country is finished, especially two case studies for Red and Mekong River Deltas.

3. Network Development

The fourth objective of the project is to create the ARPNAP network linking adaptation research and policymakers in Asia. In order to do this, a cursory review was done to identify networks and institutions that operate at a regional level.

Linkages have since been established with several of the active networks and institutions that have on-going work on climate adaptation at the regional level. These include the Asia Pacific Adaptation Network (APAN), Asian University Network for Environmental and Disaster Management (AUEDM), University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR), Orbicom – Network of UNESCO Chairs in Communication, Asian Institute of Technology, Nanyang Technology University and Kyoto University.

It was decided that ARPNAP, constituting the APN Project Partners as a cohesive unit, would initially play an active role in APAN and AUEDM. The activities of the project will be shared

with APAN at its upcoming steering committee meeting scheduled on 10 March 2012 in Bangkok, Thailand. A similar plan is proposed for the upcoming AUEDM steering committee meeting. Through participation in APAN and AUEDM, ARPNAP will pursue the following:-

- Network effectively with other adaptation and sustainable development networks in Asia and beyond.
- Create a platform to support young researchers and post-graduate students to pursue research on adaptation.
- Encourage promising students by organising annual research workshops on adaptation and recognising their research through small awards.
- Promote effective linkages between researchers and policymakers with a view to convince the latter of the importance of adaptation planning at various levels - community, local, national, regional and international.
- Proactively assist the governments to access newly available adaptation funds and where possible, utilise regional funds to maintain the relationship of APN Project Partners beyond the duration of the project.
- Encourage and provide platforms for researchers and practitioners in the region to publish their findings in peer-reviewed and indexed journals.

4. Knowledge Dissemination and Publication

The fifth objective of the project is to disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

4.1 Presentations

The following served as effective platforms for research-policy dialogues, providing inputs for APN Project Partners and also supported information dissemination:-

- LESTARI-UKM co-organised the National Symposium on Climate Change Adaptation with the Ministry of Natural Resources and Environment Malaysia on 16-17 November 2011,, which is the national focal point on climate change. The event was aimed to determine national goals and aspirations on climate change adaptation for various sectors including the agriculture and water. Relevant research outcomes were presented in posters during the National Symposium.
- The findings of several research studies, partly funded by the Project, were presented in the LESTARI Postgraduate Colloquium 2011 on 21-23 November 2011. These papers, which form part of several Master's and PhD studies, include Development of Climate Change Indicators for Malaysia (PhD), Spatial Planning Response to Climate Change: Case Study of the Selangor River Basin, Malaysia (PhD), Analysis of Sea Level and its Effects on Landuse and Environment in the area of Klang City Council (Master), and Adaptive Capacity of Water Institutions to Climate Change: An Assessment Framework (PhD).
- Dr. Nambi, APN project lead at MSSRF was part of the plenary panel that discussed on the 'National Action to Foster Community Based Adaptation' convened by World Resources Institute at the 5th Community Based Adaptation Conference in Dhaka on March 28, 2011. The APN study experience provided a basis for some of the arguments in the context of scaling issues in adaptation.
- Dr. Nambi gave the lead talk on 'Living with Climate Change: the role of Community based Adaptation' at the 'Second National Research Conference on Climate Change',

convened by IIT Delhi and Center for Science and Environment on November 5-6, 2011. Adaptation metrics and its relevance was part of the discussion.

- Dr. Prabhakar has made a presentation at the policy dialogue on 'Adaptive Policies and Measuring Mainstreaming Climate Change Adaptation into Institutional Processes: Some Experiences from Japan', 28th June 2011, Tokyo, Japan.
- Ms. Tsurita has presented the project results on 'Does Japan need to think about adaptation within its own agriculture sector? A case study of initiatives in rice production' at the 8th International NAPSIPAG Conference, Kathmandu, Nepal.
- Dr. Prabhakar has presented the project results on 'How adaptive policies are in Japan and can adaptive policies mean effective policies? Some Implications for Governing Climate Change Adaptation' at the 8th International NAPSIPAG Conference, Kathmandu, Nepal.
- The APN project staff at MSSRF are actively engaged in the UNDP India's 'solution exchange', an electronic knowledge sharing platform created to discuss community based climate relevant issues on a regular basis.
- The outputs of ARPNAP will be highlighted the Information Portal on stakeholder engagement and good practices in CCA and DRR, anchored by SEADPRI-UKM & LESTARI-UKM. The Portal will be linked to the Asia Pacific Adaptation Network (APAN), Asian University Network for Environment and Disaster Management (AUEDM) and other institutions to highlight the outputs of the APN Project.
- MONRE and UNDP organized a National Consultation Workshop on "National Strategy on Climate Change", 18th March 2011, Ho Chi Minh, Vietnam. Dr. Thang has presented a talk on "Mainstreaming Adaptation to Climate Change in Development Activities in Vietnam".
- IMHEN and UNDP co-organized a workshop on "Update and Sharing Global and Vietnam Climate Change Information to the Media in the South of Vietnam", 22rd October 2011, Cantho, Vietnam. Dr. Thang gave a talk :"Climate Change Scenario and Sea Level Rise for Vietnam".

4.2 Full papers:

Md. Azizul Baria, Rawshan Ara Begum, Abdul Hamid Jaafar, Raja Datuk Zaharaton Raja Zainal Abidin, Pereira, J.J., 2011. Water use by people function of their consumption pattern in Malaysia. Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.

Norazura Burham, Pereira, J.J. & Rawshan Aga Begum, 2011. Senario Luruan Ribut Dan Kawasan Terjejas Akibat Kenaikan Paras Air Laut: Kajian Kes Pelabuhan Klang. Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.

Rasyidah Binti Abdul Karim, Pereira, J.J, Datin Halimaton Saadiah Hashim & Shaharuddin Idrus, 2011. Kenaikan Paras Air Laut: Implikasi Terhadap Kawasan Guna Tanah dan Alam Sekitar di Majlis Perbandaran Klang. Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.

Chee Ping Ngang, Pereira, J.J, Datin Halimaton Saadiah Hashim, 2011. Spatial planning response to climate change: case study of the Selangor River Basin, Malaysia.

Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.

Mamunur Rashid, Rawshan Ara Begum, Pereira, J.J., Sarah Aziz and Mazlin Bin Mokhtar, 2011. Perspective on national security and adaptive capacity in the context of climate change in Malaysia. Research paper in the National Symposium on Climate Change Adaptation, 16-17 November 2011, Putrajaya, Malaysia.

Pereira, J.J., Tan, C.T. & Komoo, I. 2010. Mainstreaming Climate Change Adaptation and Disaster Risk Reduction – A Malaysian Approach. In Shaw, R., Pulhin, J. & Pereira, J.J. (Eds.): Climate Change Adaptation and Disaster Risk Reduction. Emerald Publishers, Bingley, U.K.

Pereira, J.J., Tan, C.T, Mazlin, M. & Sarah Aziz, A.G.A. (Eds.) 2010. Indicators for Climate Change and Sustainable Development. LESTARI Roundtable Dialogue No. 22, Institute for Environment and Development (LESTARI), Bangi. 47 pp. ISBN 978-967-5227-34-9.

Tan, C.T., Pereira J.J., Mazlin, M., Komoo, I. & Nadzri, Y. 2011. Adaptive capacity of water institutions to climate change: an assessment framework. LESTARI Postgraduate Colloquium 2011, Bangi, Malaysia, 21-23 November 2011.

Tan, C.T., Pereira J.J., Mazlin, M., Komoo, I. & Nadzri, Y. 2010. Adaptive capacity to climate change: concept and approaches for the water sector in Malaysia. Asian Journal of Environment and Disaster Management, 2(4). Research Publishing Services, Singapore.

Tan, C.T. & Pereira J.J. 2010. Climate change adaptation: an overview of Southeast and East Asia. Asian Journal of Environment and Disaster Management, 2(4). Research Publishing Services, Singapore.

IGES. 2011. Adaptation as a Problem of Decision Making: Application of Multi-criteria Techniques. IGES Working Paper. Institute for Global Environmental Strategies, Hayama, Japan.

Prabhakar, S.V.R.K., I. Yuuki, R. Shaw, J. Soulakova, T. Yukiko, and K. Takuji. 2012. Climate change implications for disaster risk management in Japan: A case study on perceptions of risk management personnel and communities in Saijo city. Journal of Environmental Hazards, DOI 10.1080/17477891.2011.618821.

Prabhakar, S.V.R.K. 2011. Climate Change Impacts in Japan and Southeast Asia: Implications for Crop Adaptation. In Crop Adaptation to Climate Change, First Edition. Ed. S. S. Yadav, R. J. Redden, J. L. Hatfield, H. Lotze-Campen and A. E. Hall. John Wiley & Sons, Ltd., Oxford, U.K.

Prabhakar, S.V.R.K., R. Mashimo, M. Aoki, I. Tsurita, and S. Hayashi. 2011. How adaptive policies are in Japan and can adaptive policies mean effective policies? Some Implications for Governing Climate Change Adaptation. In Proceedings of the 8th International NAPSIPAG Conference, 15-16 December 2011, Kathmandu, Nepal.

Prabhakar, S.V.R.K., H. Wright, I. Tsurita, L. Jones, M. Spearman, P. S. Villanueva, J. Ayers, C. Ehrhart, S. Hayashi, and T. Rossing. Monitoring and Evaluation of Progress in Adaptation to Climate Change: Advances, Challenges, and Way Forward. In J. Ayers, S. Huq, H. Reed, and L. Schipper. Scaling up community-based adaptation. Earthscan Pub Ltd., London, U.K.

Takama, T., S.V.R.K., D. Sano, and I. Tsurita. 2011. How Japan Can Contribute to Climate Change Adaptation in Developing Countries in the Asia‐Pacific? A Focus on

Agriculture and Water Sectors. IGES Working Paper. Institute for Global Environmental Strategies, Hayama, Japan.

Tsurita, I., S.V.R.K. Prabhakar, and D. Sano. Does Japan need to think about adaptation within its own agriculture sector? A case study of initiatives in rice production. In Proceedings of the 8th International NAPSIPAG Conference, 15-16 December 2011, Kathmandu, Nepal.

Nguyen Van Thang, 2010. On the development of climate change scenarios for Viet Nam. Proceedings of the Fifth Conference of Asia Pacific Association of Hydrology and Water Resources. APHW Conference in Hanoi, Vietnam. pp147-152.

Nguyen Van Thang, 2010. Assessments of climate change impacts on climate resources. Proceedings of the Fifth Conference of Asia Pacific Association of Hydrology and Water Resources. APHW Conference in Hanoi, Vietnam, 8-9 November 2010. pp255-260.

Nguyen Van Thang, 2010. Methodologies for assessment of climate change impacts on agriculture. Scientific and Technical Hydro-Meteorological Journal, No 589, pp 20-23. January, 2010.

Nguyen Van Thang, 2010. Some results of climate change research in Vietnam. Scientific and Technical Hydro-Meteorological Journal, No 592, pp 1-8. April, 2010.

Nguyen Van Thang, 2010. Assessments of climate change impacts on water resourses. Scientific and Technical Hydro-Meteorological Journal, No 594, pp 1-8. June, 2010.

Nguyen Van Thang, and et al 2010. Climate Change and its impacts in Vietnam. Scientific and technological Publishing House, Ha Noi, Vietnam.

Nguyen Van Thang, and et al 2011. Guidan book on Assessments of Climate Change Impacts and Determination of Adaptation Strategies. Viet Nam Publishing House of Natural Resources, Environment and Cartography, Ha Noi, Vietnam.

The focus will now be on increasing publications indexed journals to target authors of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR5). Papers have thus far been published in a peer reviewed journal, the Asian Journal on Environment and Disaster Management (AJEDM), Volume 2, Issue 4, 2010. The topics are as follows:

List of Papers & Authors
Mainstreaming Climate Change Adaptation in the Asia Pacific: Current Status and Way Forward for the Agriculture and Water Sectors ***S.V.R.K Prabhakar & Kyoto Matsumoto***
Climate Change Adaptation: An Overview of Southeast Asia ***Tan Ching Tiong & Joy Jacqueline Pereira***
Climate Change Adaptation: An Overview of Research in South Asia ***Rajib Shaw***
Climate Change Adaptation: An Overview of Financing Mechanisms in the Agriculture and Water Sectors ***Ancha Srinivasan & Abul Quasem Al-Amin***
Monitoring the Progress of Adaptation to Climate Change: The Use of Adaptation Metrics ***S.V.R.K Prabhakar & Takuro Kobashi***
Mainstreaming Adaptation to Climate Change in the Agriculture and Water Sectors in India: An Overview of the Challenges ***Arivudai A. Nambi***
Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector in Malaysia ***Tan Ching Tiong, Joy Jacqueline Pereira, Mazlin Mokhtar, Ibrahim Komoo & Nadzri Yahaya***

Climate Change Adaptation Policy for Agricultural Livelihood in Malaysia ***Md. Mahmudul Alam, Chamhuri Siwar & Abul Quasem Al-Amin***
Climate Change Adaptation in Water and Agricultural Sectors in the Philippines ***Juan M. Pulhin, Rose Jane J. Peras & Maricel A. Tapia***
Climate Change Adaptation in the Agriculture and Water Sectors: An Overview of Vietnam ***Nguyen Van Thang & Tran Dinh Trong***

APN Project Partners are currently participating in a book project "Implementing Climate Change Adaptation Strategies" to showcase research findings of climate change adaptation at the local level. The book is to be published by Wiley-Blackwell under the editorship of an International Fellow of SEADPRI-UKM. The target date of completion is 2012.

By the end of the Project, a publication will be prepared to document the research outputs of the Project. Different options were discussed, including a book or special journal issue. The options will be explored and determined during Year 3.

5. Finance

The meeting was informed of the following developments since June 2010:-

- The balance funding of Year 1 Budget (20%) and advance funding of Year 2 Budget were received by LESTARI-UKM and distributed to the Project Partners in March 2011. All institutions have confirmed receipt of funds.
- The Financial Report for Year 2 will be closed on 30 November 2011. The Report must be sent to the APN Secretariat before 30 December 2011. All Project Partners are currently preparing respective report. The hardcopy evidence of expenditure will be forwarded to LESTARI-UKM before 30 November 2011 for compilation. Any other document that is only available after the date will be scanned and emailed to LESTARI-UKM before 15 December 2011.
- The budget for Year 3 was provisionally agreed by the APN Secretariat in May 2010. It will be reviewed again after their acceptance of the Financial Report for Year 2.

6. Future Plans

The options for disseminating the final project outcomes in a regional policy-science dialogue were discussed. These include a side event during the 4th Ministerial Conference on Disaster Risk Reduction in Indonesia in October 2012, a back-to-back event with the International Community Based Adaptation Workshop in Bangladesh in March 2013, a special session during the Adaptation Forum 2012 in Thailand in 2012, and the IGES Asia Pacific Forum in 2012. These will be explored further and determined in Year 3.

7. Other Matters

LESTARI-UKM, in collaboration with SEADPRI-UKM, is exploring potential collaboration with the ASEAN Secretariat and their Dialogue Partners such as India and Japan. Project Partners and Affiliates will be updated on the progress.

PROJECT MEETING 2012

Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors (CRP2010-02CMY-Pereira)

11 Mac 2012, Siam City Hotel, Bangkok, Thailand

ATTENDANCE

1. Prof Dr. Joy Jacqueline Pereira, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)
2. Dr. S.V.R.K. Prabhakar, Institute for Global Environmental Strategies (IGES), Japan
3. Dr. Arivudai A Nambi, M. S. Swaminathan Research Foundation (MSSRF), India

ABSENT WITH APOLOGY

1. Mr. Tran Dinh Trong, Institute of Meteorology, Hydrology & Environment (IMHEN), Vietnam

AGENDA

1. Welcoming Remarks
2. Work Progress
3. Network Development
4. Knowledge Dissemination and Publication
5. Finance
6. Future Plans
7. Other Matters

DISCUSSION

1. Welcoming Remarks

Prof. Dr. Joy Jacqueline Pereira thanked the APN Project Partners for willing to have a quick meeting in conjunction with the Asia Pacific Adaptation Forum 2012, held on 12 & 13 March 2012 in Bangkok, Thailand.

2. Work Progress

The main purpose the APN Project Meeting 2012 is to plan the final stage of work in achieving the project objectives as listed below:-

1. To assess technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels and propose countermeasures.
2. To develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations.
3. To identify characteristics of selected policies that will enhance adaptive capacity.
4. To create a network (ARPNAP) linking adaptation research and policymakers in Asia.
5. To disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

The first three objectives of the project relate to research being conducted by all APN Project Partners in their respective countries. The findings will be channelled to peer-reviewed books and journals (e.g. Wiley).

In the final year, the focus will be on measuring mainstreaming and the following actions are to be taken:-

- Dr. S.V.R.K. Prabhakar will circulate the survey form, comprising five components for assessing mainstreaming, and preliminary results obtained in Japan.
- APN Project Partners to adapt the form and conduct a similar survey in their respective countries, and prepare the results in the form of a journal manuscript.
- The findings from APN Project Partners will be synthesized into a journal manuscript paper, with joint authorship from contributing institutions.
- The target journal is the Asian Journal on Environment and Disaster Management.
- LESTARI-UKM is to immediately inform IMHEN regarding this plan via email.

3. Network Development

The fourth objective of the project is to create the ARPNAP network linking adaptation research and policymakers in Asia. Prof. Joy Jacqueline Pereira has been appointed as a Member of the Steering Committee of the Asia Pacific Adaptation Network (APAN) administered by UNEP. She is also Vice-President for Research in the Asian University Network for Environmental and Disaster Management (AUEDM). In addition, linkages have been established with the University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR). The APN Project Partners will use this entry points to disseminate the findings of their work. The following actions are to be pursued within these platforms:-

- Network effectively with other adaptation and sustainable development networks in Asia and beyond (e.g. the on-going PROVIA effort).
- Create a platform to support young researchers and post-graduate students to pursue research on adaptation.
- Encourage promising students by organising annual research workshops on adaptation and recognising their research through small awards.
- Promote effective linkages between researchers and policymakers with a view to convince the latter of the importance of adaptation planning at various levels - community, local, national, regional and international.
- Proactively assist the governments to access newly available adaptation funds and where possible, utilise regional funds to maintain the relationship of APN Project Partners beyond the duration of the project.
- Encourage and provide platforms for researchers and practitioners in the region to publish their findings in peer-reviewed and indexed journals.

4. Knowledge Dissemination and Publication

The fifth objective of the project is to disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.
The focus will continue to be on increasing publications indexed journals to target authors of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR5). By the end of the Project, a manuscript will be prepared to document the research outputs of the Project. The target publication is the APN Science Bulletin.

5. Finance

The meeting was informed that the Financial Report for Year 2 has been submitted and approved by the APN Secretariat. The budget for Year 3 is currently under review.

6. Future Plans

The options for disseminating the final project outcomes in a regional policy-science dialogue were discussed again. The options under consideration are:-

- Fourth Ministerial Conference on Disaster Risk Reduction in Indonesia in October 2012
- International Community Based Adaptation Workshop in Bangladesh in March 2013
- Asia Pacific Adaptation Forum in 2013

7. Other Matters

A project proposal on climate change proposal has been submitted to the ASEAN Secretariat. It is now being reviewed by the ASEAN Senior Officials on Climate Change. Project Partners and Affiliates will be updated on the progress.

MINUTES OF APN PROJECT MEETING 2/2012

Strengthening Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors (CRP2011-01CMY-Pereira)

6 November 2012, Equatorial Hotel, Bangi, Malaysia

ATTENDANCE

1. Prof Dr. Joy Jacqueline Pereira, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM), Malaysia
2. Dr. S.V.R.K. Prabhakar, Institute for Global Environmental Strategies (IGES), Japan
3. Dr. Arivudai A Nambi, M. S. Swaminathan Research Foundation (MSSRF), India
4. Mr. Tran Dinh Trong, Institute of Meteorology, Hydrology & Environment (IMHEN), Vietnam
5. Prof. Dr. Juan M. Pulhin, University of the Philippines Los Banos, the Philippines.
6. Dr. Rawshan Ara Begum, Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM), Malaysia
7. Mr. Tan Ching Tiong, Southeast Asia Disaster Prevention Research Institute, Universiti Kebangsaan Malaysia (LESTARI-UKM), Malaysia

AGENDA

1. Welcoming Remarks
2. Work Progress
3. Network Development
4. Knowledge Dissemination and Publication
5. Finance
6. Reporting
7. Future Plans
8. Other Matters

DISCUSSION

1. Welcoming Remarks

Prof. Dr. Joy Jacqueline Pereira thanked the APN Project Partners attending the second APN Project Meeting in 2012. The meeting was organised in conjunction with the Workshop on Natural Disasters and Climate Change in Asia, held on 5 to 7 November in Bangi, Malaysia. The APN is one of the collaborators through the project CRP2011-01CMY-Pereira.

2. Work Progress

The main purpose the APN Project Meeting 2/2012 is to plan the final stage of work in achieving the project objectives as listed below:-

1. To assess technical, institutional and regulatory barriers to integrating climate change adaptation concerns at both policy and operational levels and propose countermeasures.
2. To develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations.
3. To identify characteristics of selected policies that will enhance adaptive capacity.
4. To create a network (ARPNAP) linking adaptation research and policymakers in Asia.
5. To disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

The first three objectives of the project relate to research being conducted by all APN Project Partners in their respective countries. The findings will be channelled to peer-reviewed books and journals.

In the final year, the focus will be on measuring mainstreaming and the following actions are to be taken:-

- Based on the survey form for assessing mainstreaming circulated by Dr. Prabhakar, the other Project Partners adapted the form and is currently conducting the survey in respective countries. The results will be prepared in the form of a journal manuscript. The target journal is the APN Science Bulletin.
- The findings from the APN Project Partners will be synthesised with joint authorship from contributing institutions. The synthesis paper may be submitted for the APN Science Bulletin or a journal manuscript.

3. Network Development

The fourth objective of the project is to create the ARPNAP network linking adaptation research and policymakers in Asia. Prof. Joy Jacqueline Pereira has been appointed as a Member of the Steering Committee of the Asia Pacific Adaptation Network (APAN) administered by UNEP. Prof. Pereira and Prof. Pulhin are Steering Committee Members of the Asian University Network for Environmental and Disaster Management (AUEDM). In addition, linkages have been established with the University Network for Climate and Ecosystems Change Adaptation Research (UN-CECAR). The Workshop is exploring the establishment of an Asian Climate Change Research Network. The APN Project Partners will use these entry points to disseminate the findings of their work. The following actions are to be pursued within these platforms:-

- Network effectively with other adaptation and sustainable development networks in Asia and beyond.
- Create a platform to support young researchers and post-graduate students to pursue research on adaptation.
- Encourage promising students by organising annual research workshops on adaptation and recognising their research through small awards.
- Promote effective linkages between researchers and policymakers with a view to convince the latter of the importance of adaptation planning at various levels - community, local, national, regional and international.
- Proactively assist the governments to access newly available adaptation funds and where possible, utilise regional funds to maintain the relationship of APN Project Partners beyond the duration of the project.
- Encourage and provide platforms for researchers and practitioners in the region to publish their findings in peer-reviewed and indexed journals.

4. Knowledge Dissemination and Publication

The fifth objective of the project is to disseminate project outcomes to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

The Workshop on Natural Disasters and Climate Change in Asia on 5 to 7 November 2012 brought together researchers, practitioners and policy makers from the climate change and natural disasters communities. The APN Project Partners shared the research outcomes of respective activities during the Workshop. In addition, the Project Partners and Affiliate also contributed ideas to the establishment of an affiliation of networks and institutions working on issues related

to climate change and natural disasters in Asia, especially for better exchange of information and collaboration between operational and research centres.

The focus will continue to be on increasing publications indexed journals to target authors of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC-AR5).

5. Finance

The meeting was informed that 80% of Year 3 budget had been disbursed by the APN Secretariat and distributed to respective Project Partners. The balance fund will only be disbursed upon approval of the financial report by the APN Secretariat. It is imperative that the APN Project Partners should utilise the entire budget applied for, and this entails an advance of 20% budget from the allocation for respective institution in Year 3.

6. Reporting

Further to an extension granted by the APN Secretariat on 10 April 2012, the new expiration date is 10 April 2013. The meeting was informed of the following reporting requirements and deadline for the final year:

a) Final Report (deadline 10 March 2013):
   - Input from the APN Project Partners to LESTARI-UKM latest by 15 February 2013.
   - Dr. Prabhakar to share the report of a past project for reference by other APN Project Partners.
   - LESTARI-UKM to request for template from the APN Secretariat and distribute to all APN Project Partners.

b) Financial Report (deadline 10 May 2013):
   - All expenses should be incurred before 10 April 2013.
   - Report and receipts in hardcopy from the APN Project to LESTARI-UKM latest by 15 April 2013. Any receipts that are only available after that should be scanned and emailed to LESTARI-UKM.

c) In preparing the Final Report, a review is to be conducted of deliverables stated in the contract.

7. Future Plans

The meeting decided to disseminate the final project outcomes in another regional policy-science dialogue. The event targeted is the Asia Pacific Adaptation Forum from 18 to 20 March 2013 in Korea. The main theme of the Forum, Mainstreaming Adaptation into Development, fits the project objectives. LESTARI-UKM will explore the opportunity with the Forum organiser, i.e. the Asia Pacific Adaptation Network where Prof. Pereira is a Member of the Steering Committee. LESTARI-UKM will also communicate with the APN Secretariat regarding an extension of the Project to accommodate this activity.

8. Other Matters

A project proposal on climate change proposal has been submitted to the ASEAN Secretariat. It is now being reviewed by the ASEAN Senior Officials on Climate Change. Project Partners and Affiliates will be updated on the progress.

Appendix 2: Conferences/Symposia/Workshops

1. Inception Workshop on "Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors", 10 August 2009, Kuala Lumpur, Malaysia.
   Organisers: Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI), Asia-Pacific Network for Global Change Research (APN) & Institute for Global Environmental Strategies (IGES)

2. Adaptive Policies and Measuring Mainstreaming Climate Change Adaptation into Institutional Processes: Some Experiences from Japan, 28 June 2011, Tokyo, Japan.
   Organisers: Institute for Global Environmental Strategies (IGES) & Asia-Pacific Network for Global Change Research (APN)

3. Restoring Agriculture and Food Sector Aftermath of Great Tohoku Disaster: Implications for the Resilience of Japan, 8 November 2011, Tokyo, Japan.
   Organisers: Institute for Global Environmental Strategies (IGES) & Asia-Pacific Network for Global Change Research (APN)

4. National Symposium on Climate Change Adaptation and the MyCLIMATE Forum on Climate Change, 16-17 November 2011, Putrajaya, Malaysia.
   Organisers: Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI), Asia-Pacific Network for Global Change Research (APN)

5. Workshop on Natural Disasters and Climate Change in Asia, 5-7 November 2012, Bangi, Malaysia.
   Organisers: Southeast Asia Disaster Prevention Research Institute (SEADPRI-UKM) and Cambridge Malaysian Education and Development Trust (CMEDT), in collaboration with Asia-Pacific Network for Global Change Research (APN) and other bodies.

APN Project (2009-2012) on

Strengthening the Capacity for Policy Research on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors

| Aims and Objectives |

The project aims to strengthen research capacity on mainstreaming climate change adaptation concerns into agricultural and water policies and create a network for adaptation policy research in Asia (**ARPNAP**: **A**daptation **R**esearch and **P**olicy **N**etwork for **A**sia and the **P**acific)

The objectives of the project are:

1. to assess technical, institutional and regulatory barriers to integrate climate change adaptation concerns at both policy and operational levels and propose countermeasures,
2. to develop metrics for monitoring the progress in mainstreaming adaptation in sectoral policies and operations,
3. to identify characteristics of selected policies that will enhance adaptive capacity, and examine how such policies can adapt to a range of conditions,
4. to create ARPNAP network linking adaptation research and policy makers in Asia, and
5. to disseminate project findings to a wider audience and enhance knowledge of adaptation in Asia through research-policy dialogues and project publications.

| Partners |

1. Institute for Environment and Development (LESTARI) / Southeast Asia Disaster Prevention Research Institute (SEADPRI), Universiti Kebangsaan Malaysia (UKM), Kaula Lumpur, Malaysia
   Contact: Prof. Dr. Joy Jacqueline Pereira, joy@ukm.my;
   Mr. Tan Ching Tiong, tctiong@gmail.com
2. Institute for Global Environmental Strategies (IGES), Japan
   Contact: Dr. S.V.R.K. Prabhakar, prabhakar@iges.or.jp
3. M.S. Swaminathan Research Foundation (MSSRF), India
   Contact: Dr. Arivudai A. Nambi, anambi@mssrf.res.in
4. Vietnam Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam
   Contact: Dr. Nguyen Van Thang, nvthang@vkttv.edu.vn

Designed by Nik Faizul

Inception Workshop on "Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors"

10 August 2009 • Corus Hotel, Kuala Lumpur

Organised by

LESTARI Universiti Kebangsaan Malaysia

APN Asia-Pacific Network for Global Change Research

IGES Institute for Global Environmental Strategies

In Collaboration with

MARDI NAHRIM seadpri southeast asia disaster prevention research institute IMHEN

PROGRAMME

0830	*Registration*
0900	**Welcoming Remarks** Prof. Dr. Mazlin bin Mokhtar, Director Institute for Environment and Development (LESTARI) Universiti Kebangsaan Malaysia (UKM)
	Chair: Dr. Ancha Srinivasan, Asian Development Bank (ADB)
0930	**Mainstreaming Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in the Asian Region** Dr. S.V.R.K. Prabhakar, Climate Policy Researcher Institute for Global Environmental Strategies (IGES), Japan
0950	**Mainstreaming Climate Change : Development of National Policy on Climate Change in Malaysia** Prof. Dr. Joy Jacqueline Pereira, Principal Fellow Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM)
1010	Discussion Session
1030	*Break*
1100	Chair: Dr. S.V.R.K. Prabhakar, IGES
1100	**Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in India** Dr. Arivudai A. Nambi, Project Director, Climate Change MS Swaninathan Research Foundation (MSSRF), India
1120	**Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in the Philippines** Prof. Dr. Juan M. Pulhin, Professor University of Philippines Los Banos, Philippines
1140	**Climate Change Adaptation in the Agriculture and Water Sectors: Current Status Issues and Challenges in Vietnam** Dr. Nguyen Van Thang, Director, Center for Meteorology and Climatology Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam
1200	**Climate Change Adaptation: Current Status, Issues and Challenges in Cambodia** Mr. Nyda Chhinh, Research Coordinator, Department of Environment Royal University of Phnom Penh, Cambodia.
1220	Discussion Session
1300	*Lunch*
1300	Chair: Prof. Dr. Juan M. Pulhin, University of Philippines Los Banos
1400	**Climate Change Adaptation and the Agriculture Sector: The Experience of Malaysia** Malaysian Agricultural research and Development Institute (MARDI)
1420	**Climate Change Adaptation: Agriculture and Livelihood** Prof. Chamhuri Siwar, Principal Fellow / Dr. Abul Quasem Al-Amin, Post-Doctoral Fellow Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM)
1440	**Adaptive Capacity to Climate Change : Concept and Approach for the Water Sector in Malaysia** Mr. Tan Ching Tiong, Research Officer Southeast Asia Disaster Prevention Institute (SEADPRI), Universiti Kebangsaan Malaysia (UKM)
1500	**Monitoring Progress of Climate Change Adaptation:The Use of Adaptation Metrics** Dr. S.V.R.K. Prabhakar / Dr. Takuro Kobashi, Researcher, Climate Policy Project Institute for Global Environment Strategies (IGES), Japan
1520	**Financing Mechanism for Adaptation to Climate Change in the Agriculture and Water Sectors: An Overview** Dr..Ancha Srinivasan, Senior Climate Change Specialist Asian Development Bank (ADB)
1540	Discussion Session
1600	*Closing and Refreshment*

WORKSHOP ON "MAINSTREAMING ADAPTATION TO CLIMATE CHANGE IN THE AGRICULTURE & WATER SECTORS", CORUS HOTEL, 10 AUGUST 2009, KUALA LUMPUR.

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WORKSHOP ON "MAINSTREAMING ADAPTATION TO CLIMATE CHANGE IN THE AGRICULTURE & WATER SECTORS", CORUS HOTEL, 10 AUGUST 2009, KUALA LUMPUR.

PRESENTERS:

No	NAME	INSTITUTION	PAPER PRESENTED
1.	Dr. SVRK Prabhakar *Policy Researcher, Climate Policy*	Institute for Global Environmental Strategies (IGES), Japan	Mainstreaming Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in the Asia Region
2.	Dr. Takuro Kobashi *Researcher, Climate Policy Project*		Monitoring Progress of Climate Change Adaptation: The Use of Adaptation Metrics
3.	Dr. Arivudai A Nambi *Project Director, Climate Change*	MS Swaminathan Research Foundation (MSSRF), India	Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in India
4.	Dr. Nguyen Van Thang *Director*	Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam	Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in Vietnam
5.	Mr. Tran Dinh Trong *Head of Tropical Meteorology and Atmospheric Physics Division*		-
6.	Dr. Ancha Srinivasan *Senior Climate Change Specialist*	Asian Development Bank (ADB)	Financing Mechanisms for Adaptation to Climate Change in Agriculture and Water Sectors: An Overview
7.	Prof. Dr. Juan M. Pulhin *Professor*	University of the Philippines Los Baños	Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in the Philippines

8.	Dr. Krishna Suryanto Pribadi *Researcher, Center for Disaster Mitigation*	Bandung Institute of Technology	-
9.	Mr. Nyda Chhinh, *Research Coordinator*	Department of Environment, Royal University of Phnom Penh, Cambodia.	Climate Change Adaptation: Current Status, Issues and Challenges in Cambodia
10.	Dr. Mohd. Zabawi Abdul Ghani, *Deputy Director*	Malaysian Agricultural Research and Development Institute (MARDI)	Potential Impacts of Climate Change on Agriculture and Adaptation Strategies: Malaysia's Experience
11	Prof. Dr. Joy Jacqueline Pereira, *Principle Fellow*	Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)	Mainstreaming Climate Change: Development of National Policy on Climate Change in Malaysia
12	Dr. Abul Quasem Al-Amin, *Post-Doctoral Fellow*		Climate Change Adaptation: Agriculture and Livelihood
13	Mr. Tan Ching Tiong, *Research Officer*		Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector

WORKSHOP ON "MAINSTREAMING ADAPTATION TO CLIMATE CHANGE IN THE AGRICULTURE & WATER SECTORS", CORUS HOTEL, 10 AUGUST 2009, KUALA LUMPUR.

SECRETARIATS:

NO.	NAME	INSTITUTION	REMARKS
1	Prof. Dr. Mazlin bin Mokhtar *Director*	Institute for Environment and Development, Universiti Kebangsaan Malaysia (LESTARI-UKM)	Project Advisor
2	Prof. Dr. Joy Jacqueline Pereira *Principle Fellow*		Project Leader
3	Datin Dr. Sharifah Munirah Syed Hussein Alatas *Senior Lecturer*		Researcher
4	Prof. Chamhuri bin Siwar *Principle Fellow*		Researcher
5	Dr. Abul Quasem Al-Amin *Post-Doctoral Fellow*		Researcher/Rapporteur/Secretariat
6	Tan Ching Tiong *Research Officer*		Researcher/Secretariat
7	Koh Fui Pin *Research Assistant*		Researcher/Secretariat
8	Nor Mazni Md. Zaini		Secretariat
9	Mohd Khairul Zain bin Ismail *Research Assistant*		Secretariat
10	Mohd Yusairi b. Mat Yusop *Technician*		Technician

Mainstreaming Climate Change Adaptation in Agriculture and Water Sectors:

Current Status, Issues and Challenges in the Asia Region

SVRK Prabhakar, IGES, Japan

Inception Workshop on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors
10-11 August 2009, Ballroom 2, Corus Hotel, Kuala Lumpur, Malaysia

sivapuram.prabhakar@gmail.com

Presentation outline

- ►Climate change impacts
- ►Vulnerability of AP region
- ►Brief update on what is going on
- ►Way forward

The review presented here broadly represents the background paper circulated

In IPCC Words

"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level"

Image source: IPCC. 2007. AR 4

Impact: Global temperatures

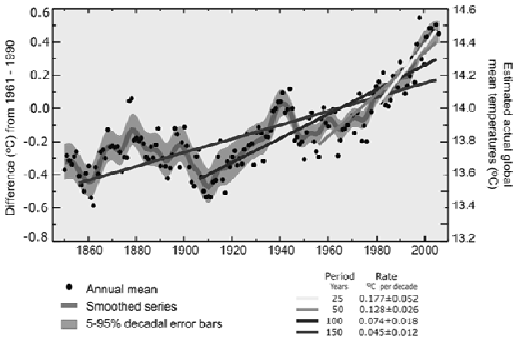


Image source: IPCC. 2007. AR 4

Impact: Sea level rise

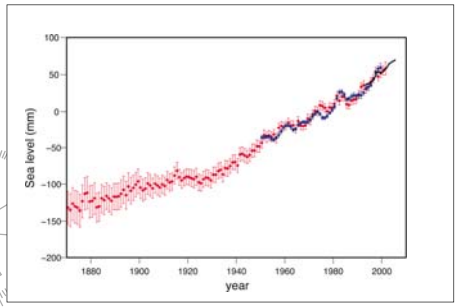
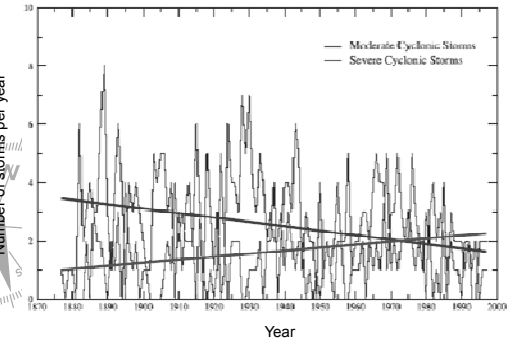


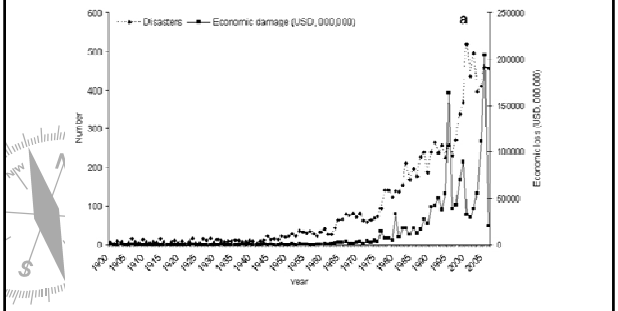
Image source: IPCC. 2007. AR 4

Impact: Natural disasters

Observed cyclonic storms in Indian ocean



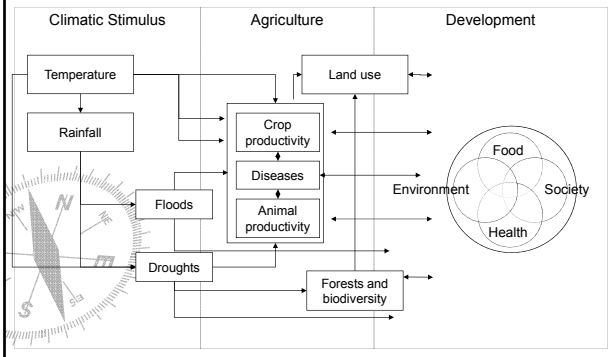
Impact: Global Trend of Hydro-met Disasters*



*Includes droughts, floods, cyclones, tornadoes

Data source: EM-DAT, 2007

The Impact Pathway of CC

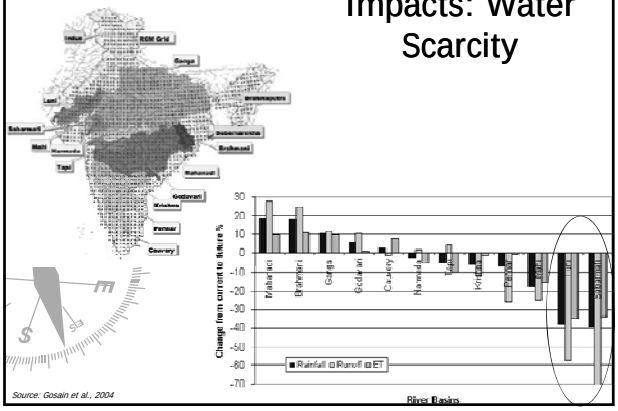


Some projected impacts on agriculture and water sectors in AP Region

- Crop yields could increase up to 20% in East and South-East Asia while they could decrease up to 30% in Central and South Asia by the mid-21st century. Along with population growth, the risk of hunger is projected to remain very high in several developing countries.
- Pressure on natural resources and the environment associated with rapid urbanization, industrialization, and economic development.
- Glacier melt in the Himalayas is projected to increase followed by decreased river flows as the glaciers recede.
- Freshwater availability in Central, South, East and South-East Asia, particularly in large river basins, is projected to decrease which, along with population growth and increasing demand arising from higher standards of living, could adversely affect more than a billion people by the 2050s.
- Coastal areas, especially heavily-populated mega delta regions in South, East and South-East Asia, will be at greatest risk due to increased flooding from the sea and, in some mega deltas, flooding from the rivers.

Source: IPCC, 2007

Impacts: Water Scarcity



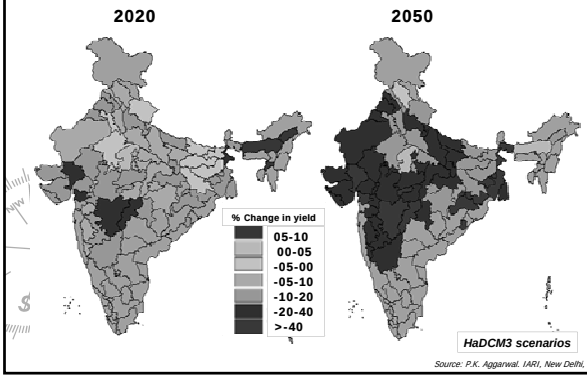
Source: Gosain et al., 2004

Impacts: Water Scarcity

- China: The Haihe-Luanhe River basin will face water scarcity, followed by Huaihe River basin and Yellow River basin. Northern arid provinces are most important.[1]
- Mekong: Upper Mekong (Yunnan Province of China), Korat Plateau and Southern Lowland will experience further reduction in rainfall and runoff + water demand due to agriculture and population growth.[2]

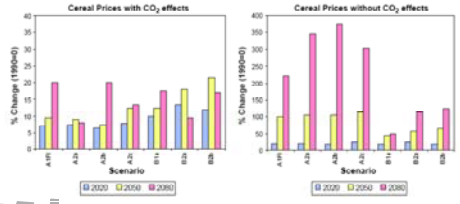
Source: 1. China Nat CC Prog., People's Republic of China, 2007.
2. Chinvanno, S. Reg Conf on Digital GMS, 2003

Impacts on Agriculture



Source: P.K. Aggarwal. IARI, New Delhi, India

Impacts on Food Prices



Changes in global cereal prices under seven SRES scenarios with and without CO2 effects, relative to the reference scenario (no climate change).

Source: M.L. Parry et.al., 2004. Global Environmental Change 14:53-67

Vulnerability: High dependence on agriculture

Region	Economically active population in agriculture (%)
World	44
Asia and Pacific	60
Latin America and Caribbean	19
E & N Africa	33
Sub-Saharan Africa	62
Developed market economies	3
Countries in transition	15

Table source: FAO. State of food & agriculture 2003-04

Vulnerability: Rural Poverty in Asia

Country/Year	Distribution of Poor: Rural	Urban
Southeast Asia		
Indonesia, 1990	83.4	16.6
Laos, 1992/93	87.8	12.2
Malaysia, 1987	86.0	14.0
Thailand, 1992	84.7	15.3
Viet Nam, 1992/93	89.1	10.9
East Asia		
China, 1995	98.9	1.1
Mongolia, 1995	43.0	57.0
South Asia		
Bangladesh, 1995/96	57.8	42.2
India, 1994	86.3	13.8
Nepal, 1995/96	94.0	6.0
Pakistan, 1990/91	75.0	25.0
Central Asia		
Kazakhstan, 1996	57.0	43.0
Kyrgyzstan, 1996	59.8	40.2
Pacific Islands		
Papua New Guinea, 1996	94.2	5.8
Average	80%	22%

Table source: Assessment of rural poverty in Asia and the Pacific, IFAD, 2002

Vulnerability: Water Scarcity

- The drought-prone countries in this region are Afghanistan, Iran, Myanmar, Pakistan, Nepal, India, China, Sri Lanka and parts of Bangladesh, Philippines, Thailand, Australia and the Pacific islands of Fiji, Vanuatu and Samoa.
- The majority of the estimated 500 million rural poor in the Asia-Pacific region are subsistence farmers occupying mainly rain-fed land.

Source: ESCAP, 2004. State of the Environment

Vulnerability: Poor Progress in MDGs

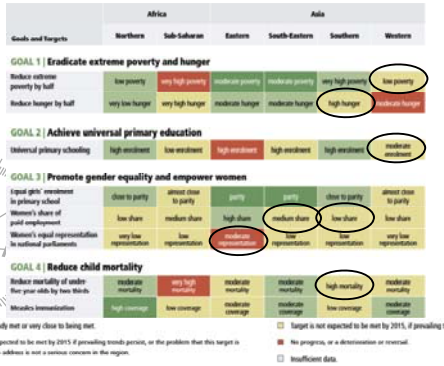


Image source: UN Millennium Development Goals: 2006 progress chart

MDGs cont...

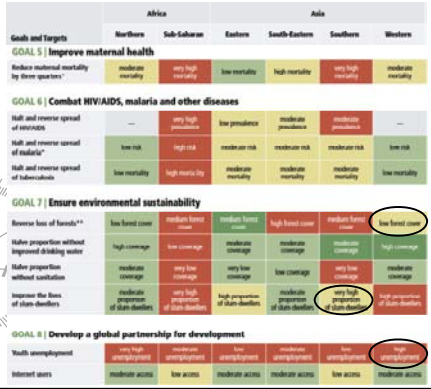
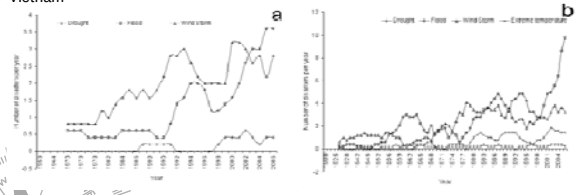


Image source: UN Millennium Development Goals: 2006 progress chart

Hydro-Met Disaster Vulnerability

Vietnam India

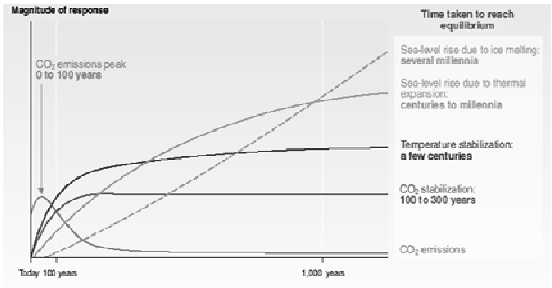


Data source: EM-DAT, 2007

- "The vulnerabilities of people due to the developmental path chosen is a major cause of concern, while the role of climate change cannot be ruled out behind the increasing disasters"
- The Asia - Pacific region accounted for 91% of the world's total deaths and 49% of the world's total damage due to natural disasters in the last century.

Munich-Re, 2006

Hence, Adaptation is Important



Source: IPCC, 2007

What have we been Doing? A Brief Update

Agriculture

- Some of the countries have already initiated vulnerability assessments with respect to climate change.
- These vulnerability assessments consisted of identifying and analyzing the impact of climate change and variability on natural eco-systems, socio-economic systems, and human health.
- Some assessments also considered the institutional and financial capacities of the local communities, assessing the spontaneous and planned adaptation measures already taken up, and developing technical, institutional and financial strategies to reduce vulnerabilities.

Agriculture...

- Major adaptation initiatives being taken up by the countries in Asia Pacific region could broadly be grouped into the following
  - Development of crop varieties that are tolerant to perceived threats that includes droughts, pests and diseases (Australia, India, Indonesia, Malaysia, Vietnam)
  - Expanding area under irrigation and efforts for better water management including watershed management practices (Australia, Bangladesh, China, India, Indonesia, Malaysia, Russia, Vietnam)
  - Improving weather forecasts and linking with farm decision making (Australia and India)
  - Drought monitoring systems are being put in place though do not completely cover the entire country or are in inception stage (China, India, Vietnam, Australia)
  - Investment in rural infrastructure that promotes access to markets that in turn enhances the resilience of rural communities which is more relevant for the developing countries in the region (India, China, Sri Lanka)

Source: From different sources

Water Scarcity

Country	Significant initiatives
Bangladesh	• National level comprehensive disaster management initiative that encompasses drought as a theme which in turn brings together various stakeholders • Promotion of groundwater use in Barind region • Development of appropriate land and crop management practices to reduce the drought risk
China	• Drought monitoring using ground based observatories and remote sensing • Drought risk zoning classification in place • Massive plantations being planned and implemented to stabilize the desertification process
India	• National crop weather watch group that monitors drought during monsoon season • Integrated watershed development projects being taken up in drought prone areas • Desert development program (DDP) has been implemented in areas prone to desertification
Indonesia	• Integrated water resource management in Citarum river basin, climate field schools, SRI
Vietnam	• Laws and decrees exist that provides for drought and water management • Peoples participation in water resource management • Development of water resource monitoring network • International cooperation in water resource management • Establishment of Mekong River Commission
Australia	• Drought relief payment system put in place for the affected farmers • National water initiative by Australian Water Fund • Water proofing projects, water strategies at state level, improving water use efficiency in various water-dependent sectors, emphasis on water recycling, water conservation measures are in place

Source: From different sources

Other Vulnerability Reduction Initiatives

Country	Land and rural development initiatives
Bangladesh	• Livestock enterprise development • Microfinance through self help groups
China	• Legal changes that would give farmers long-term security on the land (to provide tenure security)
India	• Secure drinking water supply • Wage employment, employment assurance, food for work, rural housing, social security programs, land reforms etc • Watershed development programs such as Drought Prone Areas Program (DPAP) and Desert Development Program (DDP)
Indonesia	• Food security enhancement program
Vietnam	• Agricultural diversification • Strengthening the agriculture extension programs • Ongoing efforts to improve access to rural water supply and sanitation
Sri Lanka	• Significant investment in natural resource management

Two Approaches to Climate Decision Making

- Decision making based on the past climate
  - Assumes general development programs would suffice to take care of climate change
  - Most followed ideology
  - Many national communications generally list developmental programs in the place of adaptation initiations

Two Approaches to Climate Decision Making...

- Decisions those are valid for the future, based on future climate forecasts
  - Less information
  - No dependable climate forecasts
    - Time scales (near and far)
    - Spatial scale (AR4:~110 sqkm, AR3: 180 sqkm; FAR: 500sqkm)
  - Less understanding on the climate system
    - Complex ocean and atmospheric interaction
    - Solar and lunar influence

Way Forward

Way forward

- Integrated river basin management should be given more thrust than they are being given at the moment.
- Demand side management of natural resources is another issue needs more consideration.
- A prudent water sharing mechanism between various water using sectors is an absolute necessity for the countries in the region (complete water balance).
- There is a clear linkage between coping capacity and land tenure arrangement. Countries in the region enhance the process of streamlining land tenure arrangements.

Way forward

- There is a need for enhancing the coordination between various institutions and governments at the local, national and regional levels.
- regional cooperation could be identified in the areas of drought and desertification monitoring.
- Relevant weather and climate forecasts that help the end-users to take decisions with more confidence by improving the consistency, quality and value of the forecasts.
- The potential of resource conserving technologies such as zero and reduced tillage may be explored in the region as they conserve the soil moisture and reduce the off-farm inputs considerably.

Way forward

- Enhancing the capacities of local governments and communities is important for achieving resilience to climate change.
- Community based planning can enable governments to gain better understanding on the vulnerabilities of the communities.
- A shift from ad-hoc measures to planned relief interventions that aims at creating longer-term livelihood options is an important thing to be considered for better vulnerability reduction.

Way Forward: Some requisites

- Mainstreaming climate change adaptation concerns in developmental planning
  - Strategic thinking: Short term goals vs longer term problem
  - Validity of current actions in future
    - Identification of win-win strategies
    - Act where hints are clear and keep on watch where hints are not clear
  - Reducing the uncertainty: Understanding climate system for dependable climate forecast
  - Climate Vulnerability Impact Assessment of projects and programs on the lines of EIA
- Developing capacities for decision making under uncertainty: Climate integrated decision making, climate task groups (CTGs)
- Low carbon agriculture for adaptation

Way Forward: climate regime can help progress adaptation in agriculture and water sectors

- Identify agriculture and water sectors as priority areas for investment of global adaptation funds
- New and innovative financing adaptation: Soil carbon sequestration credits can help fund adaptation
- Facilitate agro-technology transfer from haves to have-nots

Thank You!

"Today's problem cannot be solved if we still think the way we thought when we created them"

-Albert Einstein

Thank You

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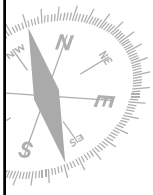
Sustainable development: A new development path

- "Many present development trends leave increasing numbers of people poor and vulnerable, while at the same time degrading the environment. How can such development serve next century's world of twice as many people relying on the same environment? This realization broadened our view of development. We came to see it not in its restricted context of economic growth in developing countries. We came to see that a new development path was required, one that sustained human progress not just in few places for a few years, but for the entire planet into the distant future."

Sustainable development

- ‘Development which meets the needs of the present without compromising the ability of future generations to meet their own needs.’



Inception Workshop on
"Mainstreaming Climate Change in Agricultural and Water Sectors"
10 August 2009, Kuala Lumpur

Mainstreaming Climate Change: Development of the National Policy on Climate Change

Joy Jacqueline Pereira
Deputy Director, SEADPRI-UKM
Principal Fellow, LESTARI-UKM

Mainstreaming

Involving administrative actors & other stakeholders whose main tasks are not connected to mitigating or adapting to climate change, to initiate their own actions to promote these objectives.

Horizontal mainstreaming - taking account of climate change throughout all agencies/ministries

Vertical mainstreaming here refers to the integration of climate issues in a single sector through Federal, State and Local levels

Climate Change – RMK9 Funded Initiatives

- **Conduct Coastal Vulnerability Index (CVI) study;**
- **Implement coastline protection programme;**
- **Develop Integrated Coastal Zone Management;**
- **Implement flood mitigation programme such as the Stormwater Management And Road Tunnel (SMART) Project;**
- **Undertake study to identify the relationship between the impacts of climate change and vector-borne diseases.**
- Increase supply and utilisation of alternative fuel such as renewable energy (RE);
- By 2010 about 300 MW of RE is expected to be generated and connected to the TNB Grid in Peninsular Malaysia and 50 MW to SESB Grid in Sabah;
- RE projects utilising municipal waste will be promoted;
- The Clean Development Mechanism (CDM) under the Kyoto Protocol will be utilised to provide support for the implementation of Small Renewable Energy Programme (SREP);
- **Supply to 55,000 unit of houses electricity generated from technologies such as hybrid solar system and micro-hidro;**
- **Encourage energy efficiency in industrial, building and transport sectors;**
- **Protect forest areas via sustainable forest management to ensure the forest areas are maintained as sink to greenhouse gas, i.e. Carbon dioxide.**

Climate Change – National Scenario

United Nations Development Programme (UNDP) / Global Environment Facility (GEF):

- 2nd National Communication (NC2) Project
- National Capacity Self Assessment (NCSA) Project
- GEF – Resource Allocation Framework 4 (GEF-RAF4)

Ninth Malaysia Plan (RMK9)

- Policy Study on Climate Change (LESTARI/UKM)
- Preparation of GHG Inventory (PTM)
- Comparative Study on Carbon Sequestration (FRIM)
- Development of CDM Secretariat
- Public Awareness and Training Programmes (TrREES, MNS, CETDEM, UPM)

Policy Study on Climate Change

- *Kajian Dasar Perubahan Iklim*
  - RMK9 project
  - Conservation and Environmental Management Division (CEMD), Ministry of Natural Resources and Environment
  - Institute for Environment and Development (LESTARI), UKM

Research Team

- **Conservation and Environmental Management Division, Ministry of Natural Resources and Environment**
  - Dr. Lian Kok Fei (Undersecretary)
  - Chong Poon Chai (Deputy Undersecretary)
  - Shahril Faizal Abdul Jani (Principal Assistant Secretary)
  - Maximilian T. Conrad (Assistant Secretary)
  - Siti Khadijah Abdul Ghani (Assistant Secretary)
- **Institute for Environment and Development, Universiti Kebangsaan Malaysia**
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  - **Researchers –** Prof. Dr. Mazlin Mokhtar; Prof. Dato' Dr. Ibrahim Komoo; Raja Datuk Zaharaton Raja Zainal Abidin; Datin Paduka Dr. Halimaton Saadiah Hashim; Dato' Shaharuddin Mohamad Ismail; Prof. Chamhuri Siwar; Assoc. Prof. Dr. Abdul Hamid Jaafar; Dr. Er Ah Choy; Sarah Aziz Abdul Ghani Aziz
  - **Manager –** Tan Ching Tiong
  - **Research Assistants –** Koh Fui Pin; Nur Azrina Azhar; Zaiwana Ngojar, Mohd. Khairul Zain Ismail

Approach & Outputs

INPUTS

CRITICAL REVIEW
- Post-2012 Responses
- Elements of the UNFCCC / KP
- OPP3 / RMK9 / Relevant National Policies / M-INC
- State Policies & Planning Processes
- Specialised Studies

COMPARATIVE STUDY
- Selected NCs
- Selected National Policies / Strategies from Other Countries

STAKEHOLDER VIEWPOINTS
- Surveys/Interviews
- National/Regional/Other Meetings
- RMK9 CC Projects
- NC-2
- NCSA

OUTPUTS

NATIONAL POSITION AT UNFCCC / KP

NATIONAL POLICY – STRATEGIES & ACTIONS

STATE POLICY & ACTION PLANS

Elements of Climate Change Policies

Issues	UNFCCC Elements	NGO CC Action Plan[1]	Singapore	Thailand	South Africa	Sweden	Finland	Proposed Climate Policy
FEDERAL LEVEL								
Vulnerability, Impacts & Adaptation	✓	✓	✓	✓	✓		✓	✓
Mitigation / Kyoto Protocol	✓	✓	✓	✓	✓	✓	✓	✓
Research & Systematic Observation	✓	✓	✓	✓	✓	✓	✓	✓
Technology	✓				✓	✓	✓	✓
Awareness, Education & Public Participation	✓	✓	✓	✓	✓	✓	✓	✓
Future Global Climate Regime	✓					✓	✓	✓
Reporting	✓	✓			✓	✓		✓
Institutional Arrangement & Other Procedural/Administrative Issues	✓			✓		✓	✓	✓
Financial Mechanism	✓				✓	✓	✓	✓
STATE LEVEL						✓	✓	✓
LOCAL LEVEL								✓

1. A Proposal for a Malaysian Climate Action Plan

Climate Change in Malaysia

- **Mitigation – driven primarily by international agreements requiring national responses**
- **Adaptation**
  - **– involves action by affected entities, requiring national, state, local and community level responses**
  - **– is unavoidable**
- **Common but differentiated responsibility...**
- **Balancing adaptation and mitigation**
- **Focus – adaptation & co-benefits of mitigation**
- **R & D required to identify opportunities for synergies**

Need for Policy on Climate Change

Source: NAHRIM (2006)

Possible climatic change in Peninsular Malaysia by 2041-2050:
- Temperature rise 2^0C
- More extreme hydrological conditions
  - Higher maximum rainfall; Lower minimum rainfall.
  - Higher high riverflow; Lower low riverflow.

Potential implications
- Water balance → Water sufficiency
- Crops yields → Food security
- Plantation → Economic loss
- Infrastructure → Repairs & reconstruction

Adaptation based on wise resource management; Mitigation to enhance adaptation and sustainable development

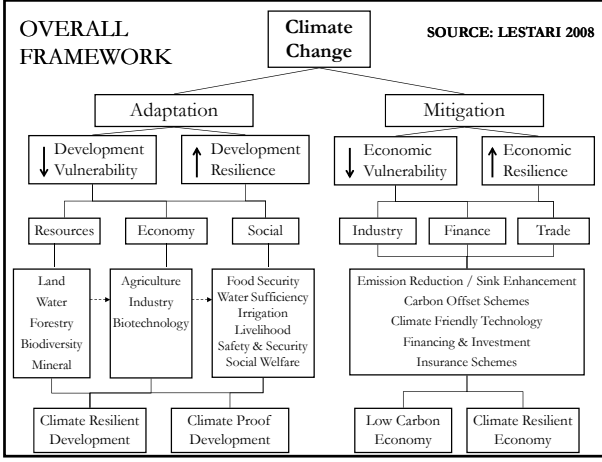
SOURCE: LESTARI 2008

Importance of Policy on Climate Change

- Climate change – cross-sectoral in nature, involves more than environmental issues, also affects economic growth and human well-being
- Climate change – transcends all levels, sectors, stakeholders and major groups
- Climate change measures need to be mainstreamed into development plans

OVERALL FRAMEWORK

SOURCE: LESTARI 2008



Stakeholder Consultation (Phase 1)
– To Understand & Document Viewpoints

- **11 Meetings from 2005-2008 (Total Participants ≈ 500)**

1. NRE/DANIDA – Workshop on Malaysia's Second National Communication to the UNFCCC, 17th January 2005, Kuala Lumpur.
2. NRE/DANIDA – Second Workshop on Malaysia's Second National Communication to the UNFCCC, 26th April 2005, Putrajaya.
3. NRE/DANIDA – Training Workshop National Communication, 27th October 2005, Putrajaya.
4. NRE/UNDP – Inception Workshop for Malaysia's Second National Communication, 19-20th March 2006, Port Dickson.
5. NRE/UNDP – Inception Workshop for Malaysia's National Capacity Needs Self Assessment for Global Environmental Management Project, 26th March 2006, Putrajaya
6. MOSTI – National Seminar on Socio-Economic Impact of Extreme Weather and Climate Change, 21–22th June 2007, Putrajaya.
7. NRE/UNDP – East Coast Stakeholder Consultation Sessions on NCSA Biodiversity, Climate Change and Land Degradation, 4–5th October 2007, Kuantan.
8. NRE/UNDP – Conference on Climate Change Preparedness: Towards Policy Changes, 11th September 2007, Kuala Lumpur.
9. NRE/British High Commission – Regional Conference on Climate Change: Reducing the Threats and Harnessing the Opportunities of Climate Change, 29–30th October 2007, Kuala Lumpur.
10. LESTARI/NRE/IUGS-GEM/GTK – Forum on Cities and Climate Change, 5th November 2007, Putrajaya.
11. LESTARI/NRE/UNDP/ISIS – Roundtable Dialogue on "A New Approach to Climate Change: Balancing Adaptation and Mitigation", 25th February 2008, Bangi.

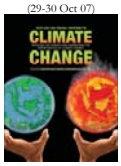
Outputs – Stakeholder Consultation Reports

MOSTI (21-22 Jun 07)

NRE/UNDP (4-5 Sep 07)

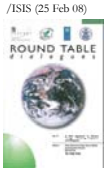
NRE/UNDP (11 Sep 07)

NRE/British HC (29-30 Oct 07)



LESTARI/ EAROPHP (5-7 Nov 07)

LESTARI/NRE/UNDP /ISIS (25 Feb 08)



MOSTI/MMD/ASM/UM /UKM (14-15 Oct 08)

Stakeholder Consultation (Phase 2)
– To Inform on Policy Formulation & Solicit Inputs

- **7 Events from 2007-2008 (Total Participants ≈ 300)**

1. NRE/UNDP – Sarawak Stakeholder Consultation Sessions on NCSA Biodiversity, Climate Change and Land Degradation, 23 – 24 October 2007, Kuching. (Topic: UNFCCC and Policy Study on Climate Change in Malaysia).
2. NRE/UNDP – Sabah Stakeholder Consultation Sessions on NCSA Biodiversity, Climate Change and Land Degradation, 1 – 2 November 2007, Kota Kinabalu. (Topic: UNFCCC and Policy Study on Climate Change in Malaysia).
3. National Environmental Conference – Facing Market Realities: Going Green for Sustainable Development, 17 – 18 January 2008, Kuala Lumpur. (Topic: Dealing with Climate Change – Initial Findings of a Policy Study).
4. Young Presidents Organisation – Outlook for the Year 2008: The Effects of Climate Change on Business, 24 January 2008, Kuala Lumpur. (Topic: Initial Findings of the Policy Study on Climate Change).
5. UKM – International Seminar on Climate Variability, Change and Extreme Weather Events (Towards Enhancing Understanding of Climate Variability and Change in the Maritime Continent and Indo-Pacific Region), 26 – 27 February 2008, Bangi, Selangor. (Topic: Initial Findings of the Policy Study on Climate Change)
6. MNS – Raptor Watch Weekend 2008, 15 – 16 March 2008, Negeri Sembilan. (Topic: Initial Findings of the Policy Study on Climate Change)
7. FMM – Seminar on "Conservation of Air and Ozone Layer", 26 June 2008, Kuala Lumpur. (Topic: Climate Change and Malaysia)

Stakeholder Consultation (Phase 3)
– To Review Policy Framework & Solicit Viewpoints

- **5 Meetings in 2008 (Total Participants ≈ 200)**

Date	Meeting	Participants
15 May 2008	Peer-review Workshop on Draft Report	17 national experts
23 July 2008	Consultation Session with NGOs	10 organisations
1 August 2008	Consultation Session with Business & Industrial Groups	4 business groups (MICCI, FMM, BCSDM & ACCA)
5 August 2008	Consultation Session with NC2 Project Members	12 government agencies
21 August 2008	National Steering Committee on Climate Change Meeting	≈ 15 agencies + NGO
4 September 2008	Briefing to the NRE Minister	Minister and Senior Officials

Stakeholder Consultation (Phase 4)
– To Review Draft Policy & Key Actions

- **National Consultation Workshop, 24 – 25 September 2008, Putrajaya (Total Participants ≈ 60) – Agreement Obtained. Request made for final round of consultation.**

- **Inputs officially requested from the State Governments of Sabah and Sarawak.**

- **Consultation Meeting in Sabah organised by the Sabah State Economic Planning Unit, 12 December 2008 – Agreement Obtained.**

- **Submission of Stakeholder Consultation Report & draft policy to NRE (ver 23 Dec 2008)**
- **Briefing to NRE's KSU & TKSU (10 June 2009)**
- **Decision on Final Stakeholder Consultation (16 June 2009)**

National Policies Relevant to Climate Change

Draft National Policy on Climate Change

Contents:

- Preamble
- Policy Statement
- Rationale
- Objectives
- Principles
- Strategic Thrusts
- Key Actions
- Glossary

Other National Climate Change Policies

Country	Climate Change Policy	Proponents/Focal Point
Singapore	National Climate Change Strategy	National Climate Change Committee (Focal Point: Ministry of Environment and Water Resources)
Thailand	Thailand's Strategic Plan on Climate Change (2008 – 2012)	Ministry of Natural Resources and Environment
South Africa	A National Climate Change Response Strategy	National Committee for Climate Change (Focal Point: Department of Environmental Affairs and Tourism)
Sweden	The Swedish Climate Strategy	Ministry of the Environment
Poland	Poland's Climate Change Policy	Ministry of Environment
Finland	Energy and Climate Policy for the Near Future – National Strategy to Implement the Kyoto Protocol	Ministry of Employment and the Economy
	Finland's National Adaptation Strategy	Ministry of Agriculture and Forestry
	United Nations Framework Convention on Climate Change	Ministry of Environment

National Drivers

1994 - National Focal Point for the UNFCCC (Ministry of Ministry of Natural Resources and Environment)

1994 - National Climate Change Steering Committee (Chair: Secretary-General, Ministry of Ministry of Natural Resources and Environment)

2009? - National Climate Change Cabinet Committee (Chair: Prime Minister of Malaysia; Secretariat: Ministry of Ministry of Natural Resources and Environment)

Project Recommendations

- The Draft National Policy on Climate Change to be tabled to the Cabinet Committee on Climate Change for consideration and endorsement for implementation.
- A dedicated Climate Change Unit be established to coordinate implementation of the Policy.

Recommendations for Mainstreaming

- **National Policy should be deemed politically significant: Commitment of the Prime Minister and other key Ministers are critical.**
- **Federal and state budgets should integrate climate change programmes.**
- **Ministries and agencies to annually prepare action plans to implement the National Policy**
- **Strengthening present functions of Focal Point and consider establishment of a new function; to be responsible for mainstreaming climate change.**
- **Establishment of a national level expert group**
- **Ascertain what legislative changes would best ensure incorporation of climate change elements.**
- **Research should be initiated, which contributes to the mainstreaming of the National Policy.**

ACKNOWLEDGEMENT

EPU; WISMA PUTRA; NAHRIM; PTM; FRIM; MMD; MARDI; JPSM; JPBD; KPKT; MOSTI; KTAK; MIMA; ISIS; RMK9 CLIMATE CHANGE PROJECTS; NC2; NCSA; MENGO; FMM; ACCA; MICCI; BCSDM; ETC

THANK YOU!

Inception Workshop on Mainstreaming Adaptation to Climate Change in Agriculture & Water Sectors

Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in India

August 10-11, 2009
Kuala Lumpur

A.A. Nambi
M.S. Swaminathan Research Foundation, Chennai
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Outline

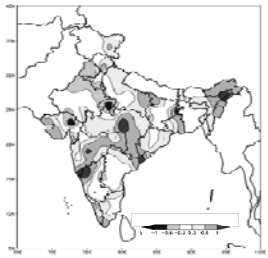
- **Overview of the current / future climate scenario**
- **Agricultural Issues**
- **Water Issues**
- **Major challenges & possible pathways**

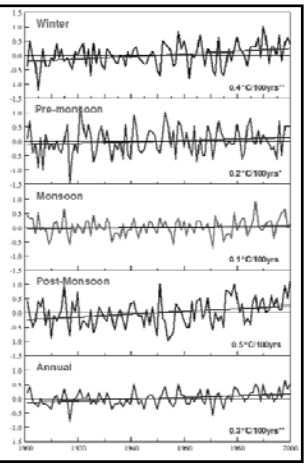
Climate Change: Current Scenario

***Temperature Changes*:**
- The mean annual surface-air temperature has risen by an average of 0.4°C in the last 50 years (1948 – 1998)
- The spatial distribution of temperature changes indicated a *significant warming trend.* This has been observed along the west coast, central India and interior peninsula and over north east India
- Cooling trend has been observed in north west and some parts of southern India.

***Variable rainfall patterns*:**
- At all India level, there is no trend in monsoon rainfall during last 100 years, but there are some *regional patterns and random variations*
- As much as *70% of the annual aggregate precipitation* is received in a short period from *June – September* during southwest monsoon
- Areas of increasing trend in monsoon rainfall are found along the west coast, north Andhra Pradesh and north-west India
- Decreasing trend over east Madhya Pradesh and adjoining areas, north-east India and parts of Gujarat and Kerala (-6 to -8% of normal over 100 years).
- There are *evidences that glaciers in Himalayas are receding at a rapid pace*.

All-India Observed Mean Surface Temperatures (1901-2000)





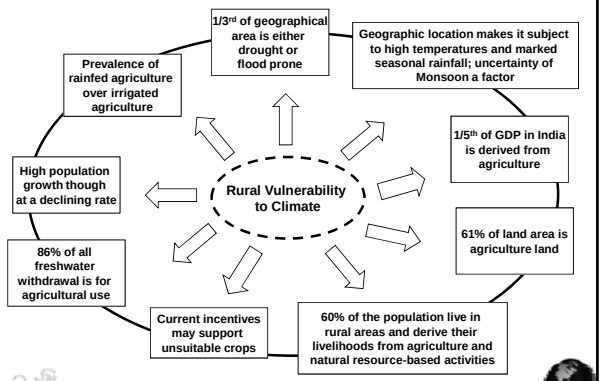
Current Trends

- Higher frequency of droughts:
  - Almost 20% of India's total land area is drought prone. The frequency of droughts has been increasing over time
- Increased frequency of floods:
  - The Ganges-Bhramaputra and Indus river systems are highly prone to flooding
  - The magnitude has *gone up from approximately 9 million ha. affected 50 years ago to 40 million ha.* in 2003, about 12% of the geographic area

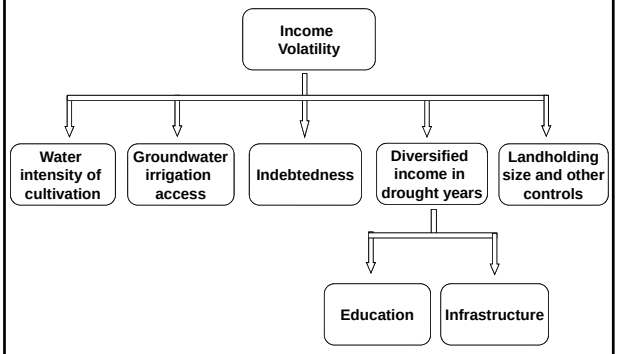
Climate Change: Future Scenario

- It is projected that by the end of the 21st century *rainfall will increase by 15 – 31%,* and the mean annual temperature will increase by 3°C to 6°C
- The warming is more pronounced over land areas, with the maximum *increase over northern India* and some parts of northwest India could witness a decrease in extreme rainfall
- The warming is also projected to be relatively greater in winter and post-monsoon seasons
- Glacial retreat caused by warming, though the extent remains uncertain
- A raise in sea level (40mm-80mm predicted in the next 3 decades) would threaten economic assets, coastal cities, and large coast-dwelling populations.

Elements of Vulnerability to Climate in Rural Areas of India



Determinants of Income Volatility



Drivers of Agriculture in an Uncertain Future

- **Agriculture in India is at present undergoing rapid transformation due to changing demands, markets and agricultural technologies**
- **Pace of these changes is likely to increase in near future**
- **Indian agriculture has become more global in its reach, more complex in trade and exchanges, more technologically grounded and ever *more challenged with balancing sustainability, productivity, profitability and inclusiveness***

Food Demand in India

Can India meet its food requirements?

Items (Food Crops)	Production (million tons)	Demand of food (million tons)	
	2000	2010	2020
Rice	85.4	103.6	122.1
Wheat	75.0	85.8	102.8
Coarse Grains	29.9	34.9	40.9
Total Cereals	184.7	224.3	265.8
Pulses	16.1	21.4	27.8
Foodgrains	200.8	245.7	293.6

Source FAO - 2001

Impacts of Climate Change on Agriculture

- Increase in temperatures, and increased variability of rainfall would considerably ***impact food production***
- Recent IPCC report and a few other global studies indicate a probability of ***10–40% loss in crop production*** in India with increases in temperature by 2080 – 2100
- Recent studies done at the Indian Agricultural Research Institute indicate the possibility of ***loss of 4 – 5 million tons in wheat*** production in future with every rise of 1°C temperature throughout the growing period
- Increasing climatic variability associated with global warming will nevertheless, result in *considerable seasonal/annual fluctuations in food production*. All agricultural commodities even today are sensitive to such variability
- Increasing glacier melt in Himalayas will affect availability of irrigation especially in the Indo-Gangetic plains, which, in turn, has large consequences on India's food production.

Impacts of Climate Change on Agriculture

- Small changes in temperature and rainfall could have *significant effect on quality* of cereals, fruits, aromatic, and medicinal plants with resultant implications on their prices and trade.
- *Pathogens and insect populations* are strongly dependent upon temperature and humidity. Increases in these parameters will change their population dynamics resulting in yield loss.
- Global warming could increase water, shelter, and energy requirement of livestock for meeting projected milk demands. Climate change is likely to aggravate the heat stress in dairy animals, adversely affecting their productive and reproductive performance. A preliminary estimate indicates that global warming is likely to lead to a ***loss of 1.6 million tones in milk production in India by 2020***
- Increasing sea and river water temperature is likely to *affect fish breeding, migration, and harvests.* A rise in temperature as small as 1°C could have important and rapid effects on the mortality of fish and their geographical distributions.

Results of Assessments of Climate Change Impacts on Crops in India

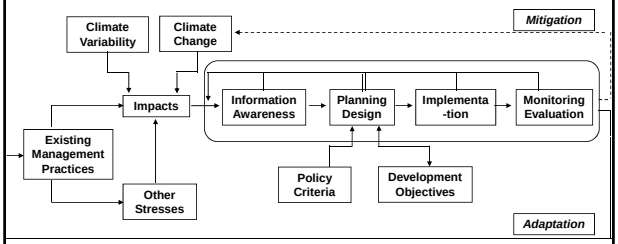
Temperature change	% change in net agricultural revenue per hectare	source
2^0C	– 3 to – 6	Sanghi, Mendelsohn, and Dinar 1998
2^0C	– 7 to – 9	Kumar and Parikh 1998
2^0C	– 8	Kumar and Parikh 2001
3.5^0C	– 20 to – 26	Kumar and Parikh 1998
3.5^0C	– 3 to – 8	Sanghi, Mendelsohn, and Dinar 1998

Adaptation Context

Adaptation is context-specific. Changing climatic conditions *will affect different populations and sectors in different ways*, **and adaptations to climatic changes must be appropriate to the needs and capabilities of those affected.**

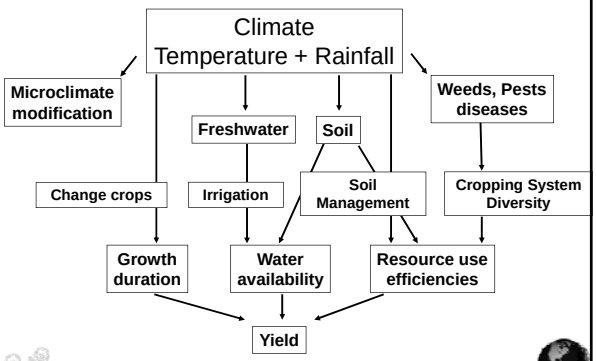
- **Not a Single Response – Portfolio of Responses**
- **Shared Responsibility that requires a framework of shared governance**
- **Links needs of today with the expected problems of tomorrow**

Iterative steps in planned Adaptation to Climate Change



- **The starting point for adaptation decisions is to have the information on the possible range of impacts to which one would need to adapt. This is a complex task in itself**

Adaptation



Adaptation of Indian Agriculture

- Use of biotechnology to formulate suitable gene constructs to impart drought resistance and heat and cold tolerance.
- Improved crop production techniques to enhance input use efficiency, use of resource conservation technologies, attain higher yields.
- Special efforts for coastal, hilly and other critical and fragile areas.

Adaptation options to Climatic Change

- **Changing varieties / crops**
- **Altering fertilizer rates to maintain grain or fruit quality and be more suited to the prevailing climate**
- **Altering amounts and timing of irrigation**
- **'Harvest' water**
- **Conserve soil moisture (e.g. crop residue retention)**
- **Use water more effectively**
- **Altering the timing or location of cropping activities**
- **Diversifying income including livestock raising**

Land use based interventions

- **Control of erosion losses –sloppy land treatment**
- **Weather based farming**
- **Development of cropping systems based on weather codes**
- **Testing of option sets (SRI, mixed cropping, varietal trials)**
- **Treatement of alkaline soils**
- **Kitchen gardens for nutritional security**

Knowledge Management

Water Crisis

Water Availability of River Basins - Issues

India's Water Resources	km³
Surface water produced internally	418
Ground water produced internally	1220
Over lap	380
Flows from other countries	638
Totally Renewable Water Resources	1896

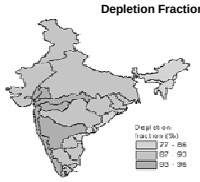
Source: FAO Aquastat

20% of World Population dependent on 4% of water

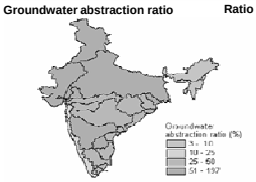
Indicators of water and food accounting in Indian river basins

Degree of Development

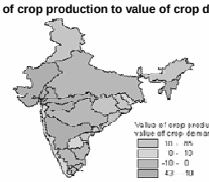
Depletion Fraction



Groundwater abstraction ratio



Ratio of value of crop production to value of crop demand

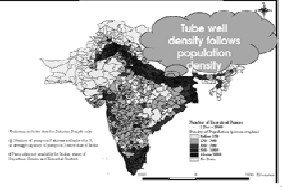


Source: IWMI_2003

Livelihood-supporting GwSEs have high population pressure on land, large agricultural population, semi-arid monsoon climate. India is a typical case.

One in four farming households in India owns an irrigation well; and the rest use purchased pump irrigation.

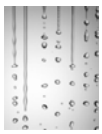
10% of India's GDP, 70% of its irrigated areas, 70-80% of its rural population, 60-70% of its farm output and incomes are linked to groundwater.



Institutional Arrangements

- Union Ministry of Water Resources is the nodal agency. NWRC, NWB, CWC, CGWB, CPCB etc.
- *Water is a state subject – responsible for financing, cost recovery, management.*
- Administration and functional responsibilities are unclear and spread over a number of institutions.
- *India has developed a relatively sound technical information base and expertise for resource development.*
- Regulatory mechanisms are inadequate to generate incentives to enhance water use efficiency.

Legal and Policy Frameworks



- **No separate and exclusive water law and legal framework specifying water rights**
- ***State has an absolute right over all lakes and rivers.***
- **Water charges are very low and energy costs for irrigation are subsidized**
- **Existing local and public institutions are too weak to address the complex emergent issues.**

Improving Institutional Capacity

- Enhance water storage capacity, especially in Himalayan region
- Improved design standards in disaster prone areas
- Enhance water productivity at all levels
- Invigorate the traditional institutions at local levels
- Promote private partnership in critical functions.

Adaptation to Floods

- Learning to live with the floods
- Improved flood forecasting
- Area inundation forecast
- Flood plain zoning, enforcement of regulations
- Community participation in flood management

Prevention and Management of Droughts & Floods

- Comprehensive, decentralized system of drought declaration and management
- Vulnerability-level based system of drought/flood response
- Shift in favor of robust and integrated system of livelihood opportunities
- Water harvesting at local, community and strategic level as a strategic intervention for mediating drought impacts

Integrated Ecosystem Management

Water harvesting and efficient use

Indigenous and advanced methods

Water based interventions

- **Lining of irrigation channels**
- **Reduction of irrigation intensity**
- **Groundwater monitoring**
- **Strengthening water harvesting structures / revival and restoration of traditional / community based water conservation measures**
- **Revival of traditional harren System**
- **Formation and revitalisation of water user groups**

Barriers in Indian Context

- Wide Geographical Area and huge diversity (physical, cultural)
- Political & Institutional Rigidity Persists
- Lack of information & knowledge
- Comprehensive, robust and accessible database
- Lack of information on adaptation costs & benefits
- Vulnerability Assessment
- Awareness of the issue at the Extension level is weak
- Land fragmentation
- Lack of focused research
- Lack of synergy among research institutes
- Lack of Resources
- Absence of a concrete plan for river linking

Adaptation Challenges

- ***Uncertainty*: Usage of macro models, no basic information on vulnerability of specific regions, Long time-frames. Different levels of certainty (projections, risk extremes, major events), poor research information on managing climate variability**
- **Irreversible losses such as agro-ecosystems / agro-biodiversity**
- **Policy action and legislation to be carried out at regional / local level by public / private sector and to be "stakeholder-led", rather than enforced**
- **Allocating costs**

Major Challenges in Mainstreaming Adaptation

***Key Policy Question*: What do we need to do differently because of the expected adverse impacts of climate change?**

- **Relevance of Climate information for Agricultural development related decisions**
- **Uncertainty of Climate information**
- **Compartmentalization of Government Departments**
- **Segmentation & other barriers within Ministries**
- **Trade-offs between climate and development objectives**

National Policy on Climate Change Eight National Missions

1. **National Solar Mission**
2. **National Mission for Enhanced Energy Efficiency**
3. **National Mission on Sustainable Habitat**
4. **National Water Mission**
5. **National Mission for Sustaining the Himalayan Ecosystem**
6. **National Mission for a Green India**
7. **National Mission for Sustainable Agriculture**
8. **National Mission on Strategic Knowledge for Climate Change**

Possible Pathways

- **Clarify Central Government Policy Guidance**
- **Enhance efforts to Systematically incorporate climate information in decision processes**
- **Integrated management, vertical integration transcending different sectors**
- **Strengthen micro-level planning to facilitate adaptation**
- **Adaptation to long-term changes will require a combination of measures at National level and changes in the behavioral patterns at local levels**
- **Increase local government capacity (Panchayat Raj Institutions)**
- **Develop sound integrated assessment criteria**
- **Build capacities at different levels**
- **Identify appropriate research, technology policy options**
- **Develop climate sensitive research infrastructure.**

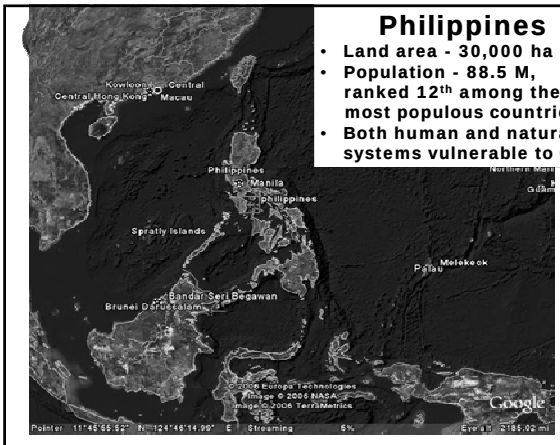
Climate Change Adaptation in the Agriculture and Water Sectors in the Philippines

Juan M. Pulhin, Ph.D.
Professor and Scientist II
University of the Philippines Los Baños

Inception Workshop on "Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors
August 10 –11, 2009
Corus Hotel, Kuala Lumpur, Malaysia

Outline of Presentation

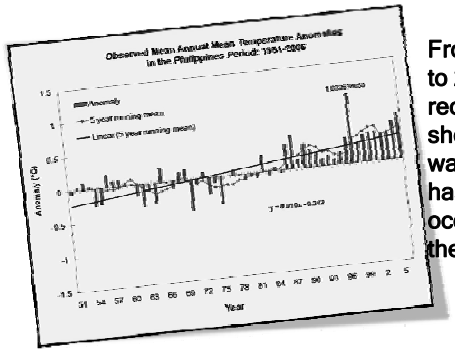
- The Philippines and Climate Change
- Potential Impacts of CC in Agriculture and Water Sectors
- Adaptation Strategies
- Issues and Challenges



Philippines

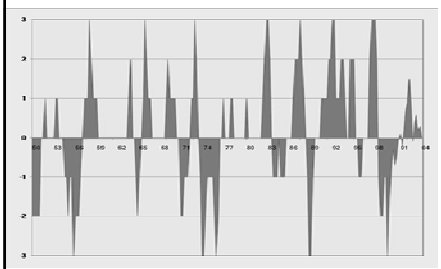
- Land area - 30,000 ha
- Population - 88.5 M, ranked 12th among the most populous countries
- Both human and natural systems vulnerable to CC

The Philippines and Climate Change



From 1951 to 2006, records show that warming has occurred in the country

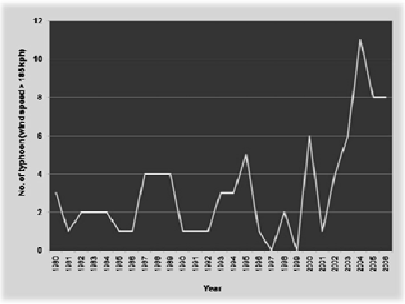
The Philippines and Climate Change



Occurrence of ENSO events was observed to become more frequent since 1980

Legend:
3 = strong El Niño event 2 = moderate El Niño event 1 = weak El Niño event
-3 = strong La Niña event -2 = moderate La Niña event -1 = weak La Niña event
0 = no El Niño or La Niña event

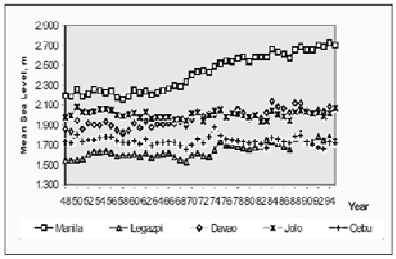
The Philippines and Climate Change



An increasing trend on the number of strong typhoons (> 185 kph wind speed) hitting the Philippines

The Philippines and Climate Change

- Rising sea levels, one of the indicators that climate change is occurring



- Annual mean sea level is observed to increase since 1960s while for the rest of the stations, sea level rise occurred in 1970s

Key Observed C-related Impacts

Average Yearly Damages from Typhoons (1975-2000)

- **Annual deaths of 593**
- **4.5 B pesos damage to property ($83 M)**
- **3 B pesos damage to agriculture($55 M)**
- **Strong typhoons + excessive rains = landslides**

Key Observed CC Impacts in RP

2006 TYPHOONS
SUMMARY OF EFFECTS

AFFECTED FAMILIES	2.38 Million
AFFECTED PERSONS	11.193 Million
DISPLACED FAMILIES	.678 Million
DISPLACED PERSONS	3.398 Million
DEAD	1,158
INJURED	3,235
MISSING	891
DAMAGED HOUSES	820,127
DAMAGE TO AGRICULTURE AND INFRASTRUCTURE	PhP 19.989 Billion

National Disaster Coordinating Council

Projected Climate Change

- **More prominent ENSO events and a shift in seasonal cycle**
- **Increase chances of summer droughts and floods**
- **Increase in tropical cyclone intensities is suggested**
- **Potential sea level rise**

Philippines' basic information on agricultural sector

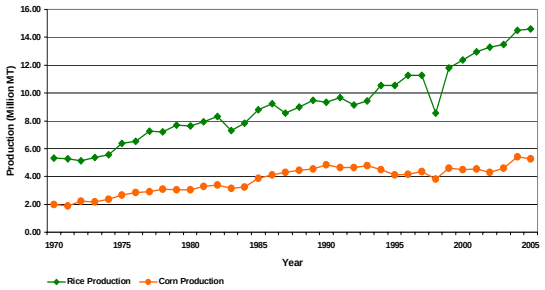
	1980	1991	2002
Number of farms (M)	3.42	4.61	4.82
Farm Area (M Ha)	9.73	9.98	9.67
Average farm area (Ha)	2.82	2.16	2.00
	2005	2006	2007
Volume of production (Th MT)	73,725.9	77,401.1	78,775.7
Value of production (MP) at current prices	410,303.1	459,585.3	510,266.2 (14% of DGP)
Area harvested (Th Ha)			
Palay	4,070.4	4,159.9	4,272.9
Corn	2,441.8	2,570.7	2,648.3
Yield per hectare (MT)			
Palay	3.60	3.68	3.80
Corn	2.20	2.37	2.54
Total employment (36% of TE in 2007)	112,502	114,451	123,855
Status of irrigation (in hectares)			
Total irrigable area	3,126,340	3,126,340	3,126,340
Total service area	1,413,236	1,427,924	1,434,597
Irrigation development (%)	45.2	45.7	46.0

CC could decrease crop production

In seasonally dry areas 1-2 ^{O}C - rise in temperature could lead to

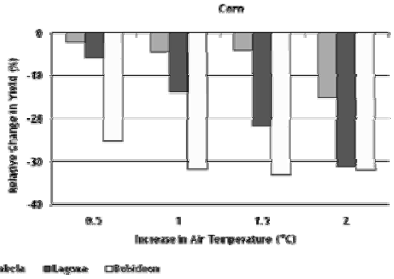
- Increase in irrigation requirement
- Decrease in freshwater availability
- Affects flowering of plants
- Decrease in productivity of rice, corn as in 1983 and 1998

Philippine Rice and Corn Production



Source of Data: BAS

Could decrease crop production



Corn

Source: Lansigan and Salvacion, 2007

Projected Impacts of climate change on agricultural productivity (%) in 2080

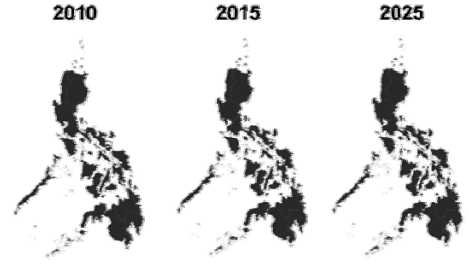
	Without carbon fertilization effect	With carbon fertilization effect
World (output weighted)	-15.9	-3.2
Industrial countries	-6.3	7.7
Developing countries	-21	-9.1
Asia	-19.3	-7.2
Philippines	-23.4	-11.9

Source: ADB, 2009)

Water availability, in Mcm

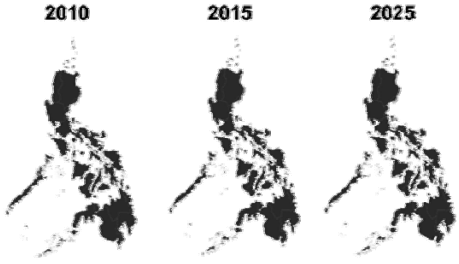
Water Resources Region	Groundwater Potential	Surface Water Potential	Total Water Resources Potential
X Northern Mindanao	2,116	29,000	31,116
XII Southern Mindanao	1,758	18,700	20,458
VI Western Visayas	1,144	14,200	15,344
XI Southeastern Mindanao	2,375	11,300	13,675
IX Western Mindanao	1,082	12,100	13,182
VIII Eastern Visayas	2,557	9,350	11,907
II Cagayan Valley	2,825	8,510	11,335
III Central Luzon	1,721	7,890	9,611
IV Southern Tagalog	1,410	6,370	7,780
I Ilocos	1,248	3,250	4,498
V Bicol	1,085	3,060	4,145
VII Central Visayas	879	2,060	2,939
TOTAL	20,200	125,790	145,990

Projected water scarcity in the Philippines based on water withdrawal-to-availability (Lansigan, 2008)



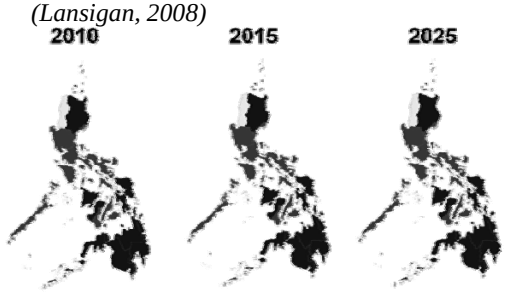
no water stress mild water stress water stress

Projected water scarcity in the Philippines based on water consumption-to-availability (Lansigan, 2008)



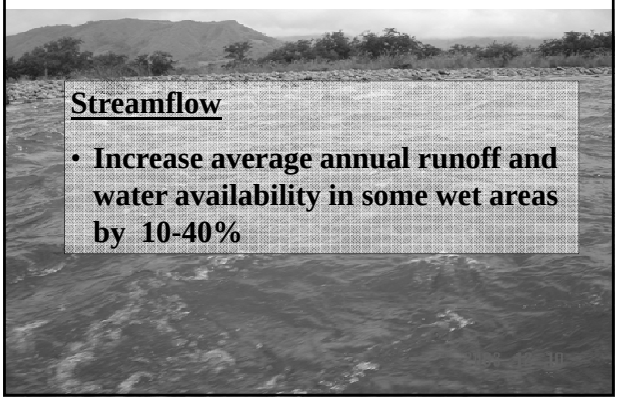
no water stress mild water stress water stress

Projected water scarcity in the Philippines based on water availability-per-capita (Lansigan, 2008)



no water stress | mild water stress | water stress

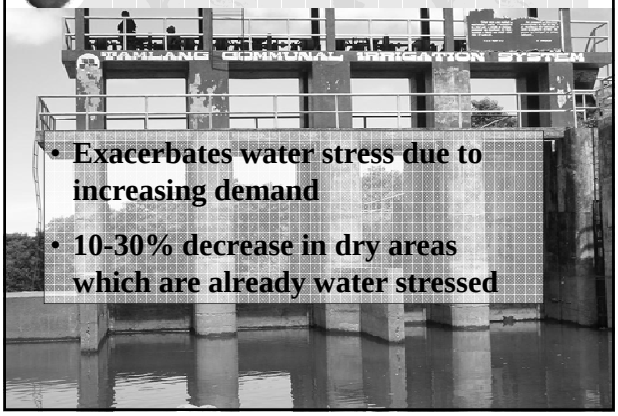
CC: Could promote over supply of water



Streamflow

- **Increase average annual runoff and water availability in some wet areas by 10-40%**

Could exacerbate water scarcity



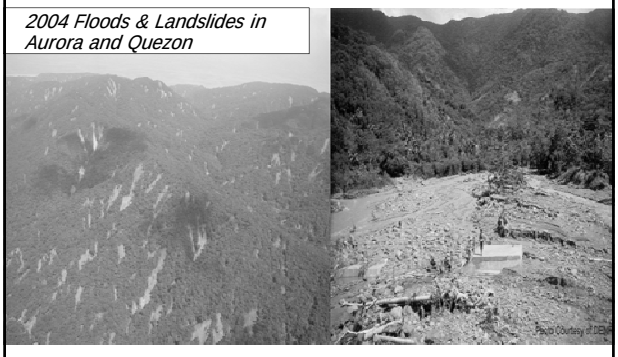
- **Exacerbates water stress due to increasing demand**
- **10-30% decrease in dry areas which are already water stressed**

Could exacerbate water-related extreme events

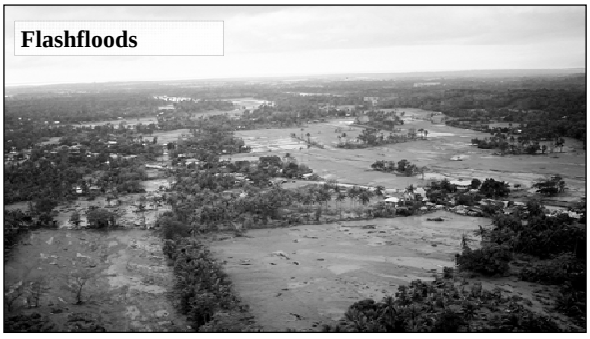
Droughts

Could exacerbate water-related extreme events

2004 Floods & Landslides in Aurora and Quezon



Could exacerbate water-related extreme events



Flashfloods

Key Adaptation Options in Agriculture

Practice	Scale	Reactive/ Proactive	Planned/ Autonomous	Example
Adjustment of cropping calendar and pattern	Local	Reactive	Autonomous	Widely used
Changes in management and farming techniques	Local	Reactive	Autonomous	Widely used
Use of heat-resistant varieties Local/Subregional	Local/Sub-regional	Proactive	Autonomous	Widely used
Diversified farming, intercropping, crop rotation	Local	Proactive	Autonomous	Widely used
Development of early warning systems	Local/ Regional	Proactive	Planned	Philippines, Thailand, Viet Nam

Sources: Boer and Dewi (2008), Cuong (2008), Ho (2008), Jesdapipat (2008), Perez (2008).

Examples of location –specific adaptation strategies to climate change in agriculture

Adaptation Strategies	Location	Literature
Reduction in area cultivated	Los Banos, Daet, Iloilo	Lansigan et al (2000)
Modification in choice of crops or cultivars	Los Banos, Daet, Iloilo	Lansigan et al (2000)
Changes in agronomic practices (fertilizer use, irrigation, and control of pests and diseases)	Los Banos, Daet, Iloilo	Lansigan et al (2000)
Using farm wastes wisely	Central Luzon	Tibig and Lansigan (2007)
Organic farming	Cordilleras	Tibig and Lansigan (2007)
Use of sulfate-containing fertilizers	Central Luzon	T.M. Corton et al (2000)
Direct seeding crop establishment	Central Luzon	T.M. Corton et al (2000)
Planned cropping sequence and schedule	Los Banos, Daet, Iloilo	Lansigan et al (2000)
Crop insurance	Isabela and South Cotabato	Lansigan (2003)

Key Adaptation Options in the Water Resources Sector

Practice	Impact to be reduced	Scale	Reactive/ Proactive	Planned/ Autonomous	Beneficiary Sector
Multi-purpose reservoirs, dams, water-impounding system	Drought, flood, erratic rainfall pattern, water shortage	Regional	Proactive	Planned	Agriculture, Household, Industry, Power generation
Metering and pricing to encourage water conservation	Water shortage	Local	Reactive	Autonomous	Household

Sources: Boer and Dewi (2008), Cuong (2008), Ho (2008), Jesdapipat (2008), Perez (2008) cited from ADB 2009.

Some Issues and Challenges

- Raising public awareness and appreciation of climate change issues and concerns
- Instituting enabling law and national adaptation framework to mainstream adaptation in development policies and programs
- Strengthening the capacity of local government units to champion effective adaptation strategies at the local level

Some Issues and Challenges

- Improving the science of climate change projection relevant to national and local level
- Enhancing capacity of researchers to conduct integrated assessment of climate change impacts, vulnerability and adaptation
- Undertaking more research to better understand climate change, its impacts and solutions, especially at local levels
- Strengthening the science-policy-local action interlink

Some Issues and Challenges

- Adopting a more holistic approach to building the adaptive capacity of vulnerable groups and localities and their resilience to shocks
- Building on the experience of indigenous adaptation strategies to enhance effectiveness of future adaptation
- Developing and using adaptation metrics for planning and monitoring purposes to enhance adaptation effectiveness

INCEPTION WORKSHOP: "MAINSTREAMING ADAPTATION TO CLIMATE CHANGE IN AGRICULTURAL AND WATER SECTORS"
Kuala Lumpur, 10-11 August, 2009

Climate Change Adaptation in the Agriculture and Water Sectors: Current Status, Issues and Challenges in Vietnam

Nguyen Van Thang
Deputy Director General, Vietnam Institute of Meteorology, Hydrology and Environment
&
Tran Dinh Trong
Vietnam Institute of Meteorology, Hydrology and Environment

Outline

1. **Introduction**
2. **Current Status of Climate Change in Vietnam**
3. **Climate Change Impacts and Vulnerabilities**
4. **Adaptation: Agricultural and Water sectors**
5. **Challenges for Adaptation**

1. Introduction

- Country position: Southeastern Asia, 8º27 to 23º23N and 102º08 to 109º30E

-Area: 330,990 km²

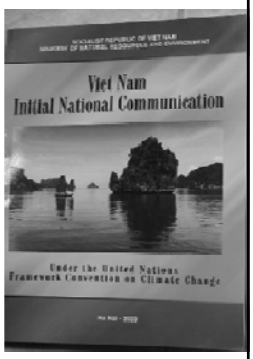
-The coastline length: 3,260 km

- Climate: Tropical monsoon suffering from natural disasters such as typhoons, floods, drought,… which affected regularly to socio-economic development

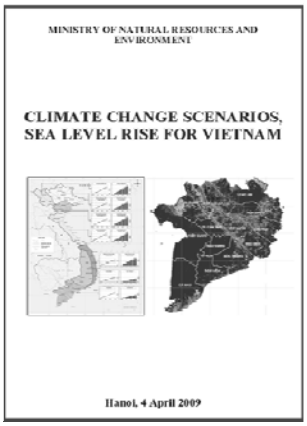
Climate change studies

Vietnam Initial National Communication (INC) to the UNFCCC in 2003: identified water resources, coastal areas, agriculture, aquaculture, forestry, energy, transport and public health as the most vulnerable to climate change

Vietnam Second National Communication (SNC): emphasizes adaptation and provides guidance to promote Climate Change Adaptation (CCA) measures in Viet Nam



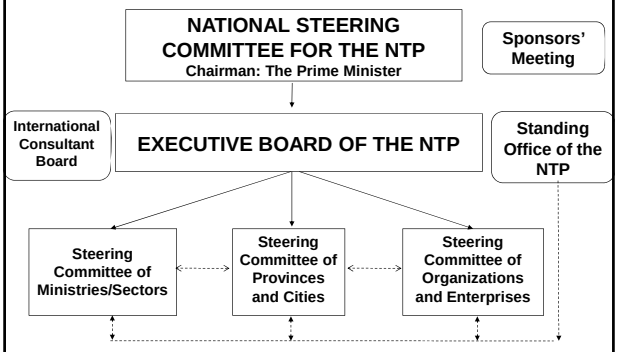
- **Climate change, sea level rise scenarios for Vietnam** is developed basing on different emission scenarios: low (B1), medium (B2) and high (A2, A1FI).



NATIONAL TARGET PROGRAM TO RESPOND TO CLIMATE CHANGE

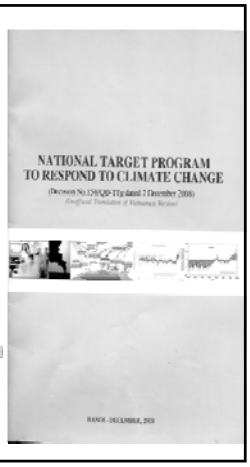
(Decision No. 158/2008/QĐ-TTg dated 2nd December 2008)

ORGANIZATION FOR IMPLEMENTATION



Specific Objectives

1. Identify the extend of climate change and assess it's impacts;
2. Identify adaptation measures, policies;
3. Promote scientific and technological activities;
4. Strengthen capacity building to respond to climate change;
5. Raise public awareness;
6. Promote international cooperation;
7. Mainstream CC into socio-economic development strategies, plans and planning;
8. Develop & Implement action plans, projects.



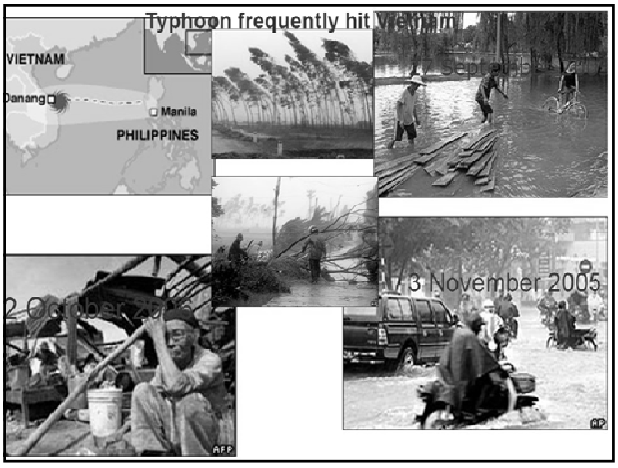
6. Promote international cooperation;
7. **Mainstream CC into socio-economic development strategies, plans and planning;**

a) **Targets by 2010:**
- Complete the assessment of CC impacts, especially SLR, on the development plans;
- Complete the classification of response measures for each development plans;
- Develop and issue legal document and guidance documents on how to comprehensively mainstream CC issues into development plans; start to mainstream CC issues into development plans according to the legal decisions issued.

b) **Targets by 2015**
- Mainstream CC issues into development plans for the period 2010-2020;
- Assess the results of the mainstreaming process for development plans for the period of 2010-2015;
- Widely and effectively implement the mainstreaming of CC issues into development plans for later periods.

2. Current Status

- Annual average temperature increased by 0.1^{0}C per decade from 1900 to 2000, and increased by 0.7^{o}C from 1951 to 2000;
- Increase in quantity and intensity of extreme-weather events (typhoon, flood, flash flood, drought, heavy rainfall);
- More abnormal patterns of storm and storms are moving toward southern;
- Sea level increased about 0.2m in the last 50 years;
- Vietnam is one of five countries that will be most seriously affected by sea level rise.



Hanoi City living with floods ! (November 2008)

A poor household in flooding

Source: http://www.tiasang.com.vn/news?id=2838

4. Adaptation: Agricultural and Water sectors

4.1 *Agriculture*

- Key activities for adaptation in Agriculture:
  - Develop and improve the framework of a synchronous legal documents, Laws and circulars to protect the agriculture of commodity, diversity and sustainable development;
  - Amend and improve policies and mechanisms to support the application of new technologies, modern scientific and technical solutions to change crops pattern, livestock and new farming techniques suitable with climate change condition.
  - Develop and implement scientific and technical activities to adapt to climate change in agricultural sector;
  - Plan effective use of agricultural land and water for fishery in consideration of immediate and potential impacts of climate change to ensure a sustainable agricultural production.

- Specific contents for adaptation in Agriculture :

-Increasing irrigation water use efficiency -Developing appropriates farming techniques: Change in planning and harvesting times, soil fertility maintenance, fertilizer use and application, erosion control.... - Increasing quantity and quality of processed animal feedings as well as selecting high productive breeds -Use of different variety/species -Development/improvement of national forest fire management plans	-Development of species resistant to drought, salt, flood, disease & pest. -Development of weather early warning system -Re-structure the agriculture production plan and cropping patterns -Protecting natural forest and enhancing reforestation / afforestation -Increasing the efficiency with forest raw materials are converted to forest products -Protecting and developing mangrove forests and natural forests. - Diversification and intensification of food and plantation crops

4.2 Water Resources

- Key activities for adaptation in water resources:
  - Develop and improve a legal framework including laws and regulations, circulars, and amended policies.
  - Related ministries/sectors strengthen their management mechanism over water resources at different levels in the context of the climate change;
  - Develop implementation plans, programs to respond to climate change in the field of water resources at all sectors and levels;
  - Identify suitable scientific and technical solutions, such as overall plan for river basins, change specifications for water use and exploitation projects, methods for cost-effective use of water sources, protection and preservation of water sources, water pollution control.
  - Raise community awareness on methods for water use in response to climate change.

- Specific activities for adaptation in water resources:

-Building reservoirs, upgrading existing dykes -Effective use of water resources. -Enhancing residual soil moisture through land conservation techniques	-Reforestation/afforestation to increase natural water storage -Conducting studies in long-term water resources prediction -Improving system of water management -Enhancement of flood controls and drought monitoring

5. Current challenges for adaptation

- Policies on CC are more commitment than implementation, more qualitative than quantitative;
- Measures on CC focuses mainly on technical aspects rather to social aspects of impacts, on short-term response to disasters and weather extremes rather risk prevention and adaptation;
- Weak mainstreaming CC policies into national, sector and regional development strategies;
- Lack of concern of local policy makers, stakeholders, and people on climate change;

Challenges…

- People do not receive much awareness, knowledge and assessment techniques relating to potential climate change impacts on extreme events;
- Social and economic impacts of climate change and adaptation options have not been studied adequately;
- Cost of impacts;
- No cost/benefit analysis available for decisions on coastal protection/dyke strengthening;
- Limited financial means and human capacities for risk reduction and adaptation efforts.

Thanks for your attention!

Climate Change Adaptation: Current Status, Issues and Challenges in Cambodia

by
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Inception Workshop on "Mainstreaming Adaptation on Climate Change
Corus Hotel, Kuala Lumpur, Malaysia
10 August 2009

Outline

1. Country Profile
2. Climate Related Hazards
3. Institutional Organization
4. Issues and challenges raised by MoE
5. RUPP Climate Change Initiative
6. Conclusion
7. Q & A

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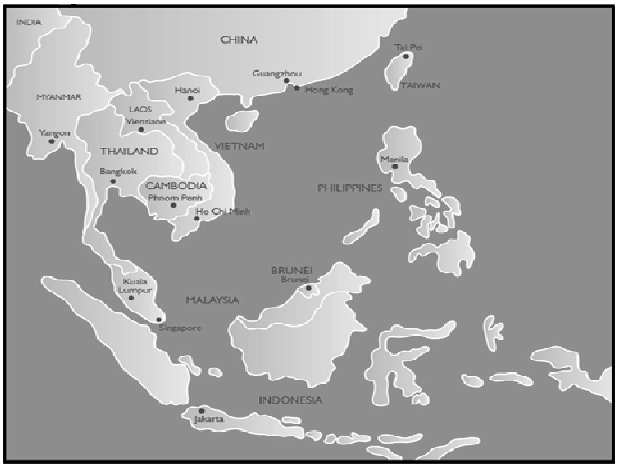
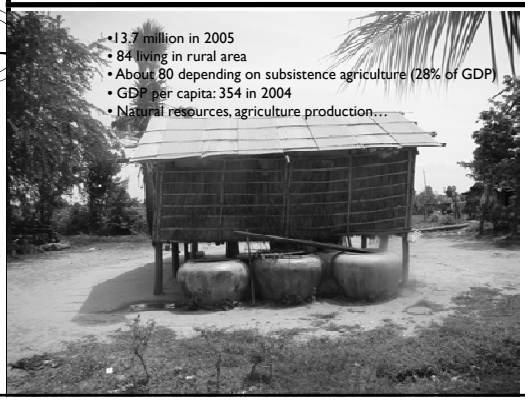
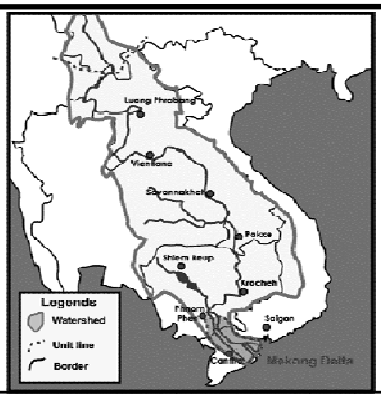


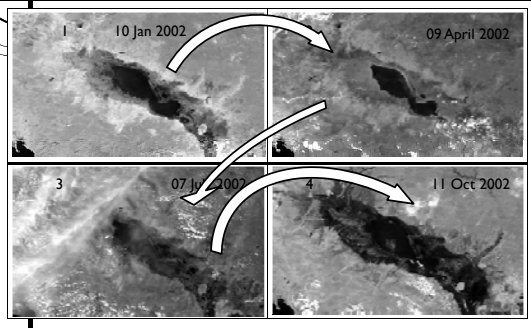
Population and Economics



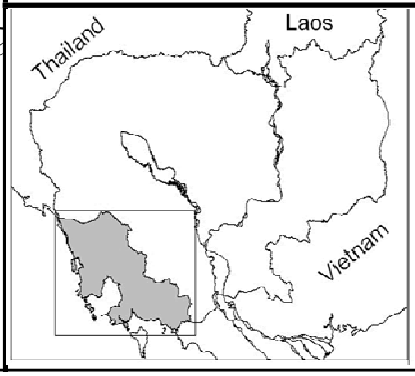
Mekong River



View of Seasonal Change of Tonle Sap Lake



Cambodia coastline



About 435 km long

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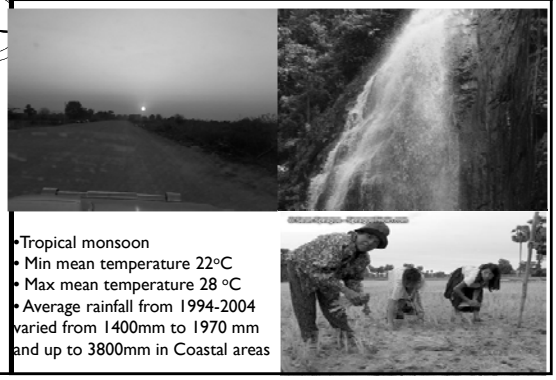
Cambodia climate



- Tropical monsoon
- Min mean temperature 22°C
- Max mean temperature 28 °C
- Average rainfall from 1994-2004 varied from 1400mm to 1970 mm and up to 3800mm in Coastal areas

Climate Related Hazards

Years/ Events	Affected People	Impacts	Death Casualty
Floods 1999	37,527	•17,732 hectare of rice destroyed • 491 houses destroyed	
2000	3,448,629	• 317,975 houses damaged • 7,068 houses were destroyed	- 347 deaths
2001	2,121,952	• 2,251 houses destroyed	- 62 deaths
2002	1,439,964	• 1,082 houses destroyed	- 29 deaths
Drought 2002	2,017,340	• 43% hh in Cambodia drink unsafe water during dry season and 24% during rainy season	
Malaria 2004 2005	No data	• Waterborne diseases • 60,000 malaria cases were reported	- 800 deaths per year, the figure can be up to 10 times higher
Dengue fever 2006		• 7,655 case	- 122 death per 4 hospital

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Institutional Organization

- Ratifies the UNFCC in 1995; into force 1996
- Acceded to the Kyoto Protocol 2002
- MoE is the National Focal Point for UNFCCC and Kyoto Protocal
- National Climate Change Committee (NCCC), which was established in 2006, served as policy-making body and measure to address CC issues within the country
- CCCO was established in 2003 to work all relevant govt. agencies, NGOs and the like. CCCO is the implement body, GHG mitigation and inventory, and climate change adaptation activities

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Issues and challenges raised by MoE

- Limited financial resources or funding for climate related activities,
- Few climate change studies and experience within the country
- Lack of climate change research and/or training institution in the country
- Lack of data availability and reliability
- Relatively low technical of local staff
- Non-comprehensive national climate change policies and/or strategy
- Lack of qualified national experts in the country
- Limited public awareness and education on climate change and
- Limited Technical, financial and institutional resources for adaption and mitigation

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RUPP Climate Change Initiative

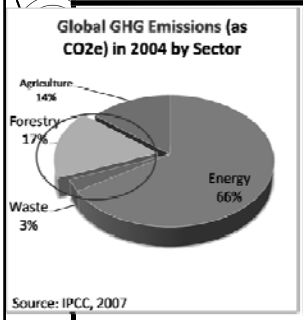
- Two researches were conducted by DES/RUPP
- One research is starting
- Curriculum on Climate Change is discussed
- More researches will be encouraged both Researchers/Lecturer and Students

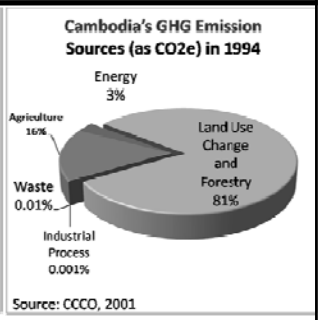
Wood fuel supply and demand, and carbon credit to avoid deforestation

Study Objective

1. Assess wood fuel supply and demand whether consumption of wood fuel cause deforestation or not
2. Estimate CO2 emissions from non-sustainable wood fuel consumption
3. Estimate carbon credits to avoid deforestation

Source of GHG emissions



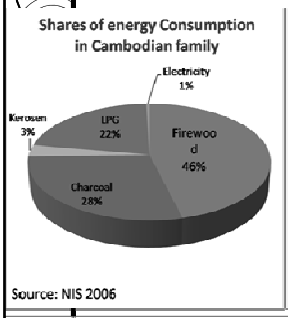


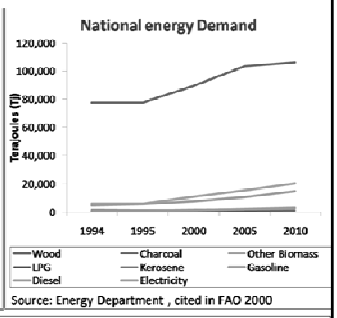
Forestry is 2nd GHG emitter in the globe.

LUCF is main GHG emitter in Cambodia.

19

Woodfuel consumption in Cambodia





Woodfuel remain a vital energy for Cambodians, especially rural people. Sustainability of woodfuel has not known yet (Top *et al., 2006)* while 50% of woodfuel they consumed is harvested from natural forest (CCCO, 2006, 2003, & 2001).

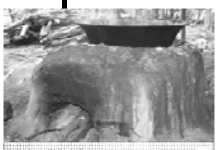
20

Type of wood consumption


Firewood (Stere wood)


Charcoal making


Pole collection


Palm sugar making


Woodfuel for Cooking

21

Opportunity cost of carbon credit

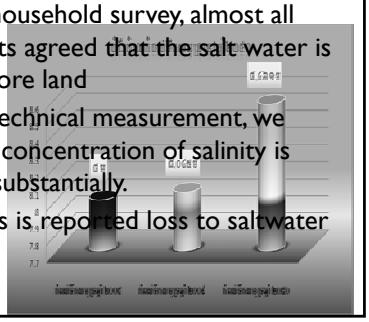
- About 4,596,896 dollars should be paid from 2010-2014 to keep forest stand.
- More study needed especially on demand increment.
- Policy maker or energy program developers should address woodfuel imbalance before promoting woodfuel as an alternative energy.

22

Study 2: Vulnerability of Climate Change in Coastal Zone

Main Findings:

- Based on household survey, almost all respondents agreed that the salt water is claiming more land
- Based on technical measurement, we found that concentration of salinity is increased substantially.
- 14 hectares is reported loss to saltwater



Study 3: Jatropha Curcas as Fuel wood Replacement?

Study related objectives

- CBA of Small Scale Jatropha curcas around the household fences
- Fossil Diesel replacement capacity
- Biofuel for Machinery or for Cooking?
- Policy implication to motivate the costs effectiveness options

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Conclusion

- More research will be done by RUPP researchers and students (1) Mitigation Option: Biofuel for Cooking as the replacement of fuel wood and (2) Adaption Option: New rice-seedling on salty soil or Rehabilitation Irrigation Systems.
- Integrate Climate Change Subject into current curriculum
- Provide training services to Government Institutions, NGOs
- Advocate through disseminate researcher results to a wide audience to adapt, mitigate and more to prevent climate hazard.

Impacts of Climate Change on Agriculture and Adaptation Strategies: Malaysia Experiences

Mohamad Zabawi bin Abdul Ghani

Outline

- Introduction
- Climate Change and Agricultural
- Types of impacts on agricultural production
- Climate and rice
- Adaptation measures
- Conclusion

Introduction

- Agriculture is the major land use across the globe,contributed to a major economic, sosial,cultural activity and ecosystems
- Highly sensitive to climate variation which causes variability in production
- Climate change will exact a major consequence on food availability and security

Climate and agriculture

- Governing factors
  - Temperature, radiation, CO_2
- Limiting Factors
  - Water, Nutrients
- Reducing Factors
  - Pest & diseases

1. Temperature

- can have both positive and negative effects on crop yields
- Generally temperature increases have found to reduced yields and quality of many crops, most importantly cereal and feed grains.
- Temperature increases lead to higher respiration rates, shorter periods of seed formation, lower biomass production, smaller and lighter grains and therefore lower crop yields and perhaps lower grain quality such as protein levels.

2. Rainfall

- CC will modify rainfall, evaporation, runoff and soil moisture storage
- Increases in precipitation (total, timing and variability) may benefit semi-arid and other water-short areas by increasing soil moisture, but could aggravate problems in regions with excess water, while a reduction in rainfall could have the opposite effects

- The occurrence of moisture stress during flowering, pollination and grain-filling is harmful to most crops such as maize, soybeans, wheat and rice
- Moisture stress mainly cause by increased evaporation from the soil and accelerated transpiration

3. Climatic variability and extreme events

- CC also change the variability of climate, particularly in the frequency of extremes weather events such as drought, flood, storm and heat waves
- The changes will exact a major consequence on food availability and security
- Certain varieties of crops are grown near their limits of maximum temperature tolerance, such as rice in Southern Asia

- The occurrence of heat spells can be particularly detrimental
- Frequent droughts not only reduce water supplies but also increase the amount of water needed for crop growth in particular to fulfill the evaporative demand
- With the potential change in extreme events, the impact of waterlodging (flood), high temperatures and water deficit (drought) on the productivity of crops seem to also be increased in the future.

Types of impacts on agricultural production

Crops and forages

Item subject To impact:	Temp	Rainfall	CO_2	Extreme Events	Sea Level
Plant Size - yield	X	X	X	X	
Water requirement	X		X		

10

Types of impacts on agricultural production

Soils

Item subject To impact:	Temp	Rainfall	CO_2	Extreme Events	Sea Level
Soil Moisture	X	X		X	
Soil fertility	X	X			

11

Types of impacts on agricultural production

Irrigation and water supply

Item subject To impact:	Temp	Rainfall	CO_2	Extreme Events	Sea Level
Quantity	X	X		X	
Seasonality of supply	X				
Non agricultural competition	X	X		X	

12

Types of impacts on agricultural production

Others

Item subject To impact:	Temp	Rainfall	CO_2	Extreme Events	Sea Level
Low lying land inundation				X	X
Weed competition	X	X	X		
Insects, fungus, and diseases	X	X			

13

Climate change and rice

14

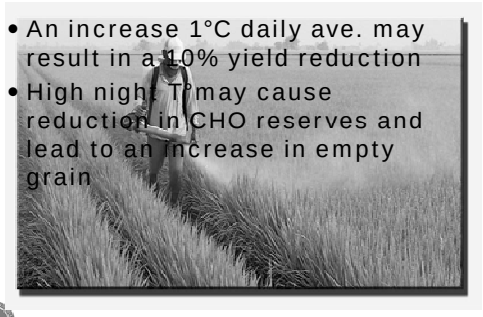
Rice – Current situation

- Consumption= 2.4 mill. ton/yr. Currently imports 30% (800,000 tonnes)
- Current SSL ~75%, aiming at 90% by 2010
- Target Yield →10 ton/ha
- Guranteed Minimum Price (GMP) RM550→RM650/ha
- Additional Fertilizer → RM140/ha.
- Certified Seeds – 2009

15

Rice

- An increase 1°C daily ave. may result in a 10% yield reduction
- High night T°may cause reduction in CHO reserves and lead to an increase in empty grain



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Climatic requirements for rice cultivation

Climatic Characteristics	No Stress	Slight Stress	Moderate Stress	Severe Stress	Very Severe Stress
Mean daily air Temperature (o C)	28-25	24-22 29-30	21-20 31-32	19-18 33-34	<18 >34
Mean daily maximum air temp. (o C)	34-29	28-27 >34	26-24	23-22	<22
Mean daily minimum air temp. (o C)	>20	20-19	18-17	16-17	<16
Mean annual Rainfall (mm)	>2000	2000-1750	1749-1500	1499-1250	<1250

17

Growing conditions in Malaysia

- Average temperature is about 26oC
- Growth temperature in Malaysia already in the optimum
- Temperature above 25oC may cause decline in individual grain
- Grain yield may decline between 9 – 10% for each 1oC increase in temperature
- Detailed studies on growth and production responses to climate change are not available

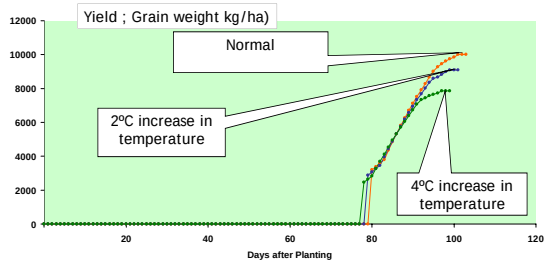
Rice: Vulnerabilities to Climate Change & Extreme weather

Simulation study

- Assessments – using local climatic data (MADA)
- DSSAT Ver. 4.5
- Developing genotype coefficient
- IRRI variety – closely related MR 219
- Current temperature, 20C and 40C increase in temperature
  > flood and drought during planting

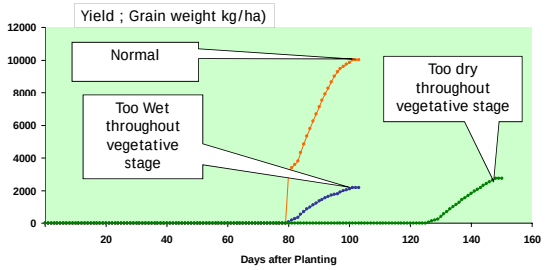
19

Vulnerability; Temperature increase



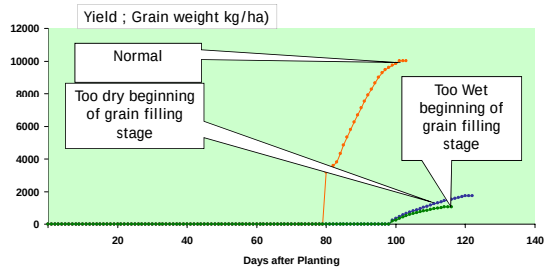
20

Vulnerability; Vegetative stage



21

Vulnerability; Reproductive stage (Grain filling period)



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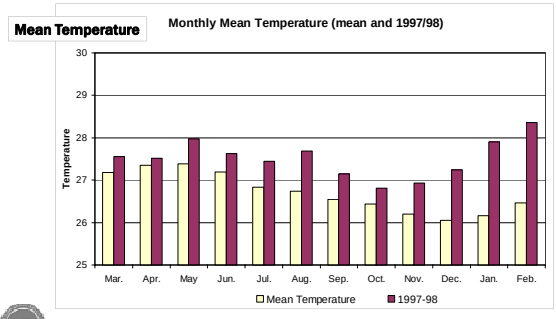
Observed Changes in Productivity Of Rice Due to Climatic Variability In the Past

ENSO activity
warm (*El Nino*), neutral or cool (*La Nina*)

23

The Malaysian climate: mean and El Nino of 1997/98



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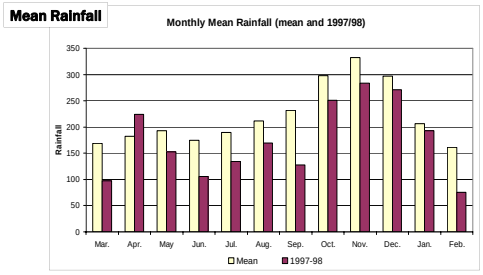
The Malaysian climate: mean and El Nino of 1997/98



25

Estimated loss of rice yield due to climatic variability: Malaysia 1980 - 1999

Item	Mean yield loss (%)
Mean yield loss for Non El Nino Years (NEY)	5.65
Mean yield loss for El Nino Years (NEY)	6.8
Net El Nino Effects	-1.15

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Estimated Net loss of rice due to El Nino

Year	Estimated % net loss	Production ('000 tonnes)	Estimated production without El Nino ('000 tonnes)	Difference ('000 tonnes)	Price (RM/ton)	Loss (RM mill)
1981	4.0	1,748.77	1,818.72	69.95	511.85	35.80
1980	1.8	1,884.98	1,918.91	33.92	660.00	22.38
1998	5.66	1,994.24	2,107.11	112.87	1,413.85	159.58
					Total net loss	217.76

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Adaptation measures

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Research and Development

- Short maturating variety
  - Latest variety : 100 days (MR 211)
  - Less risky to water stress
- Development of drought resistant varieties
  - gene bank (>12000 accessions) → drought tolerant varieties
  - Aerobic rice production
  - develop high yielding varieties to suit different rice environments, inc. drought prone areas
- Water saving technologies
  - optimize water use efficiency
  - dry rotation and dry seeding
  - improved irrigation techniques
  - reduce water loss and wastage
- Precision farming; efficient utilization of production inputs including water
- Controlled production system

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Water Resource Management

What's been done:

- Continued improvement of irrigation infrastructures
  - water recycling, effricient / timely distribution of water, conservation strategy
- Enhanced management support services
  - storage system, delivery, distribution etc.
- Management & control system
  - irrigation schedule
  - Telemetry System
- indegeneous water storage system (sugarcane plantation)
  - man-make lakes as storage + mobile sprinkler system
  - cheap and easy to maintain

30

31

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Conclusion: Agriculture in general

- Yield potential is likely to decline due to even small rises in global temperature,
- Greater frequency of droughts and floods will affect local production
- S&T must spearhead agricultural production in the next 30 years at a pace faster than the Green Revolution's during the past three decades." – FAO Director General 2007

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Conclusion: Agriculture in general

- CC adaptation is needed in all agro-ecosystems (crops livestock and grasslands).
- Adaptation may involve selection of alternative crops, revised planting dates, improved irrigation and modified chemical inputs
- Developing adaptation options for agriculture that do not exacerbate climate and other environmental changes is crucial.

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Conclusion: Rice

- Drought-resistant varieties as well as crop varieties that can survive severe flooding.
- the need to generate crop varieties with improved water-use efficiency suited to production with reduced water inputs

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Terima Kasih (Thank you)

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Mainstreaming Adaptation to Climate Change (MACC)

Climate Change Adaptation: Agriculture and Livelihood

Prof. Chamhuri Siwar
Dr. Abul Quasem Al-Amin
Institute for Environment and Development
(LESTARI)
Universiti Kebangsaan Malaysia

Universiti Kebangsaan Malaysia

- **Background:**
  - **Climate change: an overview**
- **Timescales of Climate Variation And Climate Change:**
  - **Regional perspective**
- **Framework of Climate Change and Agriculture:**
  - **Relationship between adaptation, MACC and poverty and livelihood**
- **Approaches to Adaptation and Livelihood:**
  - **Integrating climate and climatic resources assessments under a decision-oriented framework**

Three questions under the adaptation and MACC framework:

ISSUE

(1) Are planning strategies for agricultural resources in Malaysia supported by the climate record?

IMPACT

(2) What additional pressures will be placed on agriculture as a result of projected climatic variability and change?

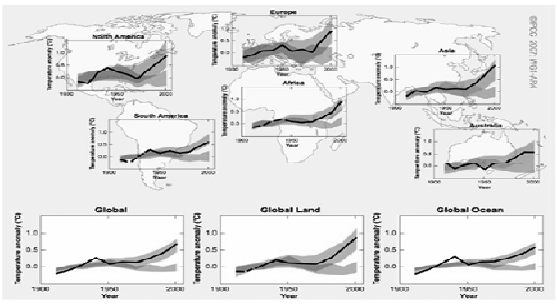
POLICY

(3) What practical strategies (adaptation options) can be engaged to reduce vulnerability and enhance livelihood outcomes?

Background

- What is climate change?
  - The variation in the Earth's global climate or in regional climates over time, such as
    - * variations in sunlight intensity
    - * greenhouse gas emission
    - * higher sunlight intensity, temperature rise
    - * extreme temperature
    - * unexpected rainfall, losses of ecosystem and so on...
  - Caused by processes of internal and external forces to the Earth
  - More recently, human activities...
  - there is 90-95% likelihood that changes in modern climate have been in part caused by human actions.
- Effects of climate change:
  - Agriculture, agricultural product and supply
  - Forests
  - Ecosystems and biodiversity
  - Water resources
  - Coastal zones....

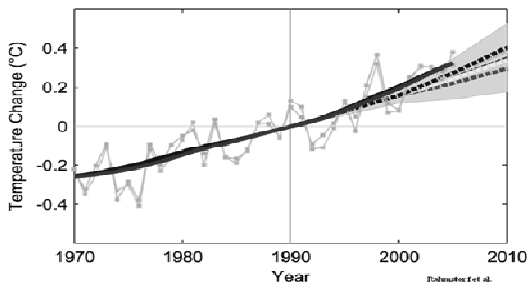
Timescales: Climate Variation and Change



Climate change between 1900 and 2000

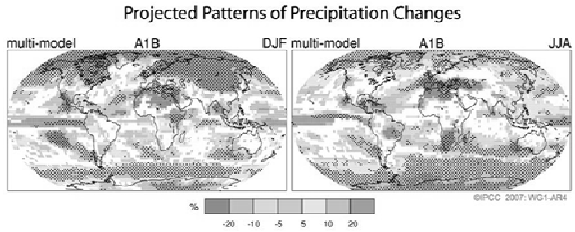
* From: IPCC, 2007: Summary for Policymakers. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Climate Change effects: Temperature



Temperature projections from 1970 to 2010

Climate Change effects: Precipitation

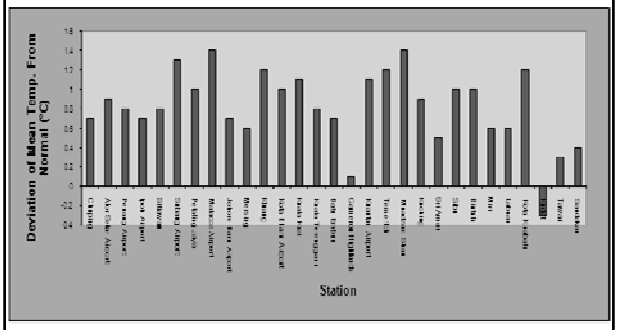


Climate Precipitation increases *very likely* in high latitudes
Decreases *likely* in most subtropical land regions

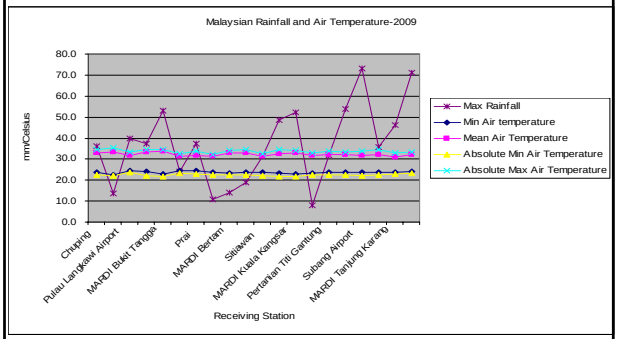
Source: CSIRO, Climate Adaptation Flagship, Australia

Climate Change (CC) and Agriculture: What about Malaysia?

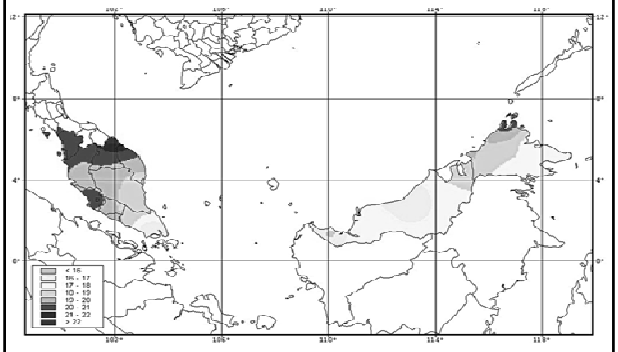
Deviation from normal of mean temperature (°C) at 29 Principal Meteorological Stations in Malaysia



Malaysian Rainfall and Air Temperature -2009



Mean Daily solar transformation on Malaysia



Climate change projections for Malaysia by IPCC

Year	2025	2050	2100
Carbon Dioxide Concentration	405 - 460 ppm	445 - 460 ppm	540 - 970 ppm
Mean Temperature Rise	0.2 - 0.4 °C	0.3 - 1.0 °C	0.6 - 2.3 °C
Mean Precipitation Change	- 5 % to + 5 %	- 5 % to + 5 %	- 5 % to + 5 %

Source: IPCC, 2001

Possible climatic change of Peninsular Malaysia in 2041-2050 by NAHRIM

Source: NAHRIM (2006)

- **Temperature rise 2^{0}C**
- **More extreme hydrological conditions**
  - **Higher maximum rainfall; Lower minimum rainfall**

Potential implications

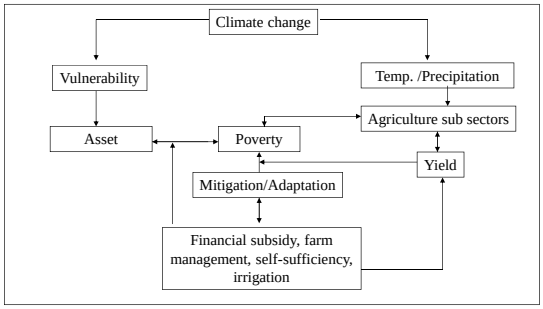
- **Water balance → Water sufficiency**
- **Crops yields → Food security**
- **Plantation → Economic loss..**

Future projection of climate change on Malaysia: selected states

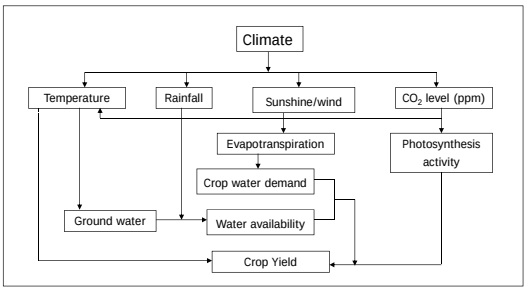
Climate Factor	Projected Change in Maximum Monthly Value			
	North West Region (West Coast, Perak, Kedah)	North East Region (North east coast, Terengganu, Kelantan)	Central Region (Klang, Selangor, Pahang)	Southern Region (Johor, Southern Peninsula)
Rainfall	+ 6.2 %	+ 32.8 %	+ 8.0 %	+ 2.9 %
Temperature	+1.80 ^{0}C	+1.88 ^{0}C	+1.38 ^{0}C	+1.74 ^{0}C

Source: NAHRIM, 2006

Relationship between Agriculture and CC



Framework of climate change impacts on agricultural productivity



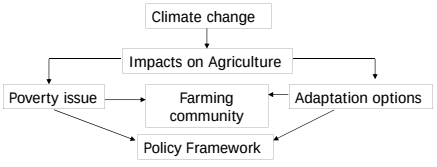
Climate Change Adaptation, MACC and Livelihood Framework

Climate Change adaptation concepts: Agriculture, poverty and livelihood…

First of all we need to understand the following concepts:

- **What is Adaptation?**
- **Why we need to pursue adaptation in Agriculture?**
- **What is poverty and livelihood concept in agricultural adaptation?**
- **Concepts of livelihood: way of thinking about the objectives, scope and priorities for development**
- **What are the linkages between climate change and agricultural impacts: vulnerability and livelihood?**

Concepts of framework for climate change, agricultural impacts: vulnerability and livelihood



Adaptation in Agriculture?

- What is Adaptation?
  - Adaptation involves developing ways to protect people and places by reducing their vulnerability to climate pattern.
  - Agricultural adaptation options could be grouped as: (a) technological developments, (b) government programs, (c) farm production practice, and (d) farm financial management.
- (a) Technological developments
  - Technological adaptations could be developed in Malaysia through research programme undertaken. These includes:

1. *Resource management innovations (e.g. water management innovation, irrigation, farm level resource mgt- to address risk of moisture deficiency)*
2. *Crop development (crop varieties tolerant to changing climatic conditions)*
3. *Weather and climate information systems (e.g. early warning system, daily and seasonal weather forecasts)*

Cont…

- (b) Government programs
  - Government programs are institutional responses to the economic risks associated with climate change and have the potential to influence farm-level risk management strategies. These includes:

1. *Agricultural subsidy and support programs (modify subsidy and insurance programs wrt to climate related loss of crop yield)*
2. *Resource management programs (water res use & mgt strategies wrt changing climatic conditions)*

- (c) Farm production practice
  - Farm production practices (i.e. diversify crop types and varieties, land use pattern, irrigation etc.) involve changes in farm operational practices, which may be stimulated or informed by government programs or industry initiatives. These includes:

1. *Farm production (diversify crop type & varieties to suit climatic changes)*
2. *Land Use (change location of production to address risks wrt climate change)*
3. *Irrigation (to address moisture deficiency wrt climate change)*
4. *Timing of operations (change to address changing duration/season due to climate change)*

Cont…

- (d) Farm financial management
  - Farm financial adaptations involve decisions with respect to crop insurance, crop shares and futures, income stabilization programs, household income(invest in crop shares & futures to reduce risks of climate change income loss)
  - Farm financial adaptation options are farm-level responses using farm income strategies such as both private and government supported to reduce the risk of climate-related income loss which might support and incentive programs greatly influence farm financial management decisions (e.g. participate in income stabilization prog. to reduce risk of income loss due to climatic conditions and variability)
  - WHAT IS OUR CURRENT STEPS FOR CLIMATE CHANGE ON AGRICULTURE?

Why do we need to know about MACC?

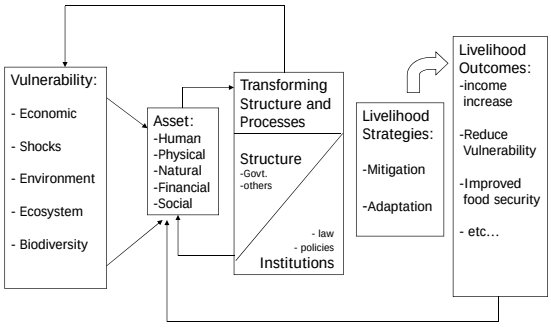
- Building capacity to identify climate change risks – among other things, this will include strengthening networks to monitor impacts on regional climate, downscaling global climate models, and developing impact scenarios;
- Building capacity to reduce vulnerability to climate change;
- Building capacity to effectively access and utilize resources to minimize the costs of climate change;
- Public education and outreach of impact modeling; and
- Harmonized methodology for assessing climate change vulnerability and adaptation toward policy making.

Why do we need to know adaptation strategy for MACC?

- To promote adaptations: (i) incorporating development concerns into climate policy and (ii) incorporating climate concerns into development policy;
- To know whether the proposed adaptation options for agricultural resources fully supported by development planning;
- To establish climate and natural resources roundtables;
- Approaches of risk communication and associate assumptions to alleviate vulnerability to the poor farmers;
- To know interventions for current adaptation appraisal whether they are effective or not;
- To establish relationship between MACC and sustainable livelihood

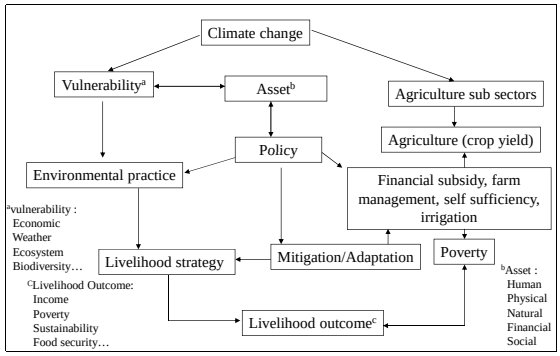
How to link between climate change, sustainable livelihood and MACC?

Sustainable Livelihood Framework and Vulnerability: linkages...



Source: DFID 2000

Framework for climate change, agricultural impact: vulnerability and livelihood



Developing effective decisions

Establish Climate and Natural Resources Roundtables (which also provide for data sharing)

- Serve as a clearinghouse mechanism for promoting, initiating and facilitating climate change programs and policies;
- Review national strategies for enhancing the objectives of the UN Framework Convention on Climate Change and advising government on the way forward;
- Evaluate options, information, and to examine the most benefited alternative from analyzing inputs among existing institutions;
- To identify the indirect influencing factors in the contest of vulnerability: natural resource seasonality, rural infrastructure, technology, economic growth, population, health & diseases, risks to climate change, flooding, drought, employment opportunities, market demands, diversification (fishing, tourism, etc);
- Explore the feasibility of establishing action plans to identify and adapt, where appropriate;
- Identify entry points for information at different levels of governance

Approaches to risk communication and associated assumptions

Approach	Assumptions and actions
Social processes of risk communication	Engage in a process that addresses concerns about risk Aimed at enhancing understanding among stakeholders
Development and delivery of a risk message	Aimed at bringing public views into line with expert views to ensure expert view of more validity for decision-making
Dialogue about risk	Interactive exchange of risk information--continuous Aimed at balancing the content of risk message Assumes both views contribute to decision-making

Institutional mechanisms: Realizing implementation

- **Past recommendations : How effective were they? What criteria are used for evaluation?**
- **Past interventions: How effective were they?**
- **Do we need to involve local organizations? If so then what will be the interest?**
- **How is the common interest pursued and secured? Where and why have particular local organizations been successful and sustained?**
- **Partnerships (not only stakeholder assessments)**

Policy?

- What activities already exist?
- What partnerships need to be engaged?
- Goals of participants: What is being valued?
  (role of experts, state agencies, NGOs, local communities)
- Trends: Robustness: choice, inventory and baselines
- Conditioning factors: reconstructing influences on events, past interventions
- Alternatives: acting under uncertain information
- Pathways to decision-making


Thank you....

CLIMATE CHANGE ADAPTATION AND THE WATER SECTOR : MALAYSIA'S EXPERIENCE

ZAINAB HASHIM
Research Officer

Ministry Of Natural Resources And Environment (NRE)

OUTLINE OF PRESENTATION

- **Climate Change**
- **Impacts on Water Resources**
- **Vulnerabilibity**
- **Adaptation**
- **The Future**


ONE EARTH

A UNDP-IMPLEMENTED PROJECT

UNDP

habitats at risk

Climate change – everyone's in one boat

All of us are adding to global warming, so each of us should do something to curb it. *Sonia Randhawa* has the task list.

Wettest town going dry

Oceans may rise to danger level by 2100, says researcher

CLIMATE CHANGE & WATER

"Observational records and climate projections provide abundant evidence that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems".

Intergovernmental Panel on Climate Change (IPCC)
Technical Paper VI: Climate Change and Water
June 2008

Climate Change Implication

- **Immediate impact with respect to water resources**
  - Extreme events of floods and droughts, affecting:
    - Water supply
    - Water quality
    - Agricultural production
    - Bio-diversity, etc

CLIMATE CHANGE AND ITS IMPACT ON WATER RESOURCES

Increases in temperature and reduced rainfall

- Reduced inflows to water storages (dams/reservoirs)
- Reduced streamflows
- Reduced water available for rainfed agriculture
- Reduced recharge of groundwater
- Threatened water supplies to cities and towns, agricultural, industrial, environmental
- Severe droughts

CLIMATE CHANGE AND ITS IMPACT ON WATER RESOURCES

Increases in temperature and increased rainfall

- Increased inflows to water storages
- Increased pressure on water storage infrastructure
- Increased availability of water for rainfed agriculture
- Increased risk of flood damage
- Possible changes to ecosystems

CLIMATE CHANGE AND ITS IMPACT ON WATER RESOURCES

Altered frequency of extreme weather events

- Increased flooding
- Increased erosion
- More sediment and nutrients in streams

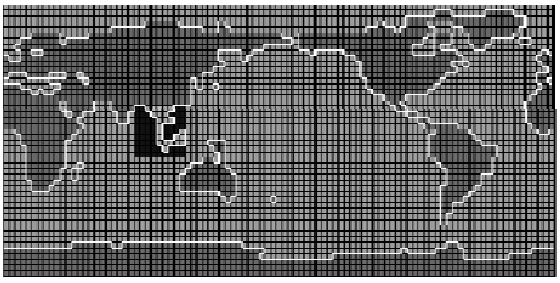
Where do we go from here?

NAHRIM Regional Hydroclimate Model of Peninsular Malaysia (RegHCM-PM)

- **Study Objectives**
  - Develop a regional hydrologic- atmospheric model to take into account climate change in Peninsular Malaysia and validate the model by historic hydrologic-atmospheric data
  - Evaluate the impact of climate change on the hydrologic regime and water resources of Peninsular Malaysia by means of the developed regional hydroclimate model (RegHCM-PM)
- Regional Hydroclimate Model of Peninsular Malaysia (RegHCM-PM) was developed by downscaling global climate change simulation data (Canadian GCM1 current and future climate data) that are at very coarse resolution (~ 410km) , to Peninsular Malaysia at fine spatial resolution (~9km).
- Able to quantify the impact of the complex topographical and land surface features of Peninsular Malaysia on its climate conditions.

10

Data grid of CGCM1 that were used in the RegHCM-PM..



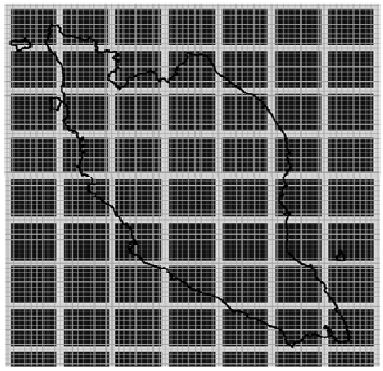


Figure 17 - Nested grids of the inner and the outer domains of RegHCM-PM under Mercator projections. The boundaries of the Peninsular Malaysia and nearby islands are overlaid on the grids.

FINDINGS

- In annual rainfall:
  10% increase for Kelantan, Terengganu and Pahang
  5% decrease for Selangor and Johor
- Temperature rise 2° C
- More droughts ie dry years (from modelling output: 2028, 2029, 2034, 2042 and 2044)
- More extreme hydrological conditions may be expected (higher high flows, and lower low flows)for Kelantan, Pahang, Terengganu and Kedah watersheds

National Communication 2 (NC2)

[2007-2009]

- Preparation of NC2
  - Chaired by Ministry of Natural Resources & Environment
  - to further integrate climate change issues and impacts into the national and local strategic, development and action plans.
- 3 Working Groups (WG) under NC2, and chairs:
  - WG 1 - Greenhouse Gases (GHGs) Inventory - FRIM
  - **WG 2 - Vulnerability & Adaptation (V&A) - NAHRIM**
  - WG 3 – Mitigation - PTM

NC2: WG2 - Vulnerability and Adaptation

- To undertake an assessment of potential impacts of climate change on several vulnerable sectors
- To formulate corresponding adaptation measures
  - 7 vulnerable sectors (and sub-committees):
    - Agriculture (MARDI)
    - Forestry (FDPM)
    - Biodiversity (FRIM)
    - Water resources (NAHRIM)
    - Coastal and marine resources (DID)
    - Public health (MOH)
    - Energy (PTM)

NC2: WG2 - Vulnerability and Adaptation

- 2 support groups under WG2
  - Climate Projections (NAHRIM) - looks at climate projections studies carried out in Malaysia, based on available climate models and data
  - Socio-Economic Impacts and Responses (LESTARI, UKM) - looks at socio-economic impact and responses from global warming and climate changes as well as adaptation measures

What Next ?

- Identifying Vulnerable Sectors
- Needed Actions to cope and adapt to the Climate Change
  - Incorporate in current development programs
    - Water Supply, Flood Mitigations and other infrastructure installations – will there be any design or O & M changes/requirements to infrastructures?
    - Re-look at planned development, incorporate planning of water needs/environmental impacts from project visualisation
    - Agriculture – cropping practices need to be accommodated to changing rainfall patterns and increase temperature

Vulnerability

STUDY AREAS

Preliminary assessment of the climate change impact on irrigation and water supply scenario of the following selected study areas:

1. Muda Irrigation Scheme
2. Kemubu Irrigation Scheme
3. Barat Laut Selangor Irrigation Scheme
4. Water supply in Klang Valley

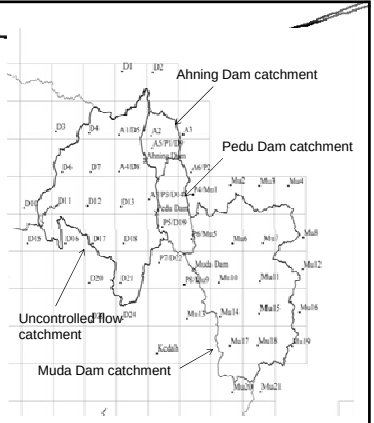
APPROACH & METHODOLOGY

- Estimate the water demands for irrigation and domestic/industrial (D&I) water supply in the Study Areas due to the projected climate change.
- Estimate water availability (catchment yields at dam and downstream) for irrigation and D&I water supply in the Study Areas using the projected climate data.
- Preliminary assessment of the climate change impact on water demand-availability scenario for the Study Areas corresponding to the periods of 2025-2034 and 2041-2050.

Monthly rainfall and ~~temperature~~ (NAHRIM 2006 projected data) were abstracted from respective grids.

The catchments weighted RF and Temp was input to the TM Model to derive the Total Runoff from the catchments.

Catchment	Number of Grids	Catchment Area (km²)
Ahning Dam	7	122
Pedu Dam	8	171
Muda Dam	21	984
Downstream	24	985



Kemubu Irrigation Scheme

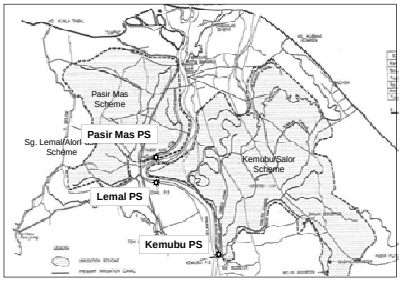
Irrigation sources –

> Direct run-of-river flows from Sg. Kelantan

> Effective rainfall

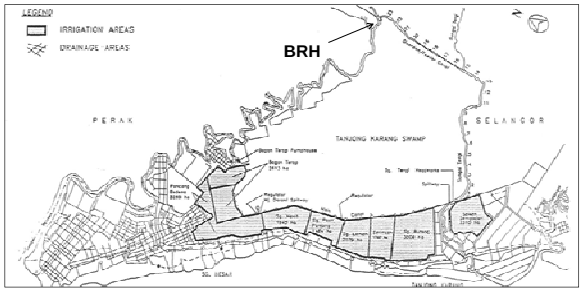
Irrigation Supply is pumped from Sg. Kelantan at the following intake points:

-Kemubu PS
-Lemal PS
-Pasir Mas PS



Barat Laut Selangor Irrigation Scheme

Covers an irrigation area of about 19,696 ha, and is located within the Northwest Selangor IADP area. Irrigation Supply is mainly diverted from Sg. Bernam at Bernam River Headworks (BRH)

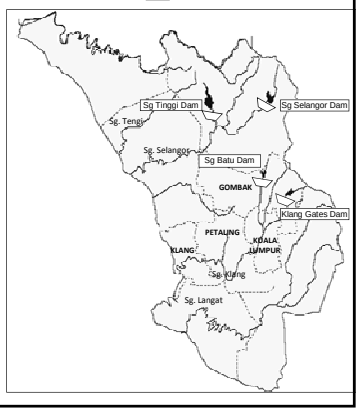


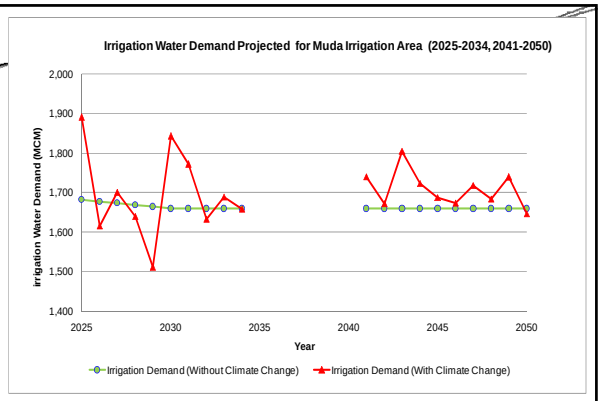
Klang Valley Water Availability

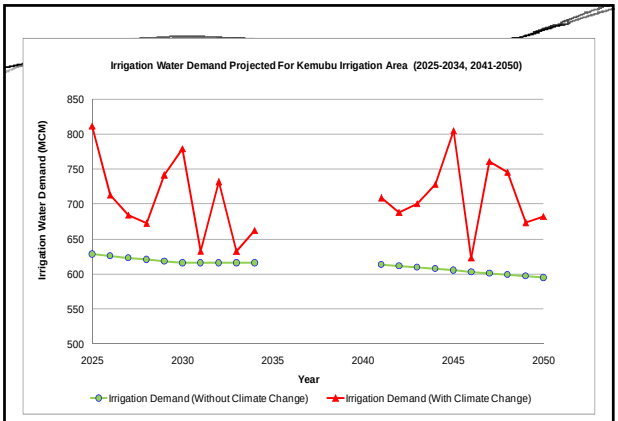
Water Supply System in Klang Valley:

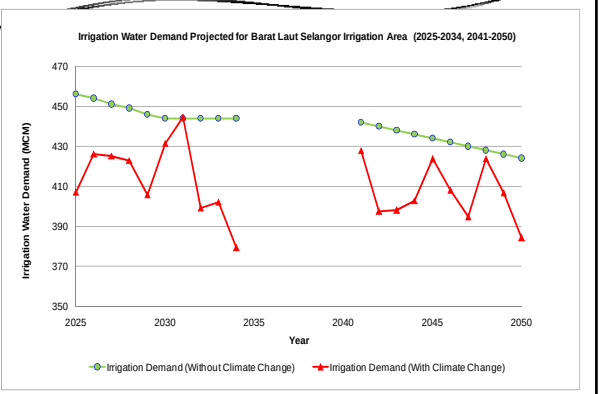
-Two storage dams (Klang Gates and Batu Dams)

- Sg Selangor Scheme comprises run-of-river & two storage dams (Sg Tinggi and Sg Selangor Dams).









Water Demand-Availability for Muda Irrigation Scheme with Dam Storage

- For water demand-availability assessment, it shows that 46 months of water deficit (19%) and 194 months of water surplus (81%) over the 240 months projection period.
- Deficit mainly occurs in Mar to July in 2027-2029 and 2048-2050
- 4 out of 20 planting seasons facing water deficits for the first 10-years, and 4 out of 20 for the second 10-year periods, most off-season crops
- Water deficit is mainly due to:
  - lower RF esp during 1st 10-year period.
  - Large variability in the monthly RF distribution
  - High Monsoonal evaporation

Water Demand-Availability for Kemubu Irrigation Scheme

- Water surplus ranges from the lowest 324 MCM (Aug 2028) to the highest 5,438 MCM (Dec 2033) is projected under climate change scenario.
- For 1 in 5 year low flow condition, water surplus ranges from the lowest 395 MCM (Jul 2031) to the highest 2,481 MCM (Dec 2033).
- The water surplus condition is mainly attributed to the large catchment size of Sg. Kelantan which provides abundant water resources.

Water Demand-Availability for BLS Irrigation Scheme

- 8 months of water deficit (3 %) under climate change scenario and 22 months deficit (9 %) for climate change scenario of 1 in 5 year condition.
- The water deficit is more frequent for the 2nd 10-year period especially for January & March.
- The water deficit is due to:
  - Lower future RF and hence lower water availability at BRH intake point at Sg. Bernam (transposed from Sg. Selangor @ Rantau Panjang) for the 2 future periods

Water Demand-Availability for Klang Valley Water Supply

- Water deficit is projected to occur for 194 out of 240 months (81 %) under climate change scenario.
- The water deficit is mainly due to:
  - Inadequate water availability from the dam and downstream catchments caused by the lower rainfall.
  - Dam storage not considered in this study.
  - Inter-state transfer is not considered – existing water sources are insufficient to meet the future water demand.
- Of the 240 months, 99 months (41%) having monthly rainfall higher than historical mean while 141 months (59%) having rainfall lower than the historical mean.

Possible Climate Change Implications

- From water demand-availability assessment, it is observed that the impact of climate change is both in the form of water deficit as well as water excess.
- Muda Irrigation Scheme largest monthly deficit in Mar 2048 amounts to -194 MCM. (Muda dam storage capacity 154 MCM).
- During the main-season, 3 to 4 months of consecutive irrigation water deficit occurred at 2026, 2034, 2042 and 2047.
- Prolonged irrigation water deficit may warrant cancellation of entire planting seasons.

Possible Climate Change Implications

- Muda Irrigation Scheme have large water excess in October 2046 and October 2048 as high as 487 MCM and 551 MCM respectively.
- Serious flooding of paddy fields will be likely to happen and will cause paddy crop damage as well.

Possible Climate Change Implications

- Kemubu Irrigation Scheme, water deficit is not a problem due to the large catchment area of Sg. Kelantan river basin.
- However, there is a problem of numerous months of excess water. The largest water excess is in December 2033 with 5,438 MCM/month.
- There are no flood mitigation dams to manage such serious flood impacts of climate change in the Kemubu Irrigation Scheme.

Possible Climate Change Implications

- The impact of climate change on the Barat Laut Selangor Irrigation Scheme is less severe.
- The largest deficit is in the month of January 2048 at -27 MCM/month (demand 28.5 MCM/month).
- The largest water excess is in May 2030 amounting to +260 MCM/month.
- There are no dams to manage excess water due to climate change.

Possible Climate Change Implications

- In Klang Valley, water rationing would have to be imposed like the past droughts due to the very prolong consecutive months of the water deficit.
- The most severe drought occurs in July 2044 with a peak deficit of -179 MCM/month.

Adaptation

The affected groups

Though they might not have called this, many already have long experience of "adaptation", for example

- People in flood-prone areas: houses on stilts
- Farmers in drought-prone areas:
  - diversify their sources of income,
  - cultivating more resilient crops,
  - optimizing the use of scarce water,
  - migrating temporarily in search for work elsewhere, etc.

The challenge is to assess and build on such traditional wisdom – helping people to protect their livelihoods and reduce their vulnerability.

Adaptation Strategies in Water Resources

- Enlarging reservoir capacity
- Flood Mitigation programme (SMART project)
- Improving hydrological forecasting
- Promoting widespread use of groundwater
- Changing land use practices
- Buffer zone for agriculture and forestry industries to minimize erosion and sedimentation

Possible Management Measures

In a situation of water stress:

- **Seasonal water rationing during times of shortage;**
- **Adapt industrial and agricultural production to reduce water wastage;**
- **Increase capture and storage of surface runoff;**
- **Better use of groundwater resources (risk: siltation)**
- **Rainwater harvesting**

Conclusion

- Global warming and climate change are real and that whatever mitigation measures currently taken, it is no longer possible to prevent the climate change that will take place over the next 2 to 3 decades
- There is a need to increase information for population in dealing with uncertainties and risks through the development of forecasting and scenarios
- Adaptation is the way forward

The Future

Needed Actions

- Paradigm shift/Mind set Change
  - What is our perception of water supply/WRM
    - can we reduce litres/pax/day? – therefore reduce stress on water resources development
      - Singapore is below 170 litres/pax/day
      - Malaysia, 270-450 litres/pax/day
    - What is our **overall objective in water supply services**
      - Supply all that is needed by each individual or
      - Do we have a conscientious supply policy to ***ensure sustainable economic development***
    - **Agriculture** – can we have precision farming and less water wastage
  - Can we treat all our waste water before discharging into the drains and river systems
    - More recycle instead of basin transfers
      - Bonus – Clean river, healthy living

NAHRIM, as an R&D Institution

- Will Continue with Hydroclimate Projection at finer scale, where necessary
- Will concurrently steer in the direction of R&D for Adaptation to Climate Change, specific to Water Resources
  - Approval of the 4th National Water Resources Council (NWRC) 20th August 2008
- Networking at Regional level
  - Water Knowledge Hub (WKH) for Climate Change Adaptation
  - AguaJaring/CapNet – IWRM Capacity Building

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THANK YOU

NATIONAL HYDRAULIC RESEARCH INSTITUTE OF MALAYSIA (NAHRIM)

Inception Workshop on "Mainstreaming Adaptation to Climate Change in Agricultural and Water Sectors" (10 August 2009)

Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector in Malaysia

Tan Ching Tiong, Prof. Dr. Joy Jacqueline Pereira, Prof. Dr. Mazlin bin Mokhtar & Prof. Dato' Dr. Ibrahim Komoo

Vulnerability & Adaptive Capacity in CC Adaptation

- The scenarios of CC:
  - Warming since industrial revolution: +0.76 ^{0}C
  - Projected future warming: +0.2 ^{0}C per decade
  - Changes in rainfall amounts & patterns
- Adaptation measures are necessary to avoid or cope with potential adverse impacts of CC
- Extent of CC Impact ← Degree of vulnerability
  - Exposure
  - Sensitivity
  - Adaptive capacity

2

Adaptive Capacity: Definition & Evolution of Understanding

- Adaptive capacity – ability of a system to:
  - Moderate the impacts
  - Take advantage of the opportunities
  - Cope with the consequences
- Evolution of understanding – links closely with vulnerability
  - End-point approach
  - Starting-point approach

3

Adaptive Capacity: End-Point Approach

- Design and implementation of adaptation:
  - Future climate change
  - Vulnerability in biophysical factors
- Uncertainties in the approach:
  - Climate scenarios
  - Climatic effects on sectors
  - Future socio-economic conditions
  - Unknown if adaptive capacity assets will be drawn in time of need
- Shortcomings:
  - Highly dependent on climate scenarios (CC may alter in a different way than expected) → adaptation measures may become inappropriate

4

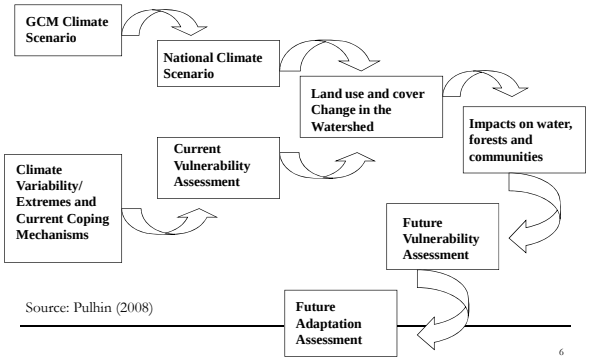
Adaptive Capacity: Starting-Point Approach

- Adaptive capacity of the present's system:
  - Socio-economic factors + Biophysical factors
  - Enhancing the present's ability to respond to stressors and secure livelihood
- Pro:
  - Practical for coping with changes and uncertainties
  - Promote sustainable development
  - Facilitate cheaper adaptation strategies
  - Target the poor and vulnerable groups more effectively

5

Integrated Assessment of Climate Change Impacts, Adaptation and Vulnerability in Watershed Areas and Communities in Southeast Asia

-- General Framework/Methodology of the Study



Source: Pulhin (2008)

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Water Management and Climate Change

- Water management has always adapted to changes
  - Water availability; demand; occurrence extreme events; etc
  - CC is just one of the pressures
- Potential implications of CC on water sector
  - Drought-related stresses; flood events; water quality problems → could impact across many other sectors
  - Effects of climate variability on hydrology and water resources
- Assessment of CC impacts (AR3-AR4)
  - Projection of effects with hydrological model driven by scenarios based on climate model simulations
  - Inclusion of current sensitivity/vulnerability & non-climatic drivers in projections & socio-economic aspects

7

Adaptation in Water Sector

- Development of adaptation techniques in the past largely independent of CC
- Adaptation options:
  - Supply-side management (e.g. building reservoirs or structural flood defences)
  - Demand-side management (e.g. managing demand or changing institutional practices)
- CC is increasingly being considered explicitly
  - Methodologies vary between and within countries depending on institutional arrangements for water resources planning

8

Adaptive Capacity to Climate Variability & CC

- Institutional:
  - capacity of water-related institutions; ability of water managers; etc
- Resources:
  - wealth of nations; etc
- Technological:
  - state of technology and framework for dissemination; etc
- Regulatory:
  - legal framework for water administration; etc
- Cultural:
  - perception on risks; mobility of human populations to change; etc
- Governance:
  - complexity of management arrangements, etc

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CC Adaptation: Malaysia's Experience

	CC in Asia: Malaysia Country Report	**Initial National Communication**
Duration	1992-1994	1998-2000
Funding	ADB	GEF/UNDP
Scope	Water resources; agriculture; coastal resources	Agriculture; forestry; water resources; coastal resources; public health; energy
Outputs	Malaysia Country Report	INC + Background report (5 sub-reports)

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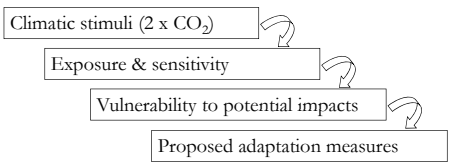
Assessment Approach

- Impact assessment approach



- Limited consideration on adaptive capacity
  - Current/Future ability to cope with future CC
- CC modeling & projection: highly uncertain

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Approach of Adaptation Measures

- Proposed adaptation strategies – not directly on CC:
  - Supply-side management
  - Demand-side management (INC)
- Types of adaptation & factors addressed:
  - Engineering or structural → physical or natural systems
  - Regulatory, institutional, planning and behavioural → human system
- Could improve ability to face projected future CC
  - Moderate the potential damages
  - Cope with the probable consequences

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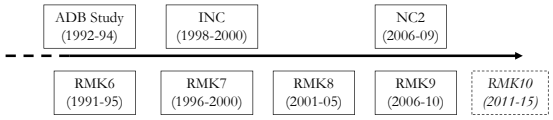
Next Steps?



- Principle hazards/issues & prioritisation
- Interventions & factors that determine/enhance adaptive capacity

⇨

- Characteristics of measures that enhance adaptive capacity
- Approach in integrating CC adaptation

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THANK YOU!

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14

Monitoring Progress of Climate Change Adaptation: The Use of Adaptation Metrics

SVRK Prabhakar and Takuro Kobashi

Institute for Global Environmental Strategies
Japan

Inception Workshop on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors
10-11 August 2009, Ballroom 2, Corus Hotel, Kuala Lumpur, Malaysia

Outline

- Need for adaptation metrics
- Determinants, criteria and types of adaptation metrics
- Adaptation metrics in Agriculture
  - Methods to identify metrics
  - Suggested metrics
- Relevance of Macro indicators
- Future line of work

Adaptation Metrics: Mitigation vs Adaptation

Mitigation	Adaptation
Has a **protocol** (KP) that governs	**No 'protocol'** to govern adaptation
There are **GHG reduction targets** to meet with coordinated efforts	There are **no 'adaptation targets'** to meet
Ways and means to measure the impact of collective actions	**No streamlined measurement system** for adaptation
Global actions and global benefits (more organized at global level)	Mostly local actions and local benefits (with some undeniable global spillover benefits)
Physical principles that govern mitigation	At nascent stages: Complex interaction of biophysical and socioeconomic elements

And…in addition

- Adaptation deals with systems
  - that are at different levels of adaptive capacity
  - Several adaptation options deferring in their effectiveness and outcomes

Need for Metrics: BAP on Adaptation (Section c, i-v)

- "Enhanced action on adaptation with consideration of …**prioritization of actions**…and support adaptation in a **coherent and integrated manner**"
- "**Positive incentives** for developing countries for **enhanced** mitigation and **adaptation actions**"

How to Prioritize and Incentivize Adaptation Actions?

- By
  - Knowing where we want to go (adaptation targets?)
  - Setting a time frame
  - Knowing how much 'adaptation' we want to achieve at each stage to meet the target
- This is facilitated by
  - And agreeing on a measurement system (adaptation metrics)
  - Setting a base line of adaptation (to compare the progress and effectiveness)

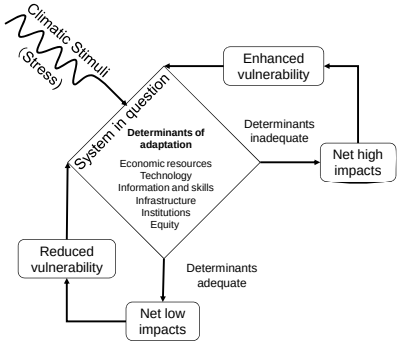
Adaptation Metrics

- Metric:
  - Is a 'measure'
  - A system of measurement
  - It has a unit of measurement
  - I has a value

Advantages of Adaptation Metrics

- Ability to **measure adaptation** at any given point of time
- Provide a **means to compare** the level of adaptation reached across locations, regions, and nations
- Help in decision making related to **identification and prioritization** of appropriate adaptation actions and for funding
- **Help track the progress** over the time
- Help in **minimizing the risk of mal-adaptation**

The Concept: Adaptation Metrics and Determinants of Adaptation



Criteria for Adaptation Metrics

- Measurable
  - Cost effective
- Scalable
- Comparable
  - Across time and geographical scales
- Context specific
  - Specific to system being measured
- Sensitive to degree of adaptation
- Learning and evolving

Different metrics

- Qualitative and quantitative
  - Cost and time resources, effectiveness
- Direct and proxy
  - To accommodate those cannot be directly measured
- Ex-ante vs. Ex-post
  - To chose options and to measure outcomes
- Local vs National
  - To accommodate differential impacts of climate change at different scales

Methods for Choosing Adaptation Metrics in Agriculture

Methodology	Geographical Scope	Source
Benefit-cost analysis	Local (L), national (N) and regional (R) scales	Tubiello and Rosenzweig, 2008
Cost-effectiveness analysis	L,N,R	Rosenzweig and Tubiello, 2006
Multi-criteria analysis	L,N,R	Dolan et al., 2001
Expert consultation (workshops)	L,N,R	Rosenzweig and Tubiello, 2007
Dynamic crop models	L,N,R	Tubiello and Rosenzweig, 2008
Modelling relationship between stressor and outcome variables	L	Luers et al., 2003
GIS based index based on normalization and aggregation of determinants	Sub-national	Swanson et al., 2007
Historical trend analysis and constructing conceptual models	Sub-national	Allison and Hobbs, 2004

Some Suggested Adaptation Metrics

Metric/s	Reference	Description on availability and limitations (includes authors judgement)
Mean and variability of yield and production, income, aggregate of value added	Tubiello and Rosenzweig, 2008	Measured and computed metrics. Available at local, national, regional and international levels in many countries. The aggregate of value added may need to be computed at the local level as such statistics will not be readily available.
Nutrition index	Tubiello and Rosenzweig, 2008	Computed metric (sum of local production and net imports divided by total food demand). Can be computed at national and regional level.
Yield estimates (remotely sensed), yield variability, highest relative yield/yield percentile	Luers et al., 2003	Estimates could help in filling the gaps in the existing yield data, validating the measured yield data etc. Accuracy could be an issue when resolution of remote sensing is low.
Agricultural export, farm income, out-migration from farming, emergency payments	Venema, 2006	Agricultural exports and out-migration of farming are mostly applicable at the macro-economic level, while data on rest of the metrics (emergency payments) could be sparingly available.
Sources of income, livestock number, source of fertilizer	Brooks and Adger, 2005	It was not clear on how many sources of income is considered as optimal, and also the number of cattle. However, it is suggested that the higher the sources of income, with more diversification into non-farm sources, the higher the adaptive capacity.

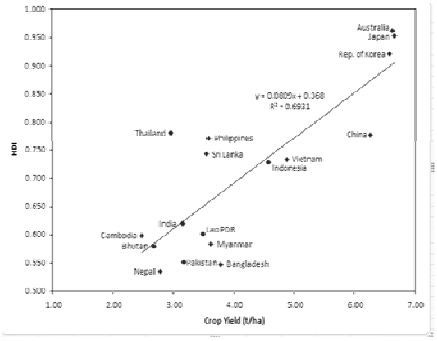
Problems with Earlier Suggestions

- Mostly single metrics and doesn't often provide an overall picture of adaptation in agriculture sector
- Policy makers may often prefer single composite index representing the entire sector with a single number (not withstanding their intrinsic limitation)

Some Composite Indices

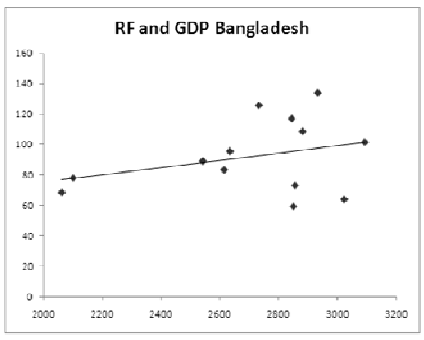
- GDP, HDI…
  - Grossly averages out, and even nullifies, the impacts at the sectoral and sub-national level
  - Criticized as either too primitive or too unattainable (e.g. HDI)
  - Lack of consensus among various stakeholders

HDI vs Rice Yields



Author calculations

GDP and Rainfall



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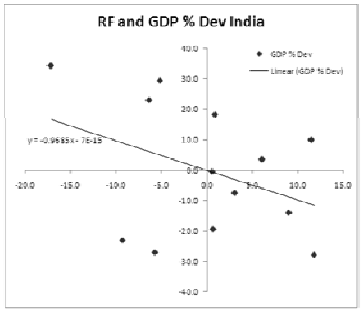

Author calculations

- Message: Not all metrics can be equally applicable to all conditions…

Food for Thought

- What is the ideal framework for measuring adaptation?
- How to identify a set of metrics (or a single Adaptation Index) that capture the multiple dimensions of adaptation
- How to prioritize among different metrics using multi-criteria approaches?
- How to validate metrics under different conditions?
- How to operationalize adaptation metrics at different levels of decision making?

Thank You!

Financing Adaptation in Agriculture and Water Sectors in Asia: An Overview

Ancha Srinivasan, Ph.D.
Asian Development Bank

Outline

- Rationale
- Guiding Principles for Adaptation Finance
- Financing needs
- Mechanisms in the Current Regime
- Proposed Mechanisms for the Future Regime
- Concluding Remarks

Why is funding for adaptation in agriculture & water sectors crucial?

- Continued reliance of Asian economies in terms of livelihoods (even if proportion of GDP is declining)
- High sensitivity of sectors to climate change
- Looming food and water insecurity
- Declining resource flows to both sectors
- Inter-relatedness
  - Food and water security vs. energy and social security
  - Biomass for energy is water-intensive
  - Desalination & energy use

Water Security and Climate Change

- "Water security links together the web of food, energy, climate, economic growth and human security challenges ….We simply cannot manage water in the future as we have in the past, or the economic web will collapse. " (World Economic Forum Water Initiative paper for Davos, 2009)
- "Water resource issues have not been adequately addressed in climate change analysis and climate policy formulations. Likewise, climate change problems have not been dealt within water resource analysis, management and policy formulation" (Bates et al., 2008).

Which adaptations do need funding?

- Some adaptations do not have major financial implications – policy-driven, institutional reform, behavioral changes.
- Some costs are borne by agricultural or water sector users, and they "finance" their own adaptation.
- Some investment is of the "soft" type, e.g. information, research, policy – Asia desperately needs!
- But "hard infrastructure" also required, with major financial implications e.g. multipurpose storage schemes, irrigated & rainfed agriculture – Again Asia is critically short of this.

Adaptations to Hard Infrastructure

- Upgrading existing infrastructure
  - Protective infrastructure: strengthening dams, coastal defenses
  - Non-protective infrastructure: reinforce roads, improving water management to cope with flood risks and water shortages;
- Designing new infrastructure
  - Protective infrastructure: New dams and reservoirs;
  - Non-protective infrastructure: Heat resistant and permeable roads (rainwater can percolate easier, smaller risk of inundation); hydropower infrastructure, water supply and demand infrastructure;

Guiding Principles for Adaptation Financing

Fund Generation

- Adequacy
- Additionality
- Predictability (automatic accrual) and reliability
- Sustainability

Fund Utilization

- Appropriateness (compensation not aid)
- DC Ownership
- Effectiveness (M&E metrics)
- Absorptive Capacity
- Governance
- Professionalism
- Accountability
- Transparency

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Estimated Costs of Adaptation in Developing Countries (worldwide)

- Stern Review (2006): **$4-37** billion (B) /year
- World Bank (2006): **$9-41** B/year
- Oxfam (2007): at least **$50** B/year
- UNDP (2007): **$86** B/year by 2015
- UNFCCC (2007): **$28-67** B/year by 2030
- UNFCCC (2008): **$70** B/year by 2020

Dr. Ancha Srinivasan ADB

Financing needs for adaptation in agriculture and water sectors

- Agriculture: $14 billion/year
- Water sector - $23 billion/year (**USD 531 billion** *from now to 2030)*
- Water supply/conservation: $11 billion/year
- Coastal zones: $11 billion/year
- LDCs: (38 NAPAs)
  - Agric (104): $270 M; Water (57): $141 M; Coastal (34): $96 M
- Water for Agriculture: Capital and recurrent costs in water-resource related management to achieve the MDG hunger goal:
  - 2005-2015: $47 billion/year
  - 2015-2030: $67 billion/year

  (Mostly irrigation development, lesser sums for upgrading rainfed, agricultural research & extension)

Sources: McCarl 2007; Kirshen 2007; UNFCCC 2008; SEI 2008

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Funding Mechanisms in the Current Regime

- UNFCCC Funds
  - GEF Trust Fund
  - Least Developed Countries Fund
  - Special Climate Change Fund
- Adaptation Fund (Kyoto Protocol)
- Other UN Conventions
  - Convention on Biological Diversity
  - Convention on Wetlands
  - Convention to Combat Desertification
- IFI Adaptation Funds
  - World Bank: Strategic Climate Fund (SCF) with a Pilot Program for Climate Resilience (PPCR)
  - ADB: Climate Change Fund, SGA, Water Financing Partnership Facility
- Bilateral Funds

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Current Mechanisms

GEF: **$50 million (M) SPA over 5 years – Fully committed already**
Share of Asia: 27% ~ $13.7 M (Kiribati: 2.1; Sri Lanka: 2.1; India: 4.4; Tajikistan: 1.1; Southeast Asia: 2; Pacific: 2)

LDC Fund: (Nov. 2008)
Pledged amount: 172.4 M
Paid: 131.2 M **Approved allocations: 53.5 M**
Commitments: 18.7 M **Disbursements: 12.8 M**
Share of Asia in approved allocations : 18.4 M
(Bangladesh: 3.7; Bhutan: 4; Cambodia: 2.1; Samoa: 2.2; Tuvalu: 3.4; Vanuatu: 3)

SCCF (Nov. 2008)
Pledged amount: 106.6 M
Paid: 94.4 M; Tech. Transfer: 16.2; Adaptation:78.2
Approved allocation: 68.6 M
Commitments: 30.7 M **Disbursements: 15.3 M**
Share of Asia in approved allocations: 31.6 M
(China: 5.8; Mongolia: 1.8; Philippines: 5.8; Pacific: 14.8; Viet Nam: 3.4)

Total GEF funds for adaptation since 1991: ~330 M
Allocations: ~172 M **Disbursements: ~78 M**

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Typical GEF Projects in Asia

- LDCF: Cambodia Building Capacities to Integrate Water Resources Planning in Agricultural Development
  UNDP PIF Approved 2.14M Co-financing: $1.95M
- SCCF:
  - China Mainstreaming Adaptation to Climate Change Into Water Resources Management and Rural Development (World Bank) - $5.8M; Co-financing: $50M
  - India Climate-resilient Development and Adaptation (UNDP) - $5.7M (in the pipeline)
  - Philippines Climate Change Adaptation Project (World Bank) - $5.8M Co-financing: $25.4M
  - Vietnam Climate-resilient Infrastructure Planning and Coastal Zone Development in Vietnam (ADB/UNDP) $3.4 Co-financing: $180M
  - Regional: Pacific Islands Adaptation to Climate Change Project (PACC) UNDP 14.8

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Bilateral initiatives

- Japan – Cool Earth Partnership
- Korea – East Asia Climate Partnership
- Australia – MRC Climate Change Adaptation Initiative
- European Commission – Global Climate Change Alliance (GCCA)
- United Kingdom – International Window of the Environmental Transformation Fund (ETF-IW)
- Spain – Millennium Development Goals (MDG) Fund
- Germany – International Climate Protection Initiative
- Norway – Agency for Development Cooperation (NORAD) Rainforest Initiative

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Other funding sources

- Public investments (Asian governments)
- Private investments (Estimated to cover 86% of global adaptation costs in developing countries)
  - Regulations and standards
  - Taxes and charges
  - Subsidies and incentives for innovation
- Insurance

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Efforts to Bridge the Adaptation Funding Chasm

- Projects that have been classified as contributing to adaptation (including ODA's component & pledges)
  - Bilateral assistance (2001-2011) ~$4.5 B
  - UN Agencies (2001-2011) ~0.6 B
  - MDBs (2001-2011) ~$1.7 B
  - Annual flows: ~$680 M (of which $570 M are pledges for the future) Source: Ryden & Cunill (2009)
- Domestic resource flows (unspecified amounts to adaptation):
  - China (part of Levy on CDM – 65% on HFC; 35% N_2O; 2% Others)
  - Bangladesh (Multi-Donor Trust fund)
  - Sri Lanka (environmental tax)

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Potential for Adaptation Fund

- Adaptation Fund (2% levy on CDM + voluntary contributions)
  - $36 million (M) per year at 2008 levels of CDM activity
  - $80-300 M (2008-2012)
  - To be operational in June 2009 with monetization of first batch of Certified Emission Reductions (CER)
- *If continued beyond 2012*:
  - $200-680 M by 2020 (EU)
  - $100-500 M (low carbon credit demand scenario) to $1-5 B/yr (high demand scenario) by 2030

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Proposed Funding Mechanisms for Adaptation in the Future Climate Regime beyond 2012

I. Global Market-based Levies

- Increasing levy on CDM (e.g. from 2 to 5%) – $0.3-1.7 b/year in 2020 (Bangladesh & Pakistan) 5% levy = $200-750 M (2008-2012)
- Extending levy to other market mechanisms (IET and JI) – 10-50 M (2008-2012); 300 M–2.25 B/year after 2012
- Currency transaction development levy (Tobin tax) – 15-20 B/year
- Air travel and Shipping Levies
  - International air travel levy @ $ 7-10/ticket ($8-14 B/year) (LDCs)
  - Solidarity Tax on air travel (France)
  - Levy on marine bunker fuels ($4-15 B/year) (LDCs)
  - Auctioning of allowances for international maritime and aviation emissions ($22-40 B/year) (Tuvalu)
- Levy on REDD funds (5% ~ $600 M)
- Agricultural carbon storage payments similar to REDD

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Other Proposed Mechanisms for Adaptation Funding - 1

I. Global Market-based Levies (Contd.)

- World Climate Change Fund– All countries contribute and receive based on GDP, GHG & Pop. – Adaptation levy of 2% from all disbursements from the fund may generate up to $1.9 B/year by 2030 (Mexico)
- Taxing $2 per t CO_2 with a basic tax exemption of 1.5 t CO_2 per person - $18.4 B/year (Switzerland)
- Global fossil fuel tax
- International CSR
- Adaptation credits
- Ad-Mit Credits and Premium Carbon Credits
- Adaptation Vouchers and Adaptation Certificates

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Other Proposed Funding Mechanisms for Adaptation - 2

II. Regional and National Market-based Levies (in Developed countries)

- Auctioning a portion of Annex I emission allowances - $15-25 B with 2% of AAUs (Norway)
- Levy on fossil fuel sales in Annex I (Tuvalu 2005)
- Portion of income from border tax adjustment measures (based on carbon intensity) by Annex I
- Auctioning a portion of EU-ETS allowances ($2.3 billion/year by 2020)
- Business adaptation (e.g. EU wine industry - CLAWINE)
- US Congress – Boxer-Lieberman-Warner bill $3-25 b/year (proposed but failed)

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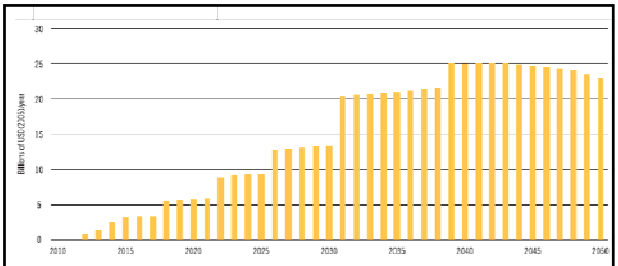

Potential annual auction revenue designated for international adaptation under Boxer-Lieberman-Warner climate bill, 2015-2050

Source: Bapna and McGray (2008)

Agricultural offsets may be an important part of US Federal Climate Change Legislation. Land use offsets in the US (1.1 b tons CO_2 eq.)
Novecta Soil Offsets standard (12 May 2009)

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Waxman-Markey discussion draft (Section 491-496 p. 632)

The American Clean Energy and Security Act of 2009

- Establishes an International Climate Change Adaptation Program within USAID, working with EPA and State
- Up to 1.5 billion tons of international offsets per year within the cap-and-trade system
- Dedicates resources to addressing the critical adaptation needs of poor and vulnerable countries
- Not more than 10% of the available funds can be spent in one country in any year
- At least 40% and up to 60% of the funds available to the Program shall be distributed to international funds created under the UNFCCC

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Other Proposed Funding Mechanisms for Adaptation - 3

III: National Market-based Levies in Developing countries

- Carbon tax
- Tax on exports of carbon-intensive products
- CSR
- Domestic aviation tax
- Portion of proceeds from energy production tax credits, investment tax credits, enhanced capital allowances, research and development tax credits

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Funding Mechanisms for Adaptation and Disaster Risk Management

- Index-based crop insurance systems (India, Thailand)
- Weather hedges
- Catastrophe bonds
- Combined micro-insurance and microcredit (loans linked to adaptation e.g., buying drought-resistant seeds)

Note: Insurance can incentivize adaptation but it is not a panacea.

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Current Problems with adaptation financing

- Funding is insufficient, unpredictable, unreliable, and voluntary (not obligatory)
- Duplication of activities
  - Overlap (of objectives) among PPCR, AF, GEF funds
  - Funding overlap among bilateral initiatives
  - Level of harmonization?
- Competition among funds for donors
- Diversion from ODA
- Limited absorption (disbursement) capacity of the recipient governments

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What needs to be done?

Agreement at Copenhagen(COP15) that can create an overarching architecture with institutions, instruments and incentives to

- Scale up efforts with greater urgency so that funds for adaptation are
  - Sufficient (*Additional to ODA)*
  - Predictable (*Bypass national budget)*
  - Fair and equitable (*Grants, not loans)*
  - Effective (target the most vulnerable)
- Improve policy coherence
- Promote independent coordination and
- Bridge the North and South in carrying out measures for the global environmental benefit.

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Concluding Remarks

- Adaptation financing is a major challenge for all countries, but more so for developing Asia. No single mechanism can bridge the adaptation funding chasm.
- New adaptation funding instruments needed *(regional approach?)* especially for the agricultural and water sectors.
  - Pay serious attention to use indigenous knowledge for adaptation
  - Finance local initiatives for natural resource conservation and use
  - Encourage local financial institutions to provide credit on timely and at low interest rate
  - Sectoral budgets may be necessary to support the most vulnerable.

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Concluding Remarks

- Mainstreaming adaptation into ODA is crucial but ODA is unlikely to provide “new and additional” adaptation funds.
- Governance of funds is as important as fund generation.
- Agreement on a new mechanism for agric. and water adaptation at global level may depend largely on the US initiative.

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Thank You!

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ADAPTIVE POLICIES AND MEASURING MAINSTREAMING CLIMATE CHANGE ADAPTATION INTO INSTITUTIONAL PROCESSES: SOME EXPERIENCES FROM JAPAN

Special meeting room (8F), Nihon Press Centre, Tokyo, 28 June 2011

Most of the current institutional systems and policy processes have been evolved mainly to deal with 'known problems with known solutions', and are often characterized with rigidity in structure, administrative procedures, and decision making mechanisms. Experience suggests that such institutional and policy processes have been ineffective to deal with issues that often change over the time and where decision making has to happen in a dynamic environment with considerable uncertainty. Climate change is one such issue where new information for decision making by policy makers continues to emerge while still the decisions cannot be postponed until such time reliable information is available for initiating actions.

The uncertain nature of climate change doesn't mean that status quo is a better alternative. Several contemporary research that emanates from the understanding of social, policy dynamics and change management research indicate that there are ways to deal with unknown and ever changing challenges by designing institutional systems and decision making mechanisms in a flexible/adaptive manner. This body of literature seems to support the hypothesis that systems that are designed flexible or adaptive can evolve better with the changing status of the issues that these systems are designed to address and hence are better able to solve them. In order to design such institutional and decision making systems, it is important to know the determinants or underlying factors that either contributes to or limits the adaptive nature of institutions and policies.

Another closely related aspect that has implications for better decision making for dealing with climate change is to know to what extent the institutions have mainstreamed climate change considerations into their administrative, decision making and business processes. If there is a possibility to rate institutions on a scale of no-mainstreaming to fully mainstreamed, it can provide an easy tool for decision makers to monitor the progression towards an ideal state of mainstreaming.

Keeping the above in view, the current expert consultation is aimed to answer the following questions: A) How various institutions and policies have responded to dynamic policy questions in the field of agriculture, food and natural resource management in Japan? B) What were the enabling and limiting factors for these institutions, policy processes, and policies to be adaptive or non-adaptive? C) Is it possible to measure the process of institutional mainstreaming on a scale between not-mainstreamed to fully mainstreamed? D) What is the current status of mainstreaming climate change adaptation considerations into the business processes of various institutions in Japan? E) What lessons these experiences can provide to developing countries in the Asia-Pacific region?

To answer the above questions, the consultation is divided into two sessions. In the first session, various experts will talk about how various agricultural policies have evolved over the past few decades in Japan along with the evolving issues and provide an analysis on various enabling factors for these policies to be dynamic in nature. In the second session, various representatives from government ministries, private agencies, NGOs and donor agencies will provide an assessment of how they evaluate their institutional processes on the provided mainstreaming scale with supportive arguments on factors contributing to better or lack of progress in mainstreaming adaptation concerns.

This consultation meeting is funded by the Asia-Pacific Network for Global Change Research (APN) through the project CRP2009-02NMY-Pereira.

Agenda

Time	Program
09:00-09:05	**Welcome remarks** *Shinano HAYASHI, IGE*
09:05-09:15	Self introduction of participants
09:15-09:30	**Overview presentation** *Prabhakar SVRK, IGE*
	Session I: Policy and institutional dynamics: Some experiences from Japan
9:30-9:45	Historical analysis of agricultural policy issues in Japan *Dr. Kazuhito YAMASHITA, Canon Global Strategy Research Institute/ The Research Institute of Economy, Trade and Industry* *Q and A(5min)*
9:45-10:00	Historical analysis of declining number of farming communities and evolution of related interventions in Japan *Prof. Ryuichi SHIGENO, Graduate School of Life and Environmental Sciences, University of Tsukuba* *Q and A(5min)*
10:00-10:15	Historical analysis of demand for land and evolution of related interventions in Japan *Prof. Toshihiro HATTORI, Meiji University* *Q and A(5min)*
10:15-10:30	Historical analysis of floods/water scarcity in agriculture and evolution of related interventions in Japan *Dr. Satoshi SAKATA, National Institute for Rural Engineering, NARO* *Q and A(5min)*
10:30-10:45	Historical analysis of agricultural fiscal policy for supporting farmers in Japan *Dr. Tetsuro SHIMUZU, Norinchukin Research Institute* *Q and A(5min)*
10:45-10:55	**Coffee Break**
	Session II: Measuring progress in mainstreaming adaptation in Japan
10:55-11:10	Ministry of Environment *Ms. Ayuko KOBAYAKAWA* *Q and A(5min)*
11:10-11:25	Sonpo Japan *Mr. Kiyoshi FUKUWATARAI* *Q and A(5min)*
11:25-11:40	Japan International Cooperation Agency *Mr. Hiroshi ENOMOTO* *Q and A(5min)*
11:40-11:50	Ministry of Agriculture, Forestry, and Fisheries *Mr. Toshiya SORIMACHI and Mr. Kenrou TAKAHASHI*
11:50-12:20	**Open discussion:** Determinants of adaptive policies and incentives for mainstreaming climate change adaptation *All participan*
12:20-12:25	**Closing remarks** *Shinano HAYASH*
12:25-1:00	Lunch and disperse

Participants List

	Sess.	Affiliation	Family name	First name
1	**Agro Policy**	Senior Scientist, RIETI(Research Institute of Economy, Trade & Industry, IAA), The Canon Institute for Global Studies	YAMSHITA	Kazuhito
2	**Farmer's population**	Professor, School of life and Environmental Science, Tsukuba University	SHIGENO	Ryuichi
3	**Landuse**	Professor, Faculty of Agriculture, Meiji University	HATTORI	Toshihiro
4	**Water**	Researcher, National Institute for Rural Engineering	SAKATA	Satoshi
5	**Fiscal Policy**	Researcher, Norinchukin Research Institute	SHIMIZU	Tetsuro
6	**MAFF**	Deputy director of division, Office Global Environment Provision, Biomass Policy Division, MAFF	SORIMACHI	Toshiya
7	**MAFF**	Deputy director of division, Office Global Environment Provision, Biomass Policy Division, MAFF	TAKAHASHI	Kenrou
8	**MOE**	Director, Office of Research and Information, Global Environment Bureau, MOE,	KOBAYAKAWA	Ayuko
9	**SONPO**	Director (Senior Researcher),Research Development Department, NKSJ Risk Management Ltd., (Reccomended by Sonpo Japan)	FUKUWATARI	Kiyoshi
10	**JICA**	Deputy Director, Climate Change Sector, Global Environment Division, JICA	ENOMOTO	Hiroshi
11	**Translator**	JAPAN CONVENTION SERVICES	NAGAI	Satoko
12	**Translator**	JAPAN CONVENTION SERVICES	OKADA	Etsuko
13	**IGES**	IGES NRM/AD Deputy Director	HAYASHI	Shinano
14	**IGES**	IGES NRM/AD Senior Researcher	SVRK	Prabhakar
15	**IGES**	IGES NRM/AD Administrative Assistant	WATANABE	Junko
16	**IGES**	IGES NRM/AD Associate Researcher	TSURITA	Izumi

RESTORING AGRICULTURE AND FOOD SECTOR AFTERMATH OF GREAT TOHOKU DISASTER: IMPLICATIONS FOR THE RESILIENCE OF JAPAN

Time and Date: 1-5PM on 8th November 2011. Venue: Room #801, Kokukaikan, Tokyo

Institute for Global Environmental Strategies, Hayama, Japan

The Great Tohoku Earthquake that occurred on 11th March 2011 is the most powerful earthquake in the known history of Japan. A chain of events unfolded after the earthquake that included a tsunami of historical magnitude that damaged critical infrastructure such as nuclear power plants located in Fukushima leading to release of unknown quantities of nuclear radiation into the environment. As a consequence of these series of events, lives of more than 25,000 people were lost, many went missing, and hundreds and thousands were displaced into various prefectures of Japan. Though Japan is known for its advanced earthquake and tsunami risk mitigation measures, these events have clearly overwhelmed the national and prefectural administration leading to a national emergency that is still unfolding.

Subsequently, many policy makers and disaster risk reduction specialists in Japan and abroad have been focused on how to rehabilitate the displaced people and how to reconstruct the affected areas. The national and affected prefectural governments have put in place several measures for rescue, rehabilitation, compensation, and reconstruction in the affected areas. Amidst all these discussions and developments, one aspect seemed didn't not get much attention as much as it deserves i.e. the radiation safety aftermath of damage to nuclear power plants in Fukushima. The release of unknown quantities of radiation into environment has several implications in terms of health safety of citizens even beyond the disaster affected areas, mistrust on Japanese exports, delayed rehabilitation in areas with high radiation exposure, demand for imported food, and implications in terms of economic growth for a country whose economy primarily depends on exports.

This raises important questions that need immediate answers from the perspective of civil society and disaster risk reduction professionals: what radiation related issues are faced by the civil society, how food safety regulations in Japan consider radiation contamination, what specific limitations are posed by the radiation for speedy disaster recovery, and what it all means for the resilience of the Japanese society as a whole? These are also the questions that the civil society in Japan is interested to know answers for, as evident from several discussion boards and networks that have emerged on Internet. This informal event aims to address these questions in a greater detail with an objective of finding a way forward. This initiative is funded by the Asia Pacific Network for Global Change Research (APN) through the project CRP2010-02CMY-Pereira.

Contact: prabhakar@iges.or.jp; +81-80-5631-0541

Agenda

13:00 Welcome remarks *SVRK Prabhakar*

13:05 Session I: Rehabilitation of food and agriculture in Japan post-Fukushima

Moderators: *SVRK Prabhakar & Hari Srinivas*

> The impact of Fukushima event on food and agriculture and measures for it [Toshihiko Takemoto, PRIMAFF]

>The impact of low concentration radiation on food in Japan [Seiichi Oshita, Tokyo Graduate School of Agricultural and Life Sciences]

>Consumers' voice and activities of Pal-System for food contaminated by radiation [Michimoto Matsumoto, Pal System Consumers Cooperation Union, Japan]

>People's voice and activities to ensure food safety from radiation [Setsuko Yasuda, Food Policy Center Vision 21]

>The radioactivity found under cooperative work of agriculture [Tomoko M. Nakanishi, Tokyo Graduate School of Agricultural and Life Sciences]

14:35 Session II:

Managing radiation hazard: Information management and linking civil and nuclear administration

Moderators: Hari Srinivas & S. Hayashi

>Health safety post Fukushima: Study findings from radiation doses in education institutions: [Masayoshi Tsuji, Fukushima Medical University]

>Information of radiation and civil society [Mikio Nakayama, Kanda University of International Studies]

>Presentations from Disaster Risk Management Professionals [Hari Srinivas, Kwansei Gakuin University]

<15:35 Coffee Break>

15:50 Session III: Citizens Charter: Civil Society Perspectives

Moderator: Peiter Franken

>Citizen perspectives: Antonio Portela

>Issues and experience from Network I: Pieter FRANKEN, Safecast

>Issues and experience from Network II: David Sidney Moore, Tokyo Kids and Radiation

16:45 Session IV:

Discussion on implications of Fukushima on the resilience of Japan and policy suggestions

Moderator: Hari Srinivas

>Open discussion among all participants

Concluding remarks *S. Hayashi*

Participants List

	Sess.	Family name	First name	Affiliation
1	Speaker	TAKEMOTO	Toshihiko	Institute of Agriculture, forestry, and Fisheries
2	Speaker	Oshita	Seiichi	University of Tokyo
3	Speaker	MATSUMOTO	Michitomo	Pal System Consumers Cooperation Union
4	Speaker	YASUDA	Setsuko	Food Policy Center Vision 21
5	Speaker	NAKANISHI	Tomoko	University of Tokyo
6	Speaker	TSUJI	Masayoshi	Fukushima Medical University
7	Speaker	NAKAYAMA	Mikio	Kanda University of International Studies
8	Speaker	SRINIVAS	Hari	Kuwansei Gakuin University
9	Speaker	PORTELA	Antonio	Hosei University, International Japanese Studies
10	Speaker	MOORE	David	Tokyo Kids and Radiation
11	Speaker	FRANKEN	Pieter	SAFECAST
12	Open Participant	PORTELA	Antonio	
13	Open Participant	TBD		
14	Open Participant	TBD		Ministry of Agriculture, Forestry and Fisheries
15	Open Participant	TBD		Ministry of Agriculture, Forestry and Fisheries
16	Open Participant	TBD		Ministry of Agriculture, Forestry and Fisheries
17	Open Participant	TBD		
18	Translator	ICHIKURA	Akiko	JAPAN CONVENTION SERVICES
19	Translator	KUMANO	Risa	JAPAN CONVENTION SERVICES
20	IGES	HAYASHI	Shinano	IGES NRM/AD Deputy Director
21	IGES	SVRK	Prabhakar	IGES NRM/AD Senior Researcher
22	IGES	KOBAYASHI	Masanori	Former IGES Researcher
23	IGES	TANIDA	Nao	IGES PMO Researcher
24	IGES	KIPP	Robert	IGES PMO Researcher
25	IGES	WATANABE	Junko	IGES NRM/AD Administrative Assistant
26	IGES	AOKI	Misa	IGES NRM/AD Research Assistant

Programme Book

National Symposium on Climate Change Adaptation

16-17 November 2011

Pullman Putrajaya Lakeside

Organised by

In Collaboration with

Message by Minister
Ministry of natural Resources and Environment

Y.B. Dato Sri Douglas Uggah Embas
Minister of Natural Resources and Environment

Climate change is no longer a distant possibility. It is a scientifically proven reality that it is already affecting all of us. Volatile weather changes, shifts in rainfall patterns and climate zones and rise in sea levels have all been linked to rising global atmospheric temperature. Due to its climate and location, Malaysia is already experiencing the force of climate events. Studies conducted under the auspices of the Ministry of Natural Resources and Environment have given us a glimpse of future climate change scenarios and potential threats to the sustainability of our nation.In addressing the challenges of climate change, everyone has a role to play but to be successful we must all act in unison.

In 2007, my Ministry initiated the Policy Study on Climate Change which culminated in the National Policy on Climate Change and approved by the Cabinet in 2009.The National Policy on Climate Change provides the framework to mobilise and guide government agencies, industry, community as well as other stakeholders and major groups in addressing the challenges of climate change in a holistic manner. The National Policy will enable us to take concerted actions and identify opportunities that can help navigate the nation towards sustainability.

Efforts to mainstream climate change adaptation in the country are currently being steered by the Working Committee on Adaptation, which was established under the Green Technology and Climate Change Council. The Working Committee will take stock of vulnerability and impacts of climate change in Malaysia, promote integration and implementation of climate change adaptation, facilitate the assessment of effectiveness and encourage knowledge-based decision-making. This first National Symposium on Climate Change Adaptation has been organised with the aspiration to strengthen adaptation planning by engaging different stakeholders on to a common platform. With the concerted efforts of all stakeholders we will ensure climate-resilient development that fulfils national aspirations for sustainability.

I thank the organiser and the co-organisers for successfully hosting this National Symposium and look forward to the recommendations for more effective formulation and implementation of adaptation actions for the benefit of all stakeholders.

Message by The Secretary General
Ministry of Natural Resources and Environment

Y. BHG. DATO' ZOAL AZHA YUSOF
Secretary General
Ministry of Natural Resources and Environment

Climate change is any change in climate over time that directly and indirectly affects humans and their activities as well as natural systems and processes. It is envisaged that even with the most stringent implementation of mitigation measures to reduce the emissions of greenhouse gases, the impacts of climate change in the next few decades cannot be totally avoided. The implications transcend all levels, sectors, stakeholders and major groups. Adaptation to such climatic hazards requires institutional capacity for implementation that is made effective through collaborative participation, based on indigenous and scientific knowledge.

The development of the National Policy on Climate Change by the Ministry of Natural Resources and Environment, and approved by the Cabinet in 2009, is one key milestone towards addressing the challenges of climate change in a concerted and holistic manner. Climate change adaptation will be implemented along with mitigation in a balanced manner to reduce our vulnerability and enhance our adaptive capacity to climate change that contributes to sustainable development.

In order to effect mainstreaming of climate change adaptation in the country, the Working Committee on Adaptation was established under the Green Technology and Climate Change Council. The Working Committee, which is anchored by the Ministry of Natural Resources and Environment and supported by other agencies, have previously organised a number of technical meetings to discuss conceptual aspects of climate change adaptation at the national level. Through this first National Symposium on Climate Change Adaptation, the Ministry aspires to strengthen adaptation planning by engaging multiple stakeholders to a common platform with the aim to understand the goals and aspirations for climate change adaptation in various sectors. The event brings together several policy and research papers for sharing of knowledge and experience of different perspectives as well as bridging the policy-makers and researchers that will ultimately contribute to shaping concrete adaptation actions at different levels in the country. This will ensure climate-resilient development that fulfils national aspirations for sustainability.

INTRODUCTION

The National Policy on Climate Change (NPCC), approved in 2009 is being implemented under the guidance of the Green Technology and Climate Change Council (GTCCC), chaired by the Prime Minister of Malaysia. Under the GTCCC, there are seven Working Committees. These are on Industry, Transport, Human Capital, Research and Innovation, Promotion and Awareness, Adaptation and Green Neighbourhood.

The Working Committee on Adaptation is anchored by the Ministry of Natural Resources and Environment. The tasks of the Working Committee on Adaptation include taking stock of vulnerability and impacts of climate change in Malaysia, promoting integration and implementation of climate change adaptation, facilitating the assessment of effectiveness and encouraging knowledge-based decision-making. Technical meetings have been previously organised to discuss conceptual aspects of climate change adaptation at the national level. As a follow-up to this, the Working Committee aspires to strengthen adaptation planning by engaging government agencies, research institutions, universities, industry and the community as well as other stakeholders and major groups on a common platform.

OBJECTIVES

The purpose of the Symposium is to understand the goals and aspirations for climate change adaptation in various sectors to consolidate support from partner institutions in the Working Committee on Adaptation. The main objectives are to:-

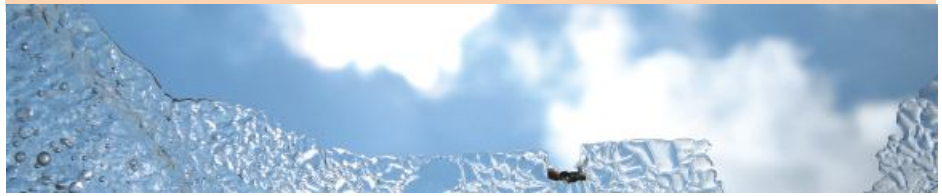
1. Identify common grounds, goals and aspirations and to delineate measures that would support effective implementation of the NPCC;

2. Inform participants and create awareness of the Working Committee on Adaptation;

3. Enhance information dissemination and bridge the policy-research interface to support knowledge-based decision-making at all levels.

Programme Overview

Wednesday, 16 November 2011 (Day 1)		
8.00 - 9.00		**PARTICIPANTS REGISTRATION**
9.00 – 10.00		**OPENING CEREMONY**
10.00 – 12.30	**Session 1**	**Climate Change Adaptation, Economics, Transportation and Industry**
14.00 – 16.00	**Session 2**	**Climate Change Adaptation and Natural Resources**
16.30 - 17.30	**Session 3**	**Research Presentation**
Thursday, 17 November 2011 (Day 2)		
9.00 – 10.40	**Session 4**	**Climate Change Adaptation, Health and Wellbeing**
11.00 – 12.40	**Session 5**	**Climate Change Adaptation and Local Level Action**
14.00 – 16.00	**Special Session: MyCLIMATE Forum on Climate Change - Country Experiences**	
16.00 – 16.30		**CLOSING CEREMONY**



Programme Details

Wednesday, 16 November 2011 (Day 1)	
OPENING CEREMONY	
9.00 - 9.15	**Arrival of VIP**
9.15 - 9.30	**Officiating Speech by** **Y.B. Dato Sri Douglas Uggah Embas** *Minister* *Ministry of Environment and Natural Resources*
9.30 - 10.00	**BREAK**

Wednesday, 16 November 2011 (Day 1)

SESSION 1	**CLIMATE CHANGE ADAPTATION, ECONOMICS, TRANSPORTATION AND INDUSTRY** *Moderator:* ***Y. Bhg. Raja Datuk Zaharaton Raja Zainal Abidin*** *Institute for Environment and Development (LESTARI-UKM)*
10.00 – 10.20	**Paper 1:** Promoting Climate Change into Development Plans - the Economics of Adaptation *Mr. Azhar Noraini* *Economic Planning Unit*
10.20 – 10.40	**Paper 2:** Setting the Scene for Malaysia – Projections for Vulnerabilities to Climate Change *Tuan Haji Ir. Ahmad Jamaluddin Shaaban* *National Hydraulic Research Institute Malaysia*
10.40 – 11.00	**Paper 3:** Impacts of Extreme Climate on the Power Sector - Issues and Challenges *Dr. Leong Yow Peng* *IEPRe, UNITEN*
11.00 – 11.20	**Paper 4:** Integrating Climate Change Adaptation in the Transportation Sector - Issues, Challenges, and Aspirations *Mr. Gurmit Singh* *Centre for Environment, Technology and Development Malaysia (CETDEM)*
11.20 – 12.30	**Dialogue Session**
12.30 – 14.00	**LUNCH**

Wednesday, 16 November 2011 (Day 1)	
SESSION 2	**CLIMATE CHANGE ADAPTATION AND NATURAL RESOURCES** *Moderator:* ***Y. Bhg. Tan Sri Dato' Seri Dr. Salleh Mohd Nor*** *Academy of Sciences Malaysia*
14.00 – 14.20	**Paper 1:** National Policy on Climate Change - Goals and Aspirations for Biodiversity, Forestry, and Ecosystems *Dr. Abdul Rahim Nik* *Ministry of Natural Resources and Environment*
14.20 – 14.40	**Paper 2:** Climate Change and Marine Life *Prof. Dr. Nor Aieni Hj. Mokhtar* *Ministry of Science, Technology and Innovation*
14.40 – 15.00	**Paper 3:** Goals and Aspiration for Coastal and Water Resources in the Context of Climate Change Adaptation *Dato' Ong Siew Heng* *Department of Irrigation and Drainage*
15.00 – 15.20	**Paper 4:** Climate Change Adaptation and Green Growth *Dr. Salmah Zakaria* *ESCAP, Bangkok*
15.20 – 16.00	**Dialogue Session**
16.00 – 16.30	**BREAK**

Wednesday, 16 November 2011 (Day 1)

SESSION 3 **RESEARCH PRESENTATION**

16.30 – 17.30 *Moderator:*
Prof. Dr. Joy Jacqueline Pereira
Southeast Asia Disaster Prevention Research Institute (SEADPRI-UKM)

1. Extreme Rainfall Changes Over Malaysia: Observation and Projection
   Kumarenthiran Subramaniam, Ling Leong Kwok & Wan Azli Wan Hassan, MMD
2. Projected Changes of Future Climate Extremes in Malaysia
   Meng Sei Kwan, Fredolin T. Tangang & Liew Juneng, UKM
3. Climate Change Impacts: Addressing the Challenges Faced by the Malaysian Marine and Coastal Ecosystems with a Focus on Tourism Islands
   Evelyn Teh, MIMA
4. Climate Change and Mangroves on the West Coast of Peninsular Malaysia: Threats and Adaptation
   Babak Kamali, Shahram Morteza Nia, Roslan Hashim & Faridah Othman, UM
5. Physiological Responses of Avicennia Marina var. Acutissima and Bruguiera Parviflora Under Simulated Sea Level Rise
   M. Z. Rasheed, O. Normaniza & M. Z. Rozainah, UM
6. Climatic Change: Effect on Ant Community
   Maryati Mohamed, UTHM
7. Aboveground Biomass Accumulation and Carbon Storage in a Rehabilitated Forest and Natural Regenerating Secondary Forest, Bintulu, Sarawak, Malaysia
   Roland, K.J.H., Nik M. Majid, G. Seca & O.H. Ahmed, UPM
8. Towards CO_2 Reduction: The Role of Biochar
   Wan Azlina Wan Ab Karim Ghani, Azni b. Idris, Nur Zalikha Rebitanim & Mohamad Amran Mohd Salleh, UPM
9. Divergent Options for Climate Change Adaptation in Seafood Production in Malaysia
   Shahbudin Saad & Saleem Mustafa, UIA & UMS
10. Minimizing Impacts of Climate Change on Coastal Aquatic Resources Through Integrated Aquaculture
    Rahman M.M., Kamaruzzaman Y.B., Shahbudin S. & Jalal K.C.A., UIA
11. Farm and Coastal Fisher Community Initiatives in Adapting to Climate Change
    Consumers Association of Penang & Third World Network
12. An Assessment of Climatic Changes Adaptability of Farmers in Malaysia
    Chamhuri Siwar, Md. Mahmudul Alam, Rafiqul Islam Molla & Basri Talib, UKM

13. Water Use and Their Consumption Pattern in Malaysia
Md. Azizul Baria, Rawshan Ara Begum, Abdul Hamid Jaafar, Raja Zaharaton Raja Zainal Abidin & Joy Jacqueline Pereira, UKM
14. Climate Change Adaptation and Freshwater Resources: the Culture of Intellectualism
Sharifah Munirah Alatas, UKM
15. Aplikasi Sistem Maklumat Geografi untuk Pemetaan Reruang-masa: Suatu Kajian Kes Denggi di Daerah Seremban, Negeri Sembilan, Malaysia
Mohamad Naim M.R., Mazrura S., Hidayatulfathi, O., Rozita, H., Shaharudin, I., Zainudin M.A. & Rosli, M.H, UKM
16. Status of Dengue in Malaysia: An Epidemiologic Perspective
Md Shahin Mia, Rawshan Ara Begum, Ah-Choy Er, Raja Zaharaton Raja Zainal Abidin & Joy Jacqueline Pereira, UKM
17. Senario Luruan Ribut dan Kawasan Terjejas Akibat Kenaikan Paras Air Laut: Kajian Kes Pelabuhan Klang
Norazura Burham, Joy Jacqueline Pereira & Rawshan Aga Begum, MMD & UKM
18. Kenaikan Paras Air Laut: Implikasi Terhadap Kawasan Guna Tanah dan Alam Sekitar di Majlis Perbandaran Klang
Rasyidah Binti Abdul Karim, Joy Jacqueline Pereira, Halimaton Saadiah Hashim & Shaharuddin Idrus, UKM
19. Risk of Forest Fire in Future Climate: Adaptation and Mitigation Strategies
N. A. Ainuddin , M. R. Sheriza & K. Norfaryanti, UPM
20. $PM_{2.5}$ and Associated Ionic Species in a Sub-urban Coastal Area of Kuala Terengganu, Malaysia
Meikee Koh, Suhaimi Suratman & Norhayati Mohd. Tahir, UMT
21. Assessment of Endophytic Bacteria on Fusarium Wilt Suppression on Black Pepper (PIPER NIGRUM L.)
Franklin, R.K., Nik M. Majid, O.H. Ahmed, W.S. King & Edkona J.E., UPM
22. National Policy on Climate Change: Towards an Integrated and Balanced Approach for Adaptation and Mitigation in Malaysia
C.T. Tan, Joy Jacqueline Pereira & Lian Kok Fei, UKM & NRE
23. Spatial Planning Response to Climate Change: Case Study of the Selangor River Basin, Malaysia
Chee Ping Ngang, Joy Jacqueline Pereira & Halimaton Saadiah Hashim, JPBD & UKM
24. Perspective on National Security and Adaptive Capacity in the Context of Climate Change in Malaysia
Mamunur Rashid, Rawshan Ara Begum, Joy Jacqueline Pereira, Sarah Aziz & Mazlin Bin Mokhtar, UKM
25. Platforms of Climate Change: an Evolutionary Perspective and Lessons for Malaysia
Koh Fui Pin, Joy Jacqueline Pereira & Sarah Aziz, UKM

Thursday, 17 November 2011 (Day 2)	
SESSION 4	**CLIMATE CHANGE ADAPTATION, HEALTH AND WELLBEING** *Moderator:* ***Datuk Fateh Chand*** *Academy of Sciences Malaysia*
9.00 – 9.20	**Paper 1:** Integrating Climate Change Adaptation and Disaster Risk Reduction - National Goals and Aspiration *Datuk Mohamed Thajudeen Abdul Wahab* *National Security Council*
9.20 – 9.40	**Paper 2:** Goals and Aspirations for Climate Change Adaptation in the Health Sector *Dr. Lokman Hakim* *Ministry of Health*
9.40 – 10.00	**Paper 3:** Goals and Aspirations for Food Security in the Advent of Climate Change *Datuk Dr. Abd. Shukor Abd. Rahman* *MARDI*
10.00 – 10.20	**Paper 4:** Climate Change Adaptation for Sustainable Development - A Way Forward *Prof. Emeritus Dato' Dr. Zakri Abdul Hamid* *Science Advisor to the Prime Minister*
10.20 – 10.40	**Dialogue Session**
10.40 – 11.00	**BREAK**

Thursday, 17 November 2011 (Day 2)

SESSION 5	**CLIMATE CHANGE ADAPTATION AND LOCAL LEVEL ACTION** *Moderator:* ***Datin Paduka Dr. Halimaton Saadiah Hashim*** *Institute for Environment and Development (LESTARI-UKM)*
11.00 – 11.20	**Paper 1:** Spatial Planning and Climate Change - Goals and Aspirations *Dato' Mohd Fadzil Hj. Mohd Khir* *Department of Town and Country Planning*
11.20 – 11.40	**Paper 2:** Environmental Sustainability and Climate Change Adaptation – Perspective of a City *Mr. Andrew Joris Ak. Noyen* *Kuching North City Hall*
11.40 – 12.00	**Paper 3:** Low Carbon Cities and Climate Change Adaptation – the Iskandar Experience *Mr. Boyd Joeman* *Iskandar Regional Development Authority (IRDA)*
12.00 – 12.20	**Paper 4:** Community-based Actions for Climate Change Adaptation *Mr. Muthusamy Suppiah* *UNDP Malaysia / GEF-SGP*
12.20 – 12.40	**Dialogue Session**
12.40 – 14.00	**LUNCH**

Special Session

MyCLIMATE Forum on Climate Change - Country Experiences

Organised by:

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Thursday, 17 November 2011 (Day 2)

SPECIAL SESSION: MyCLIMATE FORUM ON CLIMATE CHANGE - COUNTRY EXPERIENCES

Moderator:
Dr. Yap Kok Seng
Malaysian Meteorological Department

14.00 – 14.20	**Climate-related Disaster Risk Reduction in South-East Asia** *Prof. Dr. Pak Sum Low* *UKM-YSD Chair in Climate Change,UKM*
14.20 – 14.40	**Climate Change Adaptation in the Agriculture and Water Sectors: Impacts, Strategies for Adaptation in Mekong and Red River Deltas** *Mr. Tran Dinh Trong* *Institute of Meteorology, Hydrology and Environment (IMHEN), Vietnam*
14.40 – 15.00	**Enhancing Adaptive Capacity at The Local Level: An Experiment in The Semi-arid Regions of India** *Dr. Arivudai A. Nambi* *M.S. Swaminathan Research Foundation (MSSRF), India*
15.00 – 15.20	**Promoting Risk Insurance in the Asia-Pacific Region: Bottom-up Lessons for the Future Climate Regime Under UNFCCC** *Dr. S.V.R.K. Prabhakar* *Institute for Global Environmental Strategies (IGES), Japan*
15.20 – 16.00	**Discussion**
16.00 – 16.30	**CLOSING**

ACKNOWLEDGEMENT

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Natural Disasters And Climate Change in Asia

seadpri
southeast asia disaster prevention research institute

Editors:

Julian Hunt

Joy Jacqueline Pereira

Mohd Khairul Zain Ismail

The Proceeding

Workshop on Natural Disasters and Climate Change in Asia

5-7 November 2012, Equatorial Bangi

Organised by:

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FOREWORD

Assalamualaikum WBT & Salam Sejahtera

The Southeast Asia Disaster Prevention Research Institute (SEADPRI-UKM) was established in June 2008 at Universiti Kebangsaan Malaysia. The Institute addresses crucial challenges on disaster risk reduction in the Southeast Asian region. The importance of having a research focal point in this region was felt when Malaysia and neighbouring countries grappled with various issues related to science and governance in facing the 26.12.04 tsunami disaster. SEADPRI-UKM was created to provide basic solutions for disaster prevention through multidisciplinary, interdisciplinary and transdisciplinary research on risk management to bridge the science-governance interface. The focus of research is on climatic hazards, geological hazards and technological hazards. The emphasis is on capacity building, mainly through post-graduate programmes and specialised training.

SEADPRI-UKM is proud to jointly host the Workshop on Natural Disasters and Climate Change in Asia with the Cambridge Malaysian Education and Development Trust (CMEDT) in Association with the Malaysian Commonwealth Studies Centre (MCSC) at University of Cambridge, National Security Council of the Prime Ministers Department and the Ministry of Natural Resources and Environment. The Workshop serves to strengthen existing ties between University Kebangsaan Malaysia and University of Cambridge whilst exploring the possibility of establishing an affiliation of networks and institutions working on issues related to natural disasters and climate change in Asia, to facilitate better information sharing and collaboration between operational and research centres. The participation of the National Security Council of the Prime Ministers Department and the Ministry of Natural Resources and Environment, which are National Focal Points for disaster risk reduction and climate change adaptation, respectively, serves to remind us on the need for policy relevance in all our initiatives.

SEADPRI-UKM has been played an active role in building capacity to implement the Hyogo Framework for Action (HFA) 2005-2015 in the region. Our researchers have always supported the National Security Council in preparing for the bi-annual Asian Ministerial Conferences on Disaster Risk Reduction on Disaster Risk Reduction and Global Platforms for Disaster Risk Reduction of the United Nations International Strategy for Disaster Reduction (UNISDR). At the national level, SEADPRI-UKM bridges the disaster risk reduction and climate change adaptation fraternities by working closely with both Focal Points. SEADPRI-UKM is also keeping abreast of the on-going UNISDR consultation for the post-2015 HFA agreement. I hope that the Workshop will provide insights to strengthen our inputs to this discourse.

The Workshop will most certainly provide inputs for SEADPRI-UKM in refining our work programme in the coming years. I thank all the participants, co-organisers and collaborators for their contributions in this regard.

Prof. Dr. Mazlin bin Mokhtar
Acting Director SEADPRI-UKM

PREFACE

Natural disasters are having a large and growing impact on societies and economies in Asia. The impact of natural disasters may increase as a result of climate change and increased variability. Also the nature and extent of these hazards is changing as a result of climate change, as well as rapidly changing patterns in agriculture, loss of forest cover, rapid urbanisation and extractive industries. Many relevant aspects of this problem are characteristic to Asia, e.g. hazards of monsoon rains and tropical cyclones, and vulnerability from extensive coastal and island infrastructure.

Recently the Intergovernmental Panel on Climate Change (IPCC) has issued a summary report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX). The report focuses on the relationship between climate change and extreme weather and climate events, and also the impacts of these events on vulnerable societies. The long term implications for sustainable development are also emphasized. The report integrates perspectives from several historically distinct research groups studying climate science, climate impacts, adaptation to climate change, and disaster risk management. This Workshop is being held for researchers, practitioners and policy makers in Asia to review findings of the IPCC-SREX, consider action plans for their implementation and create stronger regional collaborations.

The Workshop on Natural Disasters and Climate Change in Asia aims to review and publicise progress in the region regarding research on natural disasters and climate change, and policy implications. The specific objectives are to provide a platform to bring together researchers, practitioners and policy makers from the natural disasters and climate change communities; review the role of science and technology in collaboration with policy makers for managing the risks of natural disasters and climate change especially for vulnerable communities; and explore the establishment of an affiliation of networks and institutions working on issues related to natural disasters and climate change in Asia, especially better exchange of information and collaboration between operational and research centres.

Papers and Panel Sessions have been designed to highlights developments in climate change science, prediction and risk reduction in Asia, and key issues related to the policy and practice of disaster preparedness for vulnerable communities in the advent of climate change. The final Panel Session is devoted to discuss future collaboration through the proposed Asian Climate Change Network, focusing on regional priorities, proposed actions and cooperative mechanisms.

Prof. Lord Julian Hunt and Prof. Dr. Joy Jacqueline Pereira
Convenors, Workshop on Natural Disasters and Climate Change in Asia

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Asia Pacific Network for Global Change Research (APN)

CONTENTS

THEME 1

SCIENCE, PREDICTION AND RISK REDUCTION

GLOBAL WARMING AND TYPHOON ACTIVITY IN ASIA

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In the last few years, some researchers have suggested that as a result of global warming, sea-surface temperatures (SSTs) are likely to increase. Because an increase in SST will likely provide more available energy in the atmosphere and because tropical cyclones derive their energy from the ocean, such an increase is likely to lead to concomitant increases in tropical cyclone activity and/or intensity. These researchers demonstrated this argument through both data analyses and some model simulations. However, in the last few years, global tropical cyclone activity has been on the decrease while SST continues to rise. In the western North Pacific region, the year 2010 saw the lowest number of tropical cyclones during the last 60 years. So why does such a large discrepancy exist and what is the relationship between global warming and tropical cyclone activity, and in particular, typhoon activity in Asia? This paper will attempt to address these questions.

A careful examination of typhoon activity data during the last 100 years suggests that the increasing trend in typhoon activity identified by some researchers is simply the rising segment of a multi-decadal variation that has a period of around 30 years. Such a multi-decadal signal exists in almost all the characteristics of the typhoons – annual number, annual number of intense ones, formation locations, tracks, landfall locations and even possibly size. All such variations can be explained by changes in the atmospheric circulation as well as the SST distribution. The only exception is the total amount of rainfall associated with typhoons, which appears to be on an increasing trend, a result similar to those found in other studies on the variations in the frequency of occurrence of heavy rain events. All these results will be presented at the conference.

Such results can be interpreted as follows. Global warming does provide more energy to the atmosphere through higher evaporation. More moisture in the atmosphere means that if such moisture condenses to become rain, the rain can be heavier. However, the requirements for the formation and maintenance of a tropical cyclone are not only thermodynamic, i.e. high moisture content and an unstable atmosphere. Just outside of the main convective cloud cluster that will eventually become a tropical cyclone, the atmosphere must also have a strong cyclonic rotation in the lower atmosphere and a strong anticyclonic rotation in the upper atmosphere. In addition, the vertical wind shear near the centre of the cluster must also be weak. These dynamic conditions have not shown to become more favourable under global warming. Hence, while the thermodynamic conditions may have become more conducive for tropical cyclone formation, they are simply necessary but not sufficient conditions, the latter being the dynamic ones. On the other hand, the thermodynamic conditions alone are enough to produce more rain, and hence the increasing trend of tropical cyclone rainfall.

The main implication of these results is that although the main variations in typhoon activity have multi-decadal cycles and are unlikely related to global warming, heavier rain associated with typhoons should be expected. At landfall, such heavy rain will lead to more disasters associated with flooding, which will also be contributed by storm surge that will likely be higher due to sea-level rise caused by global warming.

MULTI-SCALE MULTI-PHYSICS SIMULATIONS FOR NATURAL DISASTERS UNDER CLIMATE CHANGE

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The earth environment is one of typical complex systems that are composed of phenomena with different scales of space and time. The first prior question to be answered by scientists is how natural disasters are influenced from climate variability or climate change. As recognizing easily, multiple scales interaction and multi-physics approach should be introduced to answer the above question.

Fully coupled atmosphere-ocean-land-sea ice models are recognized widely as a most powerful tool available for forecasting future weather/climate variability. Under the condition of global warming, there have been changes in climate variability such as El Nino Southern oscillation or Indian dipole mode phenomena [1]. Furthermore, weather/climate in regional/urban areas will be influenced by climate variability or climate change. This fact requires us not only to improve model physical performance with interactions among atmosphere, ocean, land and sea-ice but also to perform a huge scale of simulations capitalizing on high performance computing capabilities.

To be focused on such emerging, diversified requirements to simulations in research on weather or climate events, the Earth Simulator Center has been developing an ultra-high resolution coupled model that incorporates non-hydrostatic atmosphere, ocean, land and sea-ice model components, which is made tailored to high performance computing architectures. We call the above coupled model Multi-scale Simulator for the Geoenvironment (MSSG) [2]. MSSG is a coupled model with a nesting scheme between the globe and a region. It means that MSSG is capable of conducting seamless, comprehensive simulations with a single model for different scales ranging from the entire globe to urban areas (Figure).

Validation simulations with MSSG will be introduced in this presentation. MSSG-A model allows us to put huge-scaled simulations into practice. The global simulation result with a world-highest horizontal resolution of 1.9 km and 32 vertical layers by using the optimized MSSG-A program on the Earth Simulator. One-week integration was performed. Results show the precipitation distribution which was obtained by incorporating cloud microphysics and is comparable to observational data. In these simulation results, the precipitation in the Indonesian region and the fine structure of fronts are captured. In addition, MSSG-A is conducted regarding 3.0km Run that is discussed in earlier sections with respect to computational performance. The structural characteristics of a typhoon such as its eye, spiral structure and associated rain band are clearly indicated. The precipitation distribution is comparable to the observational data statistically processed from the original data measured by Automated Meteorological Data Acquisition System (AMeDAS) of Japan Meteorological Agency, thus demonstrating the reproducibility of meteorological events with MSSG-A in high resolution simulations. Furthermore, now we are promoting research on various aspects of heat island phenomenon and local downpour which are unique in urban areas [3]. Tokyo metropolitan city is one of the hottest cities over the world and is well known that temperature in the area is getting increasing with three degree during this one hundred year. The increasing temperature would be caused by variety of reasons. Those reasons are complex and still not clear. In addition, during these 15 years, the frequency of heavy rain is increasing in Tokyo. In our recent research, we try to understand the consequence between heat island phenomena and increasing heavy rain using simulations with ultra high resolution MSSG. These challenges offer the basic knowledge on adaptation scenarios whether urban environment is improved by “water and green” city planning and measures.

In order understand mechanism with multi-scale interaction in climate variability, several typical events which have impacts to local area were simulated and analyzed. Those latest results will be presented and discussed from point of view multi-scale interactions.

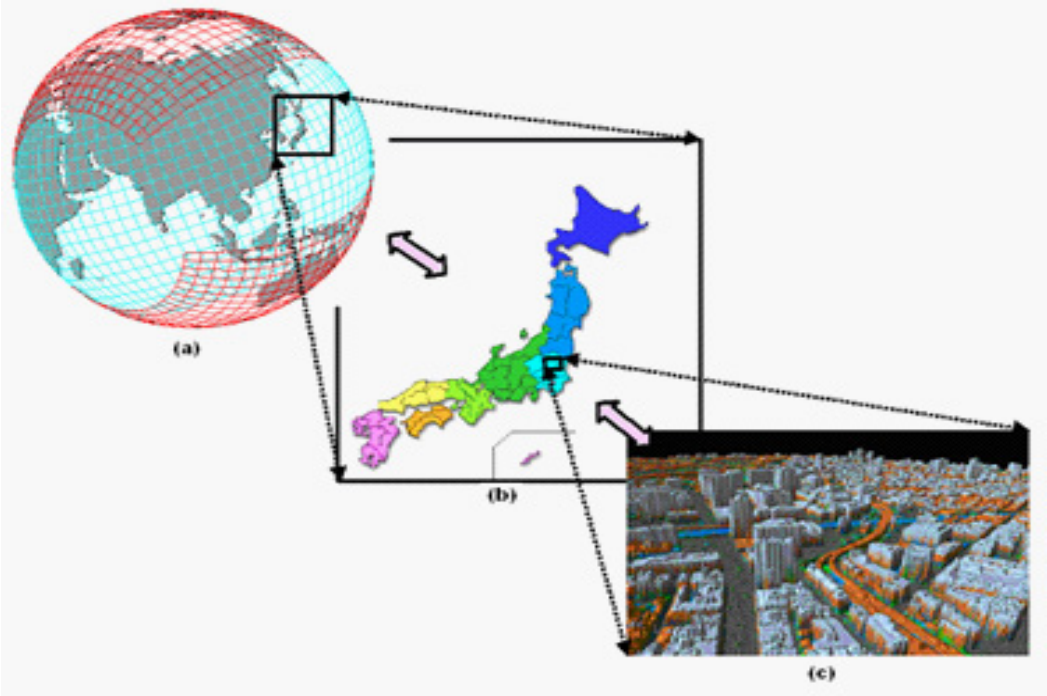

Figure. Multi-scale model representation. (a) The Yin-Yang gird system is used for global modeling. The regional model such as (b) is nested with the global model by incorporating one/two-way interactions. (c) Urban-scale weather/climate simulations are allowed with two-way interactions through the coupling with global/regional scale simulations. The urban topographical data were provided by Geographical Survey Institute.

References:

[1] K. Ashok and T. Yamagata. 2009. The El Niño with a difference., Nature, 461, 481-484.
[2] K. Takahashi, R. Onishi, T. Sugimura, Y. Baba, K. Goto, and H. Fuchigami. 2009. Seamless Simulations in Climate Variability and HPC. High Performance Computing on Vector Systems 2009 (M. Resch et.al.(eds.)), 199-219.
[3] http://www.mext-isacc.jp/eng/staticpages/index.php?page=theme_index

INTRODUCTION OF CORDEX-EAST ASIA DATABANK

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East Asia area has complex and unique geographical characteristics so that it's associated regional and/or local atmospheric phenomena are highly complicated due to non-linear interactions among climate systems as well as multi-scale interactions from mesoscale to planetary motions. Furthermore, climate change impacts in the East Asia such as extreme events or natural disasters (floods, droughts and so on) are likely expected very various and serious according to the 4th IPCC (Intergovernmental Panel on Climate Change) assessment report (AR4). Thus, high resolution climate information or dataset easily collectible and distributed is preferentially required for climate adaptation and risk management.

The CORDEX (Coordinated Regional climate Downscaling Experiment) is one of programs supporting by WCRP (World Climate Research Program) to organize an international coordinated framework to produce regional climate change projections based on research communities over the world for climate change impact and adaptation studies within the 5th IPCC Assessment Report (AR5) timeline. In addition, the major aims of the CORDEX initiative is to provide a coordinated model evaluation and a climate projection framework, and an interface to the applicants of the climate simulations in climate change impact, adaptation, and mitigation studies.

The CORDEX-East Asia databank (http://cordex-ea.climate.go.kr) which is designed as a web portal for user friendly system will be operated by KMA since the end of December 2012. All climate projections in this databank are currently produced by National Institute of Meteorological Research (NIMR)/KMA and three universities (Seoul National Univ., Yonsei Univ., and Kongju National Univ.) in Korea. Other countries such as the UK, Japan and China etc. will join in near future. The model domain set based on the CORDEX-East Asia domain (50km horizontal resolution) which is the biggest domain among eleven CORDEX domains over the world, covers most of Asia, the western Pacific, the Bay of Bengal, and the South China Sea (Fig. 1). However, all experimental regimes are different among climate projections, which will be discussed in the presentation.

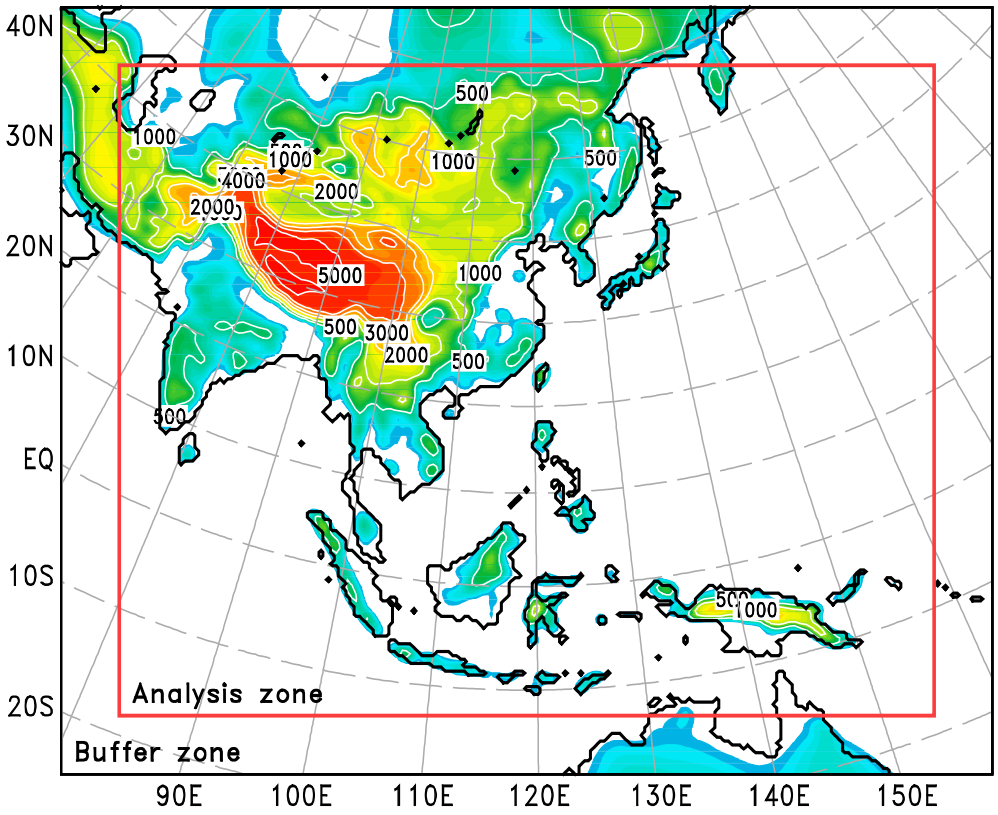

Fig. 1 Model domain and orography (m)

All output format and variables are followed as CORDEX Archive Design proposed by DMI (Danish Meteorological Institute), however, especially CORDEX-East Asia databank produces graphical products based on core variables and additionally anomalies can be calculated by users using simple statistics. Three classes of variables are provided and defined as followed; (1) Core, relevant to all communities (or users): monthly and seasonal mean (43 variables) (2) Tier 1, relevant to most communities (or users): daily surface/selected upper air data (59 variables), and (3) Tier 2, higher frequency and more complete atmospheric/surface variables (37 variables of 6-hourly and 13 variables of 3-hourly). All outputs are easily accessible and downloadable as data-files on stand lat-long grids and netCDF file conforming to agreed standards.

NIMR/KMA produced its climate projection data using HadGEM3-RA which is a Regional Climate Model (RCM) that is based on the atmospheric component of the latest Earth System Model developed by Met Office Hadley Centre (HadGEM3, 135 km resolution) under IPCC Representative Concentration Pathway (RCP) 8.5/ 4.5. The period of historical and future runs covers for 1950-2005 (56 years) and 2006-2100 (95 years) respectively. Result of historical simulation shows that the HadGEM3-RA has small large-scale drift from lateral boundary forcing and at the same time has ability to produce small-scale features due to its high resolution. This feature may lead that the RCM simulates current climate more improved than the Global Climate Model (GCM) around complicated topography and coast lines. Other climate projections based on three universities will be explained in the presentation.

DEVELOPMENTS IN THE OPERATIONAL FORECASTING OF SEVERE WEATHER EVENTS IN THE CONTEXT OF A CHANGING CIMATE

Chris Gordon
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The IPCC SREX report (IPCC, 2012) highlights that many weather extremes are likely to either occur more frequently and/or change in intensity as a consequence of anthropogenic climate change. In a number of regions this includes the increase in frequency of heavy rainfall events and the intensity of maximum cyclone winds. These extreme weather events can lead to increases in local flooding and wind damage and subsequent impacts on vulnerable populations. The SREX report also highlights the role of 'no-regrets measures' to deal with changing weather related risks. They are 'no regrets' in that these measures bring benefits under current climate and under a range of future climate change scenarios. One such measure is improved early warning systems. Put simply, if high impact severe weather events become more frequent and intense, the importance to provide early warnings of these events increases.

An important step in improving the availability of severe weather forecasts to some regions of the world has been taken by the World Meteorological Organisation (WMO) by the establishment of the Severe Weather Forecast Demonstration Projects (SWFDPs) in Southern and Eastern Africa, South Pacific Islands and SE Asia (with Bay of Bengal also planned). The main goals of SWFDP are to improve severe weather forecasting, to improve the lead-time of warnings and to improve the interaction of National Meteorological and Hydrological Services with media, disaster management and civil protection authorities. Where the provision of forecasts is concerned, the global producing centres, which run the state-of-the-art global forecast systems, make their forecasts available to the region. The models used in the global forecasting systems typically have a resolution of 20-50km. These model forecasts are provided within the SWFDPs via web portals along with guidance and interpretation provided by a specialist centre within the region.

Regional models at higher resolution are often used to provide a better representation of local weather systems. Over a number of years the Met Office has developed a UK regional forecast system based around a model that can explicitly represent atmospheric convection and that also provides a much improved representation of topographical influences on the weather. The first part of this talk will focus on this recent development in forecasting systems. The resolution of the models described will be either 4 km or 1.5 km. The forecasts produced show much greater detail in quantities that are important in severe weather, such as the forecast heavy rainfall amounts or maximum wind speeds. A further characteristic of the fully operational forecast system is that it has been designed to be relocatable to any geographical region with a minimum of effort. The forecast system was first implemented operationally in the UK and is now also being used in a number of other regions around the world. Examples will be given from the simulation of severe weather events in the UK, Australia, Lake Victoria and South Asia.

One issue that is widely recognised by the climate research community is that the climate models used in IPCC are of a too coarse resolution to properly resolve many of the weather features that are responsible for extreme weather events. For this reason, the quantitative results given in the SREX report, of for example changes in heavy rainfall events, should be regarded as preliminary estimates. In the second part of this talk, research from the Met Office Hadley Centre will be described where the high resolution models developed for severe weather forecasting (described earlier) are used in the climate context. A 1.5 km model covering the southern part of the UK has been used to simulate the statistical properties of rainfall events and these have been compared with the equivalent statistics derived from rain radar observations. These have also been compared to simulation of a regional model at a resolution typically used in the generation of regional climate scenarios. It is found that the new generation of high resolution models provide a substantially improved representation of the statistics of heavy rainfall events. This will clearly be important to estimate changes in local flood risk due to the changing frequency of these heavy rainfall events. Finally, a joint UK-US project to carry out a similar study over much of the US will be described.

The main message of this talk is that recent significant developments in science and operational forecasting systems can now be applied in the world's most vulnerable regions to substantially enhance severe weather early warnings. Working through partnerships, implementation of these systems in any region of the world is technically relatively straightforward. The increase in forecast capability needs to be combined with strengthened capacity of National Meteorological Services, emergency responders and end-user communities to enable the best use of these forecasting products in the provision of effective early warning systems.

UNDERSTANDING GLACIAL DYNAMICS IN THE HIMALAYA

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The Himalaya has one of the largest concentrations of glaciers and large area is also covered by snow during winter. Many Himalayan rivers including Indus, Ganga and Bramhputra and their numerous tributaries originate from the snow and glacier bound regions. Melt water from snow and glaciers make these Himalayan rivers perennial, and has helped to sustain and flourish several Indian civilizations along the banks of these rivers for ages. However, this source of water ought not be considered permanent, as Himalayan cryosphere is constantly changing.

However, controversial statement by IPCC report as, "Glaciers in the Himalaya are receding faster than in any other parts of the world. If present rate continues, the likelihood of them disappearing by year 2035 and perhaps sooner is very high if the Earth keeps warming at the current rate" and another statement in MoEF discussion paper, " A large mountain glacier would take 1000 to 10,000 years to respond to warming today, while small mountain glaciers take 100 to 1000 years to respond. Thus, one explanation for the glacier retreat could be: they are responding to natural warming that occurred either during the Medieval warm period in the 11 th century or to an even warmer period that occurred 6000 years ago". Both the statements are not supported by scientific evidences and speculative in nature. This error was occurred due to incomplete understanding of glacial dynamics in the Himalaya.

Conventionally health of glaciers is assessed using changes in glacial length. This could be misleading, as change in length can be influenced by numerous climatically insensitiveterrain parameters as slope, area altitude distribution, size, debris cover and orientation. In addition, retreat can also be influence by climatically sensitive parameters like mass budget and supra glacial lakes. Theseinfluences can produce complex pattern of glacial retreat and it may lead to erroneous conclusions. Therefore, it would be useful to understand changes in glacial mass to assess future changes in glacial extent.

Measurements of mass budget for glaciers in H-K region are relatively few and for short duration. The available data suggest that mass budget over large part of Himalaya has been negative over past decades and rate of loss is increased after roughly 1995. Rough estimates suggest that glaciers in Indian Himalaya losing mass at the rate of 16 Gt per year.The loss in mass for many small glaciers located in low altitude range could be larger than mean and it could be as high as 1m per year. This is substantial loss considering mean depth of small glaciers could be between 30 and 50 m. These small glaciers and ice fields are important source of water for many mountain communities. By considering small volume and large mass loss, this source of water could be significantly influenced in near future and could affect sustainability of many mountain communities. Therefore, major program needs to be undertaken to study changes in small glaciers and its impact on local communities.

The investigations in Indian Himalaya suggest that most of the glaciers are retreating and also loosing mass. This consistent shrinkage in mass and areal extent can affect stream runoff over a long term. In addition this process can be further influenced if more glacier lakes are formed due to increase in debris cover and if Black Carbon is transported in accumulation areas of the glaciers. Therefore, continuous monitoring is needed to understand changing dynamics of Himalayan glaciers.In my talk, I will discuss these issues. In addition, I will also discuss present state of Himalayan glaciers and its long term effect on people living on the banks of rivers originating from glaciated terrain.

Key words: glacier, mass balance, Himalaya, retreat, climate change

CURRENT UNDERSTANDING OF CLIMATE CHANGE AND KNOWLEDGE GAPS IN MALAYSIA

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Scientific knowledge of climate change at local and country levels is the basis for decisions on adaptation measures. At a global scale, the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) is the most comprehensive assessment of climate change scientific knowledge (IPCC 2007). However, the report provided limited assessment for regional scales. For example, the assessment for the Southeast Asia region was limited. Moreover, there was no assessment for Malaysia as IPCC report was not intended for any particular country. Hence, this paper provides an assessment of scientific knowledge of climate change over Malaysia and surrounding region based on available published literatures. For any region or country, assessment of climate change should encompass the evaluation of changes on mean climate, climate variability and extremes. Malaysia lies in the heart of the Southeast Asia region where its climate on the annual timescale is basically modulated by the Southeast Asia monsoon system. There was no available literature on the long-term changes on the onset, intensity and duration of the monsoon over Malaysia or the Southeast Asia region. In fact, there was no convincing evidence of long-term changes of mean precipitation over Malaysia associated with monsoon shifts. However, a recent study by Zhou et al. (2011) based on the satellite data indicated precipitation intensification for the last 20-30 years period over the rising regions of Walker and Hadley circulations which suggest shifts in the monsoon system. Juneng and Tangang (2010) indicated the strengthening of easterly wind over the South China Sea during winter monsoon, which may be an indication of changing monsoon circulation. However, surface mean temperature over Malaysia has been rising steadily since the last 40 years (Tangang et al. 2007). Future projection indicates some significant changes on rainfall. Similarly, the mean surface temperature is projected to increase by 3-5oC by the end of the 21st century. Several studies also indicated changes in the extreme precipitation (e.g. Suhaila et al 2010). Juneng and Tangang (2010) showed increased frequency of Borneo vortices that may result in increase of precipitation extreme events. On intra to inter-annual time scales, the climate over Malaysia and the surrounding region is also influenced by the El Nino – Southern Oscillation (ENSO) (e.g. Tangang and Juneng, 2004 and Juneng and Tangang 2005), Indian Ocean Dipole (IOD) and Madden-Julian Oscillation (MJO). Future changes on the characteristics of these phenomena due to warming climate are very likely changing the characteristics of their impacts such as drought and floods (i.e. in terms of severity, duration and affected area). For example the tendency for the ocean-atmosphere coupled system in the tropical Pacific Ocean to favor El Niño Modoki instead of the conventional El Niño in a warmer environment (e.g. Ashok et al., 2007) would mean expansion of drought affected region over Malaysia to include the Peninsular Malaysia (e.g. Feng et al., 2010). However, understanding of how major modes of climate variability such as ENSO, IOD, and MJO would be affected by anthropogenic warming is incomplete partly due to the inability of most climate models to simulate these phenomena. Overall, the amount of available literatures for assessment of scientific knowledge of climate change in Malaysia is low and much lower compared to developed countries and other countries in Asia such as Japan, Korea, China and Taiwan.

References:

Ashok, K., Behera, S.K., Rao, S.A., Weng, H.Y. & Yamagata, T. 2007. El Niño Modoki and its possible teleconnection. Journal of Geophysical Research-Oceans 112: C11007, doi:10.1029/2006JC003798.

Feng, J., Wang, L., Chen, W., Fong, S.K. & Leong, K.C. 2010. Different impacts of two types of Pacific Ocean warming on the Southeast Asian Rainfall during boreal winter. Journal of Geophysical Research 115(D24122), doi:10.1029/2010JD014761.

IPCC. 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental panel on Climate Change, hlm. 996. Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M. & Miller, H.L. (pnyt.). United Kingdom: Cambridge University Press.

Juneng, L. and Tangang F.T. 2010. Long-term trends of winter monsoon synoptic circulations over the maritime continent: 1962-2007. Atmospheric Science Letter, 11: 199–203.

Juneng, L and F.T. Tangang 2005. Evolution of ENSO-related rainfall anomalies in Southeast Asia region and its relationship with atmosphere-ocean variations in Indo-Pacific sector. Climate Dynamics, 25:337-350

Tangang, F.T. & Juneng L. 2004. Mechanisms of Malaysia rainfall anomalies. Journal of Climate 17(18): 3615-3621.
Tangang, F.T., L. Juneng and S. Ahmad. 2007. Trend and interannual variability of temperature in Malaysia: 1961-2002. Theoretical and Applied Climatology, 89, 127-141.
Suhaila, J., Deni, S.M., Wan Zin, W.Z. & Jemain, A.A. 2010b. Spatial patterns and trends of daily rainfall regime in Peninsular Malaysia during the southwest and northeast monsoon: 1975-2004. Meteorology and Atmospheric Physics 110: 1-18.
Zhou, Y. P., K.-M. Xu, Y. C. Sud, and A. K. Betts (2011), Recent trends of the tropical hydrological cycle inferred from Global Precipitation Climatology Project and International Satellite Cloud Climatology Project data, J. Geophys. Res., 116, D09101, doi:10.1029/2010JD015197.

CLIMATE CHANGE AND WEATHER EXTREMES IN MALAYSIA

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Introduction

According to the IPCC Fourth Assessment Report (IPCC, 2007), the updated 100-year linear trend from 1906-2005 shows that the global temperature has risen by 0.74±0.18oC, which is larger than the corresponding trend of 0.6oC for 1901-2000 given in the Third IPCC Assessment Report (IPCC, 2001). In the context of global warming, extreme weather and climate events have assumed significant changes in intensity, areas and frequency of occurrence (IPCC, 2007). However, extreme events are rare and difficult to identify their long-term changes (IPCC, 2012). Despite of the difficulty, understanding the trend in frequencies and occurrences of extreme weather events are of utmost importance for disaster preparedness and the enhancement of the adaptive capacity for disaster risk management. It is therefore crucial to understand the extremes trend in Malaysia, particularly on rainfall events.

Data and Methodology

The hourly precipitation data from Principal Meteorological Stations in Malaysia and projection data for the period 2000 – 2099 from the PRECIS Regional Climate Model (UNDP-GEF, 2003) driven by the HadCM3 AOGCM were used in this study. Bias correction was performed on this data using the cumulative distribution function-based downscaling method (Iizumi et. al, 2011) to scale the data for the selected station locations. Rainfall intensity was computed based on the actual highest accumulated rainfall for 1-hour, 3-hour and 24-hour period for each year, and their time series were plotted for the selected stations. The non-parametric Mann-Kendall test (Yue et al. 2002) was performed on the observed data at 95% confidence interval to detect the presence of a significant trend. Wavelet power spectrum analysis based on Torrence & Compo (1998) was performed on the observed and projected annual daily rainfall maximum data, by decomposing the time series data into time-frequency space, to determine both the dominant modes of variability and how those modes vary in time. The rainfall return period analysis was also performed according to Makkonen (2007). A 100-year return period was computed to describe the change in return periods between two 30-year periods: 1951-1980 and 1981-2010 of the observed data. A comparison of up to 100-year return periods between 2000-2099 of the PRECIS projection data and 1951-2010 observed data for the highest daily rainfall were also performed for the same meteorological stations.

Results and Discussion

Most parts of Malaysia show inconsistent and mixed trends for the 1-hour, 3-hour and 24-hour rainfall intensity. However, the central part of Peninsular Malaysia and whole of East Malaysia have their 1-hour and 3-hour rainfall intensity trends consistently increased although their respective 24-hour intensity have a decreasing trend or no apparent change, which suggests that highest intensity of rainfall from small scale convective rainfall that last only for a few hours has increased over the said region.

The wavelet power spectrum of annual daily rainfall maximum shows that most of the significant signals are found within 2 to 7-year periods and lack of regularity, which is consistent with the ENSO's irregular cycles. The projected wavelet power spectrum of the annual daily rainfall maximum from 2000 to 2099 for several referred stations shows most of the significant signals are also found within 2 to 7-year periods, indicating the ENSO remain as the main feature in modulating the temporal distribution of rainfall in this maritime continent country, but the 2 to 7-year periods are more well distributed, indicating possible increase in the frequency of ENSO events in the future climate change with more regular patterns compared to the current climate. The return period analysis shows Northern Peninsular Malaysia and West Coast of Sabah have their decrease in rainfall return period indicating an increase in the extreme rainfall events, while most parts of Malaysia have an increase in the return period indicating a decrease in extreme rainfall events. For the projection of future climate, comparison of up to 100-year return periods of the highest daily rainfall between 2000-2099 and 1951-2010 shows both significant decrease and increase in projected return periods at different locations in Malaysia.

Concluding Remarks

Changes in the large-scale atmospheric circulation as the results of global warming and natural climate change have apparently influenced the regional and local atmospheric circulation, and possibly increased climate variability and weather extremes in Malaysia. By virtue of its location in the maritime continent, Malaysia is vulnerable to the impacts of climate change.

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References
Iizumi, T., M. Nishimori, K. Dairaku, S. A. Adachi, and M. Yokozawa, 2011: Evaluation and intercomparison of downscaled daily precipitation indices over Japan in present-day climate: Strengths and weaknesses of dynamical and bias correction-type statistical downscaling methods, J. Geophys. Res.: 116.
IPCC, 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, J.T. Houghton, Y.Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell and C.A. Johnson, Eds., Cambridge University Press, Cambridge, 881 pp.
IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
IPCC, 2012: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation - Summary for Policy Makers [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G,-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley(eds)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. World Meteorological Organization, Geneva, Switzerland, 24 pp. (in Arabic, Chinese, English, Russian, and Spanish).
Makkonen, L, 2007: Problems in the extreme value analysis. Science Direct. Structural Safety: 405–419.
Torrence, C. and G. P. Compo, 1998: A Practical Guide to Wavelet Analysis. Bull. Amer. Meteor. Soc., 79, 61-78.
UNDP-GEF, 2003: Generating High Resolution Climate Change Scenario Using PRECIS Hadley Centre, National Communication Support Unit Workbook, Global Environment Facility, United Nations Development Programme.
Yap Kok Seng, Wan Azli Wan Hassan, Fredolin Tangang, Liew Juneng, Mohan Kumar Sammathuria and Kumarenthiran Subramaniam, 2012: Malaysia Climate Change Scenarios, Malaysian Academy of Science Series on Climate Change.
Yue, S., P. Pilon and G. Caradias, 2002: Mann-Kendall and Spearman's rho tests for detecting monotonic trends in hydrological series, J. Hydrol.: 254-271.

DROUGHT AND ITS IMPACTS IN CHINA

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The surface wetness index, Palmer drought severity index and the retrieval of soil moisture over China were calculated using monthly precipitation and monthly mean surface air temperature. Based on the contrast analysis of the variation of the above three indices and precipitation, the dry/wet spatio-temporal pattern of northern China in the last 54 years was revealed, and the evidence of drying trend over northern China was analyzed, especially. The results show the following four facts: (1) The drying trend is the main characteristic of the eastern part of Northwest China and the central part of North China since the 1980s and it was enhanced in the last 15 years mainly due to the precipitation decrease and the temperature increase; (2) During the last 54 years, there was only one dry/wet shift at the interdecadal scale occurring in the eastern part of Northwest China and the central part of North China in the late 1970s, which was related to 1977/1978 global abrupt change, whereas there were three shifts in Northeast China, one was in the mid of 1990s and the other two were in 1965 and 1983, respectively; (3) Unlike the variation trend of other sub-regions of northern China, the western part of Northwest China is currently located in a relatively wetting period, which is weakened due to the temperature increase; (4) The extreme drought frequency is obviously increasing in the eastern part of Northwest China, the central part of North China and Northeast China since the 1980s, which is closely related to the precipitation decrease and temperature increase in these sub-regions.

Based on monthly precipitation and monthly mean surface air temperature (SAT), the dry/wet trendsand shift of the central part of North China and their relationship to the Pacific Decadal Oscillation (PDO)from 1951 to 2005 have been analyzed through calculating surface wetness index (SWI). The resultsindicate that there was a prominent drying trend and an abrupt change in the analysis period. A persistentwarming period with less precipitation from the mid and late 1970s to present was found, and ashift process exists from the wet to the dry in the central part of North China during 1951-2005. Thetransition is located in the mid to late 1970s, which should be related to the shift variation of large-scaleclimate background. The correlation analysis has brought about a finding of significant correlativitybetween PDO index (PDOI) and SAT, precipitation and SWI in this region. The correlation exhibits thatthe positive phase of PDOI (warm PDO phase) matches warming, less precipitation and the droughtperiod, and the negative PDOI phase corresponds to low SAT, more precipitation and the wet period.The duration of various phases is more than 25 years. The decadal variation of sea surface temperature(SST) in the North Pacific Ocean is one of the possible causes in forming the decadal dry/wet trend andshift of the central part of North China.
Finally, we give the impacts of droughts on agricultural production and water resource across China.

References

Dai A G, Trenberth K T, Qian T T. A global dataset of Palmer droughtseverity index for 1870-2002: relationship with soil moisture and effects of surface warming. J Hydrometeorol, 2004, 5: 1117-1130
Ma Zhuguo, Fu Congbin, Some evidences of drying trend over North China from 1951 to 2004: Chinese Science Bulletin, 2006, 51(23): 2913-2925
Ma Zhuguo, The interdecadal dry/wet trend and shift of North China and their relationship to the Pacific Decadal Oscillation (PDO), Chinese Science Bulletin, 2007, 52(15): 2130-2139
Mantua N J, Hare S T.The Pacific decadal oscillation. J Oceanogr,2002, 58: 35-44

EXPLORING AEROSOL-CLOUD LINKS IN DROUGHTS AND FLOODS OVER SOUTHERN INDIA

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The past decade witnessed severe drought waves in many districts of southern India and farmer suicides were reported from the state of Andhra Pradesh. In order to augment precipitation over the rain shadow region of this state, a suite of seeding experiments were conducted during 2008. Calcium Chloride was released from aircraft-based hygroscopic flares into cloud bases. Clouds were then seeded at altitudes between 1200 to 2500 metres above the mean sea level. Precipitation enhancement was indeed observed for many cases (Samaddar et al 2012). For example, during August 2008 the percentage of Rainfall attributed to cloud seeding operations in 12 disctricts of Andhra Pradesh was of the order of 18% with a cost of approximately 500,000 USD. For a developing nation the seeding costs are substantial. It was observed that these seeding experiments were not preceded by any aerosol-cloud microphysical modelling studies to consolidate optimal aerosol size distributions- in this paper we present detailed aerosol-cloud process modelling analyses to prescribe the most suitable size distributions vis-à-vis the prevailing dynamics. From an examination of the post seeding flight log, it was ascertained that the cloud base temperatures were around 20oC-ensuring the preponderance of warm rain microphysics. A detailed parcel model, with resolved microphysics was used to study the condensational growth of droplets from an observed aerosol spectrum released from the flares. The model used is one of the most sophisticated models of its kind with the capacity of handling multi-component aerosols (Ghosh et al 2007; Rap et al 2010). Repeated modeled runs consolidated the most favourable conditions during cloud seeding for the conversion of dry aerosol particles into cloud condensation nuclei (CCN). Modified Kohler Theory was invoked to ascertain activation diameters. The growth rate depended sensitively on dry aerosol particle size, updraft speed, pressure, temperature and relative humidity. Both modelling and the seeding operations showed that since the size of seeded particle were smaller than natural air-borne salt particles; the efficiency of precipitation augmentation was much curtailed. Times of onset of precipitation were calculated from analytical solutions using an optimized Kessler scheme (the preferred scheme in most Large Eddy Simulations and Climate models) scheme. Observed precipitation rates, and onset times compare favourably with modelled results.

Indian media is currently awash with claims that climate change induces extreme weather patterns. This being a sensitive issue, the subsequent focus of the paper concerns large scale flooding associated with tropical storms over the Bay of Bengal. A large number of cyclones form over this region severely affecting the coastal regions of India, Bangladesh and Myanmar. These cyclones are responsible for property damage, agricultural crop destruction, and severe loss of human life (Paul 2010). A tropical disturbance was first reported on December 23rd, 2011, by the Joint Typhoon Warning Center (JTWC) to the east of Indonesia. Over the course of the next five days the depression developed into a severe cyclonic storm as the wind speed picked up to a maximum of 150 km h-1. The cyclone, on 30th December, made landfall on the eastern coast of India resulting in a death toll of 46 and heavy damage to public property. An ENVISAT image analysis is coupled with Large Eddy Simulation (LES) runs to study the growth, progression, and dissipation of Thane. The ENVISAT analysis shows a cloud cover increase exceeding 197.5% as compared to the usual northeast monsoon cloud covers. The large cloud cover resulted in high precipitation rates over a large spatial extent. The LEM analysis shows high mean winds of the order of 20 m s-1 over Chennai city and a succession of strong up draughts and downdraughts indicating very vigorous convective activity. Interestingly, the LESs show large velocities but low to moderate wind shear ensuring that the severe cyclonic activity was not blown apart even at land fall close to Chennai. Since cyclonic storms are sensitive to precipitation forming processes, the paper analyses how cloud condensation nuclei (CCN) weaken storms by slowing down the conversion of cloud drops into precipitation.

References:

Ghosh, S, Smith, M. H., and Rap, A.: Integrating biomass, sulphate and sea-salt aerosol responses into a microphysical chemical parcel model: implications for climate studies, Phil. Trans.
Roy. Soc. A., 365, 2659–2674, 2007.
Rap, A., Ghosh, S., and Smith, M. H.: Shepard and Hardy Multiquadric Interpolation Methods for Multicompon Aerosol-Cloud Parameterization, J. Atmos. Sci., 66, 105–115, 2009.
Paul, B.: Human injuries caused by Bangladesh's Cyclone Sidr: an empirical study. Natural
Hazards, 54, 483-495, 2010
Samaddar, A., Roohani, Y., Ghosh, S. and Rao, B.V. : Microphysical Characterisation of cloud seeding experiments in India. International Conference on water resources (ICWR) in conjunction with the 20th UNESCO-IHP Regional Steering Committee meeting for SE Asia and the Pacific, Malayasia, 2012

THAILAND FLOODS 2011: CAUSES AND SHORT & LONG TERM MEASURES

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During July-November 2011, Central Plain of Thailand suffered from the serious flooding started from July in the northern area and the flood went downward to middle area and near Bangkok area in September and October. It was the first time that flood water reached the inner city of Bangkok and caused flash flood to many main industrial estates in the suburb of Bangkok. The damages of this flooding was estimated to be more than ten times of the previous major past flooding especially to the industrial sector and in the ranking number four of disaster damage in the world. The floods also induced huge impacts to the world's insurance and hard disk industries.

Hydrological data were collected and analysed to investigate the flow peak and volume compared with the past flood events and regulating rules. The investigation on flooding causes were also conducted via interviews, field visit and data collection. Thai Government had set up a strategic committee and working teams to review and draft the long and short term flood prevention measures which included operational rule of main dams for flood fighting. Some measures had been implemented to counter this year possible flood event.

The study summarized the hydrological analysis and the causes of flooding. The Government's short & long term measures and operational rules of flood fighting were reviewed and commented.

KEYWORDS: floods, causes, short, long term, measures, operational rule, flood fighting

DEALING WITH GEOHAZARDS IN A CHANGING CLIMATE CHANGE

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Introduction

The Hyogo Framework for Action (HFA) encompasses disasters triggered by geological hazards, hydrometeorological hazards, biological hazards, technological hazards and environmental degradation (UNISDR 2005). Hazardous events are different from hazardous processes (Schimidt-Thome 2006). Hazardous events are intense events that cause abrupt situational change over a specific period of time, which then reverts back to normal. The event is generally measurable with specific start and ending times. Examples include earthquakes, tsunamis, volcanic eruptions, landslides, floods, storms and forest fires. In contrast, hazardous processes are insidious and relatively slow, permanent or long lasting with unclear start and ending times. Examples of such processes are erosion, soil degradation, desertification and climate change. Events and processes are distinguished by their location, intensity, frequency and probability and they may be interrelated depending on the circumstances. The risk of a disaster may increase if a hazardous process influences a hazardous event or vice versa. Climate change is a process that influences all hydrometeorological hazards. Generally, geological hazards are not influenced by climate change. However, landslides and subsidence are to a certain extent influenced by the water table level that is sensitive to rainfall which is in turn susceptible to climate change. Depending on the circumstances, biological hazards, technological hazards and environmental degradation may also be influenced by climate change.

The Intergovernmental Panel on Climate Change released its Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) in early 2012. The SREX documents findings from the assessment of scientific literature on issues that range from the relationship between climate change and extreme weather and climate events ("climate extremes") to the implications of these events for society and sustainable development. The SREX presents evidence that parameters such as warming of extreme daily minimum and maximum temperatures; intensification of extreme precipitation; and increasing extreme coastal high water levels due to increase in mean sea level have changed as a result of anthropogenic influences, including increases in atmospheric concentrations of greenhouse gases. However, the link between single extreme events to anthropogenic climate change has not been established.

Susceptibility, Exposure and Vulnerability

The definition of vulnerability in the SREX has been modified to harmonise its usage between the disaster management and climate change adaptation communities. In the Fourth Assessment Report of the IPCC, vulnerability refers to "The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes". This definition of vulnerability includes both the physical aspects i.e. causes and its impacts; as well as the social context as expressed by concepts such as exposure, sensitivity and adaptive capacity. Vulnerability has been defined as in the SREX as "The propensity or predisposition to be adversely affected". This definition of vulnerability separates the physical aspects and emphasizes explicitly its social context.

The concept of vulnerability now has more clarity when juxtaposed with susceptibility, exposure, adaptive capacity. Susceptibility is described as the "physical predisposition of human beings, infrastructure and environment to be affected by a dangerous phenomenon due to lack of resistance and predisposition of society and ecosystems to suffer harm as a consequence of intrinsic and context conditions making it plausible that such systems once impacted will collapse or experience major harm and damage due to the influence of a hazard event". Exposure refers to "The presence of people, livelihoods, environmental services and resources, infrastructure, or economic, social, or cultural assets, in places that could be adversely affected"; and adaptive capacity is "The combination of the strengths, attributes, and resources available to an individual, community, society, or organisation that can be used to prepare for and undertake actions to reduce adverse impacts, moderate harm, or exploit beneficial opportunities".

The simplicity of explanations in the SREX paves the path for developing a conceptual framework that addresses disaster risk management and climate change adaptation. The conceptual framework has to take into account the spatial context as well as existing and future susceptibility, exposure and vulnerability, in addition to projected climate and impacts. It should also draw on the best available science in the country, ranging from the atmospheric, geological, biological, chemical, and engineering to the social sciences and humanities.

Given the limitations in Malaysia, the focus should be on starting point adaptation to identify no-regret options that strengthen disaster risk reduction, in conjunction with stakeholder engagement (Pereira et al. 2012a). Research is required to produce tools that support decision-making at appropriate scales. One potential tool is the geological terrain assessment conducted by the Minerals and Geoscience Department of Malaysia (Pereira et al. 2012b). In order for terrain assessment to be more relevant to climate change adaptation, the current information on susceptibility, which represents the intrinsic weakness of a system, has to be expanded (Pereira & Ng 2010). The assessment has to include potential interaction with climate related stressors. The priority should be to delineate areas that highly susceptible to hazardous events particularly in the wake of climate change, including climate variability and extremes.

References

IPCC 2007, 'Climate change 2007: impacts, adaptation and vulnerability', in Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E.(eds), Cambridge University Press, Cambridge, UK. 976 pp.

IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Field, C. B., Barros, V., Stocker, T.F., Qin, D., Dokken, D., Ebi, K.L., Mastrandrea, M. D., Mach, K. J., Plattner, G.-K., Allen, S. K., Tignor, M. and Midgley P. M. (eds.), Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 582 pp.

Pereira, J.J. & Ng, T.F. 2010, 'Climate-resilient development in urban areas — a perspective from Malaysia', in Proceedings of the 9th International Symposium on "New Technologies for Urban Safety of Megacities in Asia (USMCA 2010)", The University of Tokyo, Kobe, Japan.

Pereira, J.J., Tan, C.T, Lian, K.F. & Shahril Faizal A.J., 2012a. Strengthening the Capacity for Policy Research on Mainstreaming Adaptation to Climate Change – A Malaysian Perspective. Presentation at APN and START Science-Policy Dialogue: Meeting the Challenges and Opportunities of Climate Change - Vulnerability, Adaptation and Risk Management, 19-21 July 2012, Bangkok.

Pereira, J.J. Komoo, I, Tan, C.T., Che Moin, U. & Lian, K.F. 2012b. Climate Change and Disaster Risk Reduction. Academy of Sciences Malaysia, Kuala Lumpur 16 pp.

Schmidt-Thome, P 2006, Integration of natural hazards, risks and climate change into spatial planning practices, Geological Survey of Finland, Espoo.

UNISDR 2005, 'Hyogo framework for action, 2005–2015', in Building the Resilience of Nations and Communities to Disasters, UNISDR, Geneva.

BEYOND GREENHOUSE GASES: DIRECT HYDROCLIMATIC CONSEQUENCES OF MEGAPOLITAN EXPANSION

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The world's urbanized regions are expected to add more than 2.5 billion new inhabitants by 2050. Meeting the rising demand of urban infrastructure will require substantial conversion of natural to built environments, resulting in newly developing and rapidly expanding megapolitan areas. The emerging vulnerability of urban inhabitants to the twin forcing agents of global climate change and impacts arising from built environment growth requires assessment to begin prioritizing effective adaptation and mitigation strategies aimed at offsetting harmful consequences.

We use the rapidly ex panding Sun Corridor as a case study to investigate direct hydroclimatic consequences of rapidly urbanizing megapolitan complexes and their relation to global climate change. The Sun Corridor is the most rapidly growing megapolitan area in the United States, and is composed of four metropolitan areas in Arizona (USA): Phoenix, Tucson, Prescott and Nogales. We use scenario-based projections of Sun Corridor growth through 2050 in conjunction with the WRF modeling system, coupled to an urban canopy model, to explore direct climate consequences of rapidly urbanizing megapolitan complexes.

Multi-year, ensemble-based simulations are conducted over the continental US with a low Sun Corridor expansion scenario (SUNCORR_Lo), and a high Sun Corridor expansion scenario (SUNCORR_Hi), and are compared to a modern day representation of the urban complex. In addition, one adaptation approach (SUNCORR_Ad) is conducted, identical to SUNCORR_Hi in every respect except for the incorporation of highly reflective "cool roofs".

Results show that locally greatest summertime warming due to expansion to SUNCORR_Hi approaches 4°C, with urbanizing regions primarily experiencing a 3-4°C increase in near-surface temperature. The incorporation of cool roofs reduces this warming by about half, while a reduced expansion scenario illustrates similar magnitude warming as SUNCORR_Ad. Relative to warming owing to increased levels of greenhouse gases (LLGHGs), expansion to SUNCORR_Hi induces temperature increases at least two or three times greater through mid-century, highlighting the importance of incorporating land-based adaptation and mitigation strategies that extend beyond greenhouse gases. The particular contribution of urban-induced warming relative to LLGHGs, however, is critically dependent on urbanization paths and emissions scenarios.

Finally, we demonstrate the importance of assessing such impacts beyond a mere focus on mean temperature and argue in favor of policies targeting sustainable expansion that includes consequences for the entire climate system (e.g., to include consequences for the regional hydrologic cycle).

References and Further Reading

Georgescu, M., M. Moustaoui, A. Mahalov, and J. Dudhia (2011), An alternative explanation of the semi-arid urban area "oasis effect", J. Geophys. Res., 116, D24113, doi: 10.1029/2011JD016720.

Georgescu, M., M. Moustaoui, A. Mahalov, and J. Dudhia (2012), Summertime Climate Impacts of Projected Megapolitan Expansion in Arizona, Nature Climate Change, doi: 10.1038/nclimate1656.

Georgescu, M., A. Mahalov, and M. Moustaoui (2012), Seasonal Hydro-Climatic Impacts of Sun Corridor Expansion, Environmental Research Letters, In Revision.

THE EFFECT OF CLIMATE CHANGE ON LONG WAVES PROPAGATING ONSHORE

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Climate change and anthropogenic factors are having a major impact on the near shore topography. The two effects which will be considered in this talk will be an increase in sea levels and an increase in sea temperatures. Sea levels are increasing due to 1) thermal expansion and 2) melting of trapped water in glaciers and icebergs. Sea levels are due to increase by as much as 0.6m by 2100 (IPCC 2007), which can increase the distance up a beach that a wave has to travel by about 30m for a typical beach of slope α=0.02. The second climatic change which will be considered is that sea temperatures are increasing by as much as 1.1 C at the sea surface (Roemmich et al. 2012), which can result in coral reefs being severely degraded (Selig et al. 2012). This, in combination human influences such as coral reef mining can completey destroy coral reefs, which can result in increased tsunami inundation due to decreased drag and jetting effects, Fernando et al. (2008). The effects of this were seen during the 2004 Boxing Day tsunami in Sri Lanka, where inundation levels, where blast mining was prevalent, were far greater than in regions where this practice did not occur.

In this work, high resolution 2D numerical simulations of the Navier-Stokes equation are carried out to look at a solitary wave's momentum and energy as it propagates in typical near shore topography. The geometries which will be considered are a wave propagating over uniform depth and then interacting with a submerged semi-circular cylinder and secondly a shoaling solitary wave interacting with a submerged semi-circular cylinder. Baseline simulations with no obstacles present are carried out to highlight the effect of the obstacles. Integral measures such as momentum and energy are extracted by accurately calculating sensitive boundary and domain integrals. Morison's semi-empirical equation, which splits the force on an obstacle into drag, inertial and hydrostatic pressure differences (due to an asymmetry of the wave height across the obstacle) gives a leading order estimate for the force on an obstacle. The force on the obstacle is split into its viscous and pressure components and it is found that the pressure contribution is far greater than the viscous contribution. For a shoaling wave, the significant effect of the horizontal component of the hydrostatic pressure force on the horizontal momentum can be well predicted by the mass of the wave over the shoaling region. This shows that even for inviscid shoaling solitary waves, horizontal momentum is not conserved. As the shoaling solitary wave steepens and increases in height, it would be expected that the potential and kinetic energy would increase and decrease respectively. However, the fluid elements local to the crest of the wave are accelerated to approximately four times the fluid particle velocity over uniform depth resulting in the kinetic and potential energy increasing and decreasing respectively Qualitative diagnostics such as the normalized second invariant of the velocity gradient tensor (which distinguishes between irrotational, shearing and vortical flow regions) and vorticity are used to help interpret the flow field.

Bibliography:

IPCC. (2007). Fourth assessment report.

Fernando, H.J.S., Samarawickrama, S.P., Balasbramanian, S., Hettiarachchi, S.S.L. & Voropayev, S.I. (2008) Effects of porous barriers such as coral reefs on coastal reefs on coastal wave propagation. J. Hydroenvironmental Res. 1, 187–194.

Roemmich, D., Gould, W.J., & Gilson, J. (2012) 135 years of global ocean warming between the Challenger expedition and the Argo Programme. Nature Climate Change. DOI: 10.1038/nclimate1461

Selig, E.R., Casey, K.S., & Bruno, J.F. (2012) Temperature-driven coral decline: the role of marine protected areas. Global Change Biology. 18, 1561–1570.

QUADTREE FLOOD SIMULATIONS WITH SUB-GRID DIGITAL ELEVATION MODELS

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Flooding is an increasing hazard to society. Good governance nowadays implies careful water management in terms of design, planning and control of urban and rural areas. This requires that rainstorms, extreme water levels, etc. are taken into account with relevant precision. A great aid is the existence of Graphical Information Systems with raster based Digital Elevation Models. Due to modern technology, like LIDARWIKI, DEM are of ever increasing resolution. In this contribution we describe how, without adaptations, DEM can be used efficiently for detailed 2D flooding simulations. The method is based on four components: (1) sub-grid method (Casulli, 2009 or Casulli and Stelling, 2011), (2) bottom friction derived from the divided channel method. (e.g. Sturm, 2010) (3). finite volume staggered grid method for Shallow Water Equations with rapidly varied flows (Stelling and Duinmeijer, 2003) and (4) quadtrees (e.g. Wang, Borthwick and Eatock Taylor, 2003)

Cartesian grids have many advantages like simple numerical equations while generating suitable meshes is relatively quick and can be fully automated. But the accurate representation of arbitrary land water boundary outlines is often a problem. Land water interfaces vary in type. Steep walls, like quays and dikes, do not move in space as the water level changes. Here finite elements and unstructured grids might be a better solution. However for land/water boundaries that move horizontally as well, like tidal flats, river banks with mildly sloping bottoms or overland flow, every method faces similar problems. The last decades have shown a resurgence of Cartesian grids for CFD. The classical disadvantage has been largely removed by proposing flow solvers, such as cut cell , immersed boundary method, quadtrees, etc. that deal with moving and arbitrary boundaries (e.g. Aftosmis, Berger and Melton, 1998, Causon, Ingram, Mingham, 2001, Mittal and Iaccarino, 2005, Rosatti, Cesari and Bonaventura, 2005). Another development of the last decades is by raster based Digital Elevation Models of ever-growing resolution. These DEMs are often applied in flooding simulations (e.g. P.D. Bates and A.P.J. de Roo, 2000, Horritt and P.D. Bates, 2001, Marks and Bates 2000). In some papers detailed bathymetric data is used as sub-grid (Bates, 2000, Yu and Lane, 2006) that is taken into account by some kind of porosity (Cea and Vazquez-Cendon, 2010, Sanders, J.E. Schubert and H.A. Gallegos, 2008). The effect on bottom friction of sub-grid depth variation inside a coarse grid cell, might be accounted for by the definition of the so-called "effective depth (Defina 2006, Yu and Lane, 2006). Casulli (2009) and Casulli and Stelling (2011) apply detailed sub-grid data in combination with unstructured grids, both for 2D and 3D flow equations. This approach combines the advantages of accurate representation of both sharp and mild land/water interfaces. Casulli (2009) explains the non-linearity of the continuity equation due to the sub-grid combined with flooding and drying. Brugnano and Casulli (2009) give a rigorous proof of convergence of the Newton method for a sparse system of non-linear equations if the wet surface is a non-decreasing function of the water level. Flooding problems may contain different flow types within one domain such as: overland flow and rapidly varied flow due to dam break and/or dam overflow. Rapidly varied flow is often simulated with Godunov type of methods (Begnudelli, Sanders and Bradford, 2008, Cea and Vazquez-Cendon, 2010, Liang, Borthwick and Stelling, 2004) These methods however are often not very efficient for overland flow and flow in deeper water due to explicit time integration and time consuming computational procedures on non-staggered grids. Stelling and Duinmeyer (2003), Kramer and Stelling (2008) and Kernkamp, Van Dam and Stelling (2011) describe a semi-implicit method that is reasonably accurate and efficient for a variety of situations such as rapidly varied flow, overland flow and flow in normal conditions such as rivers, estuaries and coastal seas.

In our contribution we combine the best of the afore mentioned literature. Our method is based on four components: (1) sub-grid method including flooding and drying of Casulli(2009), (2) bottom friction based on the concept of roughness depth, described in this paper (3). finite volume staggered grid method for Shallow Water Equations with rapidly varied flows (Stelling and Duinmeyer, 2003) including semi-implicit time integration (Casulli and Walters 2000) and (iv) quadtrees (e.g. Wang, Borthwick and Eatock Taylor, 2003)

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First we define our grids. Then we describe the integration of a fine raster grid, the DEM, with a Cartesian coarse grid. For this goal we use indicator functions to get approximating step functions with a continuous domain. The result is suitable for the application of a finite volume method. The local variation of the bottom within a coarse grid cell requires special attention for friction. For overland flow this is a dominant aspect of the momentum balance. The notion of roughness depth will be defined here to account both for depth- and roughness variation. Advection of momentum is applicable to rapidly varied flows, like dam overflow. The implicit time integration includes non-linear implicit equations suitable for flooding and drying is. We will show that a sufficiently refined sub-grid can represent both sharp and soft land/water interfaces with satisfactory accuracy, similar to cut-cells. We also show some practical examples of very efficient flood assessment in The Netherlands with the approach outlined in this contribution.

References

Alkema, D. and H. Middelkoop (2005), The Influence of Floodplain Compartmentalization on Flood Risk within the Rhine–Meuse Delta, Natural Hazards 36: pp 125–145.

Aftosmis, M.J., M.J. Berger and J.E. Melton (1998), Robust and efficient Cartesian mesh generation for component-based geometry, AIAA JOURNAL, 36,6, pp 952-960.

Bates, P.D. and A.P.J. De Roo (2000), A simple raster-based model for flood inundation simulation, Journal of Hydrology 236 pp. 54–77.

Bates, P. D. (2000), Development and testing of a sub-grid-scale model for moving boundary hydrodynamic problems in shallow water, Hydrological Processes, 14,pp 2073-2088.

Begnudelli, L. , B. F. Sanders and S. F. Bradford (2008), Adaptive Godunov-Based Model for Flood Simulation, Journal of Hydraulic Engineering, Vol. 134, No. 6.

Brugnano, L. and V. Casulli (2009), Iterative solutions of piecewise linear systems with applications to flows in porous media, SIAM J. Sci. Comput., 31-3, pp 1858-1873.

Carrivick, L. (2006), Application of 2D hydrodynamic modelling to high-magnitude outburst floods: An example from Kverkfjoll, Iceland, Journal of Hydrology 321, pp187–199.

Casulli, V. and G.S. Stelling (2011), Semi-implicit sub-grid modelling of three-dimensional free-surface flows, Int. J. Numer. Meth. Fluids, Volume: 67, Issue: 4, Pages: 441-449.

Casulli, V. (2009), A high-resolution wetting and drying algorithm for free-surface hydrodynamics, Int. J. Numer. Meth. Fluids; 60:391–408.

Casulli, V. and R.A. Walters (2000), An unstructured grid, three-dimensional model based on the shallow water equations, Int. J. Numer. Meth. Fluids; 32: 331–348.

Causon, D.M. and M. Ingram (2001), A Cartesian cut cell method for shallow water flows with moving boundaries, Advances in Water Resources,24, pp 899-911.

Cea, L. and M. E. Vazquez-Cendon (2010), Unstructured finite volume discretization of two-dimensional depth-averaged shallow water equations with porosity, Int. J. Numer. Meth. Fluids; 63:903–930.

Defina, A. (2000), Two dimensional shallow flow equations for partially dry areas, Water Resources Research, 36-11, pp 3251-3263.

Hesselink, D.M, G.S. Stelling, J.C.J. Kwadijk and H. Middelkoop (2003), Inundation of a Dutch river polder, sensitivity analysis of a physically based model with historic data, Water Resources, 39 (9): art. no. 1234.

Horritt, D.M. and P.D. Bates (2001), Effects of spatial resolution on raster based models of flood flow, Journal of Hydrology,253, pp 239-249.

Kernkamp, H.W.J., A. van Dam, G.S. Stelling and E.D. de Goede (2011), Efficient scheme for the shallow water equations on unstructured grids with application to the Continental Shelf, Ocean Dynamics, 61-8, pp 1175-1188.

Kramer, S. C. and G. S. Stelling (2008), A conservative unstructured scheme for rapidly varied flows, Int. J. Numer. Meth. Fluids (2008), Volume: 58 Issue: 2 Pages: 183-212.

Liang, Q., A. G. L. Borthwick and G.S. Stelling (2004), Simulation of dam- and dyke-break hydrodynamics on dynamically adaptive quadtree grids, Int. J. Numer. Meth. Fluids, 46:pp: 127–162.

Marks, K. and P. Bates (2000), Integration of high-resolution topographic data with floodplain flow models, Hydrological Processes, 14, pp 2109-2122.

Mittal, R. and G. Iaccarino (2005), Immersed Boundary Methods, Annu. Rev. Fluid Mech. 37:239–61, 2005

Poretti, I. and M. De Amicis (2011), An approach for flood hazard modelling and mapping in the medium Valtellina, Natural Hazards and Earth System Sciences, 11, 1141–1151.

Rosatti, G., D. Cesari and L. Bonaventura (2005), Semi-implicit, semi-Lagrangian modelling for environmental problems on staggered Cartesian grids with cut cells, Journal of Computational Physics 204 pp 353–377.

Sanders, B.F., J.E. Schubert and H.A. Gallegos (2008), Integral formulation of shallow-water equations with anisotropic porosity for urban flood modeling, Journal of Hydrology, 362, 19– 38.

Stelling, G.S., and S.P.A. Duinmeyer (2003), A staggered conservative scheme for every Froude number in rapidly varied shallow water flows, Int. J. for Num. Meth. in Fluids,.43;1329-1354..

Stelling, G.S. and A. Verwey (2005), Numerical Flood Simulation, Encyclopedia of Hydrological Sciences I, pp 257–270.

Sturm, T.W.(2010), Open channel hydraulic, second edition, McGraw Hill.

Tarekegn, T. H., A.T. Haile, T. Rientjes, P. Reggiani, D. Alkema (2010), Assessment of an ASTER-generated DEM for 2D hydrodynamic flood modeling, International Journal of Applied Earth Observation and Geoinformation 12, pp 457–465.

Wang, J.P., A.G.L. Borthwick and R. Eatock Taylor (2003), Finite-volume type VOF method on dynamically adaptive quadtree grids, Int. J. Numer. Meth. Fluids; 00:1-22.

Ye T., R. Mittal, H. S. Udaykumar and W. Shyy (1999), An Accurate Cartesian Grid Method for Viscous Incompressible Flows with Complex Immersed Boundaries, Journal of Computational Physics 156, 209–240.

Yen B.C. (2002), Open Channel Flow Resistance, Journal of Hydraulic Engineering, Vol. 128, No. 1, pp 20-39.

Yu, D. and S. N. Lane (2006), Urban fluvial flood modelling using a two-dimensional diffusion-wave treatment, part 1: mesh resolution effects, Hydrol. Process. 20, 1541–1565.

Yu, D. and S. N. Lane (2006), Urban fluvial flood modelling using a two-dimensional diffusion-wave treatment, part 2: development of a sub-grid-scale treatment, Hydrol. Process. 20, 1567–1583.

THE IMPACTS OF CLIMATE CHANGE IN LAO PDR

Ella Marley-Zagar
Lao PDR

Lao PDR has a high exposure, high sensitivity and low adaptive capacity to climate change (ADB, 2009). This is largely due to the fact that 80% of the Lao population rely on agriculture for their livelihood; with poor and disadvantaged groups unable to adapt to a shifting climate events. Extreme weather events and flooding have presented a serious issue for the livelihoods and welfare of the Lao people. Floods in the South of Lao PDR during the monsoon season last year caused a reported 34 people to lose their lives, 64,400 rice paddy fields to be destroyed and 140,000 homes to be under water.In the years 2000 to 2009, the total cost of flood damage in Lao PDR was USD 322.8 million (APFM, 2011). Hoanh et al. (2004) conducted an analysis of the impact ofclimate change scenarios on the flow of the Mekong River, and estimated a 16-19 percent increase in the delta maximum monthly flows, which indicates there will be more regular floods than those experienced in the south of Lao PDR last year. Minimum monthly flows in the Mekong delta were estimated to decrease by 26 – 29 percent (Hoanh et al. 2004), which will likely result in water shortages for crop irrigation and freshwater supplies during winter months. Chinvannoet. Al (2006) have identified midseason dry spells as the main risk for damaging young plants, and late-season floods before harvest as severely damaging to crop yields. Fisheries will also be affected by climate events in Lao PDR, due to the changing patterns of precipitation and snow melt, which will affect hydrology and water quality (Easterling et. al, 2007). Indirect negative effects will also arise from a change in vegetation patterns, which could alter the food chain and increase soil erosion. This will have an impact on the 1,000 species of fish commonly found in the river and the fisheries that it supports (MRC, 2003). In addition, air quality is a growing concern in the major cities of Lao PDR, especially the capital Vientiane. It is a generally held belief, by those in the Lao PDR Government and in International Agencies, that the air quality in Vientiane will deteriorate much like the cities in neighbouring countries, such as Bangkok (Thailand) and Hanoi (Vietnam). In fact, the United Nations Environment Programme and World Health Organisation have identified air quality in Vientiane as a potential issue for the future, which will be further intensified by the effects of climate change.

References

Asian Development Bank. 2009. Building Climate Resilience in the Agriculture Sector of Asia and the Pacific. Philippines: International Food Policy Research Institute, Asian Development Bank (ADB).

Associated Programme on Flood Management (APFM), 2011. An overview of consequences of floods in the LMB in the period 2000-2009 [Online].Available at: http://www.apfm.info/pdf/Hanoi_workshop/Floods_2000-2009_Inventory_NB.pdf.

Hoanh, C.T., H. Guttman, P. Droogers and J.Aerts, 2004: Will we produce sufficient food under climate change? Mekong Basin (South-east Asia). Climate Change in Contrasting River Basins: Adaptation Strategies forWater, Food, andEnvironment, J.C.J.H. Aerts and P. Droogers, Eds., CABI Publishing,Wallingford, 157-180.

Chinvanno, S., Souvannalath, S., Lersupavithanap, B., Kerdsuk, V. And ThiHienThuan, N. 2006. Climate risks and rice farming in the lower Mekong River countries.AIACC Working Paper No. 40. Available at: http://www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP40_Chinvanno.pdf.

Easterling, W.E., P.K. Aggarwal, P. Batima, K.M. Brander, L. Erda, S.M. Howden, A. Kirilenko, J. Morton, J.-F. Soussana, J. Schmidhuber and F.N. Tubiello, 2007: Food, fibre and forest products. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution ofWorking Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 273-313.

MRC, 2003: State of the Basin Report: 2003,Mekong River Commission, Phnom Penh, 300 pp.

IMPACTS OF NATURAL HAZARDS IN THE PHILIPPINES AND THE LATEST GOVERNMENT INITIATIVE TO ADDRESS RECURRING DISASTERS

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The Philippines being a locus of typhoons, tsunamis, earthquakes and volcanic eruptions, is a hotbed of disasters. Natural hazards inflict loss of lives and costly damage to property. Last year, the devastating impacts of Pedring, Quiel and Sendong resulted in a high number of fatalities with economic losses amounting to billions of pesos. Early this year a shallow focus 6.2 magnitude earthquake generated landslides that left 51 dead and 62 missing with total damage amounting toPhP363.5 million Situated in a region where climate and geophysical tempest is common, the Philippines will inevitably suffer from calamities similar to those experienced recently. With continued development and population growth in hazard prone areas, it is expected that damage to infrastructure and human losses would persist and even rise unless appropriate measures are immediately implemented by government.In response to President Aquino's instructions to put in place a responsive program for disaster prevention and mitigation, specifically, for the Philippines' warning agencies to be able to provide a 6 hour lead-time warning to vulnerable communities against impending floods and to use advanced technology to enhance current geo-hazard vulnerability maps, the Nationwide Operational Assessment of Hazards (NOAH) was launched by the Department of Science and Technology (DOST).NOAH's mission is to undertake disaster science research and development,advance the use of cutting edge technologies, and recommend innovative information services in government's disaster prevention and mitigation efforts. NOAH's immediate task is to integrate current disaster science research and development projects and initiate new efforts within the DOST to achieve this objective. Presently there are eight (8) component projects under the NOAH program, namely: 1) Hydromet Sensors Development, 2) LIDAR 3-D Mapping Project, 3) Flood NET-Flood Modeling Project, 4) Hazards Information Media, 5) Enhancing Geo-hazards Mapping through LIDAR, 6) Doppler System Development, 7) Landslide Sensors Development Project, and 8) Storm Surge Inundation Mapping Project. Initial efforts of Project NOAH include: deployment of weather-related sensors; use of state-of-the-art methods to construct high-resolution flood and landslide hazard maps that are relevant to the community; delivery of readily accessible, timely and accurate hazards information through various media and communication platforms; multidisciplinary disaster research and development; integration of disaster efforts by the national government, academe, civil society organizations and private sector; empowerment of Local Government Units (LGUs) and communities by providing access to near real-time data and information; and application of a bottom-up disaster prevention approach for more resilient communities.Through the use of science and technology and in partnership with the academe and other stakeholders, the government is taking a multi-disciplinary approach in developing systems, tools, and other technologies that could be operationalized by civil authorities to help prevent and mitigate disasters.

References:

ADRC,(2011) Asian Disaster Reduction Center GLIDE: TC-2011-000189-PH http://www.adrc.asia/ accessed July 8, 2012.

ASTII (2012) Automated Weather Station Manual. Department of Science and Technology Advanced Science and Technology Institute http://embedded.asti.dost.gov.ph/wp-content/uploads/downloads/2011/11/aws-user-manual.pdf

Elona, J. (2011) Damage due to Pedring and Quiel reaches P15 billion. Philippine Inquirer http://newsinfo.inquirer.net/ accessed July 8, 2012

Guba, G. (2012) Sensor network developments in ASTI.APAN 33rd conference. Thailand.

Halcrow, 2012 ISIS-2D case study.Modelling to support water management strategies in the low Pilcomayo river basin: Argentina-Paraguay.ISIS by Halcrowhttp://www.halcrow.com/isis/ access July 8, 2012

Hutchinson, M.F. (1998) Interpolation of Rainfall Data with Thin Plate Smoothing Splines - Part I: Two Dimensional Smoothing of Data with Short Range Correlation. Journal of Geographic Information and Decision Analysis, vol. 2, no. 2, pp. 139-151

Jaboyedoff, M. (2002) Matterocking 2.0: A program for detecting rockslide instabilities.Crealp, Sion, http://www.crealp.ch.

Jaboyedoff, M. (2003) Conefall 1.0: A program to estimate propagation zones of rockfall, based on cone method. Quanterra, Lausanne, http://www.quanterra.ch

JMA (2012) MTSAT and its system.Satellite Program DivisionJapan Meteorological Agency. http://www.jma.go.jp/jma/jma-eng/satellite/about_mt_index.html accessed July 15, 2012

Lagmay, A.M.F. 2011. Policy notes on lessons learned from recent Philippine disasters.University of the Philippines Policy paper.

Marciano, J.,Zarco, M.A.H. Talampas, M.C.R. Catane, S.G., Hilario, C.G., Zabanal, M.A.B. , Carreon, C.R.C. , Mendoza, E.A. , Kaimo, R.N. , Cordero, C.N. (2011) Real-World Deployment of a Locally-Developed Tilt and Moisture Sensor for Landslide Monitoring in the Philippines. Global Humanitarian Technology Conference (GHTC), 2011 IEEE.10.1109/GHTC.2011.96

NDRRMC (2011a) Sitrep no. 13 Effects of typhoon "Quiel" as of 11 October 2011 (Nalgae) National Disaster Risk Reduction and Management Council

NDRRMC (2011b) Sitrep no. 26 as of 11 October , 2011 Effects of Typhoon Pedring (Nesat) National Disaster Risk Reduction and Management Council

NDRRMC (2011c) Sitrep no. 22 as of 20 February 2012 Effects of the 6.9 Earthquake in Negros Oriental National Disaster Risk Reduction and Management Council

O'Brien J.S. (2009) FLO-2D Users Manual, Version 2009.

PAGASA (2012) PAGASA Radar programme: Status and maintenance plan. Powerpoint presentation.

Paringit (2012) Dream Program Brief. UP TCGAP

Pack RT, Tarboton DG, Goodwin CG (1999) SINMAP—a stability index approach to terrain stability hazard mapping. SZ Terratech, Salmon Arm.

PcMag (2012) PC Mag Encyclopedia.The Computer Language Company Inc.

Tarboton GD (1997) A new method for the determination of flow directions and upslope areas in grid digital elevation models. Water Resour Res 33/2:309–319.

Rodolfo, K.S., 1995, Pinatubo and the Politics of Lahar: Eruption and Aftermath, 1991: Quezon City, Philippines, University of the Philippines Press, 340 pp. [Winner, National Book Award, science category.]

Sandra G.Catane, Mark Albert H. Zarco, Cathleen Joyce N. Cordero, Roy Albert N. Kaimo, Ricarido M. Saturay, Jr. (2011) Laboratory Experiments on Steady State Seepage-Induced Landslides Using Slope Models and Sensors Science Diliman, Vol 23, No 1 pp. 17-30

CLIMATE-RELATED DISASTERS IN SOUTH-EAST ASIA: NATURAL OR HUMAN INDUCED?

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South-East Asia (SEA) is particularly vulnerable to climate-related hazards, such as droughts, floods, and typhoons, which can be triggered by natural climate variability (e.g., El-Niño Southern Oscillation)or human-induced climate change or a combination of both. As a result of the warming trend, theSouth-East Asian countrieswith coastal and low-lying areas are also facing the threat of sea-level rise, and storm surges, which cause coastal erosion.

A hazard, whether natural or human induced, can become a disaster if there is a loss of human lives and/or a destruction of properties and ecosystems. Climate-related hazards are no exception. However, climate-related disasters have often been termed "natural" disasters.

This paper reviews three well-known climate-related disasters in South-East Asia: the 1997 forest fires and haze associated with a prolonged drought in Indonesia, the 2008 Cyclone Nargis in Myanmar and the 2011 6-month flood in Thailand. It examines the underlying factors that contribute to the scale and severityof these disasters, and concludes that these disasters were not entirely "natural" but caused by a combination of natural and human-induced factors.

STUDY OF IMPACTS, ADAPTATION AND MITIGATION OF GLOBAL WARMING ON PADDY FIELD, OF SIKEP SAMIN COMMUNITY PATI DISTRICT, CENTRAL JAVA, INDONESIA

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Global Warming

Global average of temperature on earth increased 0.74 ± 0:18° C over the past 100 years. Global warming affects patterns of precipitation, evaporation, runoff, soil moisture and climate variations are very volatile. Climatic aberrations such as heavy rainfall, triggering floods and landslides. Climatic aberrations such as low rainfall accompanied by an increase in air temperature, causing drought. Threaten the success of the overall food production.

Community of Sikep Samin, Sukolilo - Pati Central Java.

Community of Sikep Samin are groups of people who try to run their daily lives according to the teachings of Samin. This Community of Sikep Samin most are in the Bojonegoro, Lamongan, Blitar, Madiun East Java province and region Blora, Pati, Kudus, Central Java. In carrying out this teaching (since Samin Suryo Sentiko passing away in 1914 in exile in the city of Padang West Sumatra) Community of Sikep Samin have started to adapt to the changing times and not too rigid in running pure concept teaching. Community of Sikep Samin only working on agricultural activities and exerting to make ends meet.

Climate and Rainfall

Oldeman's climate classification devide by the number of rainfall in each month. Based on the sequence of wet and dry months with specific terms are sorted as follows: (1) wet when rainfal l > 200 mm, (2) humid when precipitation 100-200 mm, (3) dry when rainfall is < 100 mm. Climate A: If > 9 consecutive wet months. Climate B: If 7-9 consecutive wet months. Climate C: If 5-6 months of wet berurutan.Iklim D: If 3-4 consecutive wet months. Climate E: If < 3 consecutive wet months.

Cropping Patterns & Field Production

Cropping pattern arranged according to the needs of farmers. The choice of plants cultivated tailored to market needs. The determination of cropping patterns and crop heavily influenced the availability of water. Cropping pattern at different water deficit when the addition of water to do. Prevalent cropping pattern: (1) rice - rice - rice, (2) rice - rice - soybean, (3) rice - rice - bero, (4) rice - soybean – without plant, (5) rice - rice, (6) rice – soybean, (7) rice.

The basic method used in this research is descriptive method (deskriftive analysis) quantitative and qualitative quantitative analysis using correlation and multiple regression analysis with the following production function: Y = f (X1, X2, X3, X4, X5). Where Y = Production, Productivity = X1, X2 = Area planted, X3 = Area harvested, X4 = Month damp / humid and X5 = Adaptation to climate change.

Tables 1 and 2 show the comparison Sikep Samin community that can reduce the risks of climate change on rice plants. Rice crop productivity of Sikep Samin higher than the average productivity in Pati regency, Central Java.

Table 1: Impact of Climate Change on Rice Plant,
Pati District, Central Java

		2006	2007	2008	2009
Planting Broad (ha)	104480	280622	104018	109937	96277
Harvested (ha)	91277	92911	75131	94349	
Failed Harvest (ha)	13205	12289	28887	15587	
Flood (ha)	217	7234	2751	11398	8587
Flood (%)	0,21	8,89	2,64	10,37	
Drought (ha)	1.137	207	18.987	341	
Drought (%)	1,9	0,26	22,25	0,31	
Production (tons)	40654	459823	368025	541944	527903
Rate of Production		53283	-91789	175919	-152961
Rate of Production (%)		13.11	-19.96	47	-2.93

Table 2: Impact of Climate Change on Rice Plant,
Sikep Samin Community, Pati District, Central Java

	2005	2006	2007	2008	2009
Planting Broad (ha)	101.4	101.4	101.4	101.4	101.40
Harvested (ha)	93.288	94.302	87.204	90.246	90.25
Failed Harvest (ha)					
Flood (ha)	8.11	7.10	14.20	11.15	
Flood (%)	12.5	14.29	7.14	9.09	
Drought (ha)	0,3	0	0	0	
Drought (%)	0,3	0	0	0	
Production (tons)	764.96	773.3	715.07	740.02	740.02
Rate of Production		8.31	-58.20	24.94	0.00
Rate of Production (%)		1.08	-8.14	3.37	0.00

Pattern Adaptation and Mitigation of Climate Change

In dealing with climate change, Sikep Samin Commnities said that crop failure occurs manage to land his own fault. Land should be valued, respected and venerated as the mother who gave birth. Land that gave birth to life everything is well off from the beginning until now. For Sikep Samin Community , respect, nurture, and preserve the balance of nature is done by understanding the nature of which should only be used to taste (not greedy) to survive in life. If not, do not be surprised if that would set the balance of nature itself, such as the presence of flooding and landslides.

Sikep Samin Community now trying to return to organic farming methods without chemical fertilizers and pesticides. They make a liquid fertilizer ingredients derived from nature, the coconut water, water used to wash rice (Leri), Moringa leaves and banana stems, fermented with molasses for about a month. When dry climate people use river water from hundreds of springs that tipped in Kars Region G. Kendeng to meet irrigation needs. That is also why community of Sikep Samin with the very fight to againts environmental destruction that is and will be happening in Kars Region G. Kendeng, where spring comes.

Conclusion

Pati climate classification Oldeman including drier climates (E). Changes in climate (wet / humid) greatly affect rice production in Pati and Community Sikep Samin. Sikep Samin community better able to adapt to climate change compared to the farming community at large. Sikep Samin community to mitigate climate change are consistent with the farming community in general.

Keywords: Climatological hazard, Climate change mitigation and adaptation, Samin Sikep Community.

CLIMATE CHANGE AND CARBON DIOXIDE SEQUESTRATION

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U.K.

Global consumption of energy has quadrupled over the last fifty years and shows no sign of abating. Nearly 90% comes from the combustion of fossil fuels. As a consequence, anthropogenic emissions of 34 gigatonnes per year of carbon dioxide have led to an increase in the carbon dioxide content of the atmosphere from 315 to 385 parts per million from 1960 to 2012, and a concomitant increase of average global temperature by approximately 1^{o}C. A possible solution to this potentially disastrous imbalance is to store carbon dioxide by pumping liquid, or supercritical, carbon dioxide into porous reservoir rocks, such as depleted oil and gas fields and regional saline aquifers. The presentation will discuss the rate and form of propagation to be expected. It builds on theoretical and experimental investigations of input of liquid of one viscosity and density from a point source above an impermeable boundary, either horizontal or slanted, into a porous medium saturated with liquid of different viscosity and density. In the Sleipner natural gas field, in Norway carbon dioxide has been injected at the rate of ~ 1 Mt/yr since 1996. We will apply our results to interpret these field observations and suggest possible means of exploitation of these ideas in Asia.

NO REGRET MEASURES: RISK MANAGEMENT AND EARLY WARNING SYSTEMS FOR WEEKS TO YEARS AHEAD

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One of the strongest recommendations to reduce the negative impacts of climate change in the IPCC SREX report (IPCC, 2012) is the implementation of early warning systems to increase the lead time of warnings and deployment of protective measures, and the use of end-to-end risk management systems to reduce the exposure of vulnerable populations and environments to natural disasters.

These are defined as 'no-regrets measures' because, independently of the benefits they would bring in the future to mitigate the adverse effects of climate change, these systems are necessary now to reduce the negative impacts of severe weather (e.g. flooding and wind damage). In other words: they are an optimal strategy to adapt to climate change in the future because they improve our adaptation to climate variability today. Crucially, if high-impact weather events were to become even more frequent and intense than they currently are, the importance to manage the risks and provide early warnings of these events would increase even further.

A clear implication of this is that we need to extend the usefulness of our operational forecasts beyond a few days and into the period covering from one week to a few years ahead. However, until recently most of the efforts and resources in the weather and climate community have been focused in either short timescales (a few days ahead as typically done for Numerical Weather Prediction) or very long timescales (50-100 years ahead for Climate Change studies). This is changing rapidly though as people start recognising the importance of improving our forecasting capabilities for intra-seasonal to inter-annual predictions (also known as near-term climate predictions).

At the Met Office – a WMO designated Global Producing Centre for long-range forecasting – a new generation of operational forecasting systems for lead times between 1-week and a few years ahead have been developed including an important design feature: these forecasting systems are now fully integrated within our scientific and technical model development process. This allows us to implement improvements faster than any other centre world-wide. For example, we have increased the horizontal resolution of our seasonal forecasting system from 300 km in 2009 to 50 km in 2012.

Forecasting for long-range remains a notoriously difficult endeavour and the skill is limited but, as will be shown in this talk, when connected to early warning and risk management systems, these forecasting systems can provide useful guidance to disaster management and civil protection authorities.

THE IMPACT OF CLIMATE CHANGE IN MYANMAR

Tun Lwin
Myanmar Climate Change Watch

By using the climatological records and the Myanmar Daily Weather Reports (MDWRs) for the period from 1950 to 2010, the changes in Myanmar Monsoon Climatology and the behavior of extreme weather events have been investigated. Three phases of changes in weather are found. These are regarded as long term, medium term and short term changes.

Long term changes are observed in monsoon climatology as early as since 1978. Delayed onset, earlier withdrawal and shorter duration in rainy season comparing to the long-term average are the main features of changes in monsoon. In addition, other changes like substantial decrease in frequency of monsoon depressions, annual increase in annual temperatures and annual decrease in annual rainfalls are also the chief findings in the investigation.

As for the mid-term change, occurrence of adverse weather and the extreme events such as thunderstorms, tornados, flash floods, land slides, heavy falls, heat waves, are more frequent annually both in terms of intensity and frequency. Moreover, Myanmar has been struck by storms each and every last six years since 2006. Increase in fatalities caused by thunderstrikes has been reported every year. In some year more than 100 fatalities caused by thunderstrike are also reported. Ten to Fifteen tornados are reported every year since 2006.

The short-term changes are primarily the frequent occurrence of El Nino and La Nina events, which normally lasted for 12-18 months. In the past the El Nino and La Nina episodes occur with a periodicity of 5 to 7 years. However, starting from 1990s, they occur more frequently in almost every one to two years.

Thus, the country is experiencing impacts from the changes in Myanmar climate in increasing the adverse weather and the weather related disasters.

COASTAL LIVING IN ASIA: WILL THE RISKS BE GREATER IN A FUTURE WARMER CLIMATE?

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Geological (e.g. Woodruff et al., 2009; Lane et al., 2011; Nott, 2011), archaeological (e.g. Roland and Ulm, 2012) and historical evidence(e.g. Lee et al., 2012) have been used to investigate the periodicity of large tropical cyclone events in many parts of the world. In Asia this type of work is in its infancy however several recent studies clearly show the vulnerability of many Asian coastlines and their inhabitants (Yu et al. 2009; Switzer and Yu, in press). Unfortunately many Asian coasts are experiencing unprecedented rates of rapid coastal development much of which is on what are clearly vulnerable coasts e.g. low lying deltas (Syvitskiet al., 2009). In many cases this development is poorly regulated with little due diligence or consideration for future scenarios of sea level rise (e.g. Kemp et al., 2011),the response of coastlines to rising global temperatures (e.g. Mann et al., 2009) and the potential for changes in cyclone periodicity or intensity (e.g. Donnelly and Woodruff, 2007). Only through integrated programs that incorporategeological analysis of long-term recurrence intervalswith shorter records from historical archives, archaeology and indigenous knowledge the task of developing affective planning policies, risk analysis and insurance pricing will likely remain ineffective. The development of such programs is timely and essentialif we are to help our rapidly developing Asian societies avoid some of the mistakes of the past.

References

Donnelly J.P. and Woodruff J.D. 2007, Intense hurricane activity over the past 5,000 years controlled by El Nino and the West African monsoon. Nature, 447, 465-468.

Kemp A.C., Horton, B.P., Donnelly, J.P., Mann, M.E., Vermeer, M. and Rahmstorf, S. 2011, Climate related sea-level variations over the past two millennia. Proceedings National Academy Sciences, 108, 11017-11022.

Lane P., Donnelly, J.P., Woodruff, J.D. and Hawkes, A. 2011, Adecadally-resolved paleohurricane record archived in the late Holocene sediments of a Florida sinkhole.Marine Geology, 287, 14-30.

Lee, Y.S, Yu, F., Switzer, A.D., Gouramanis, C., Lau, A.Y.A and Terry J.P. Developing a historical typhoon database for the southeastern Chinese coastal provinces, 1951-2010. In Proceedings of Annual International Conference on Geological & Earth Sciences (GEOS) 2012, Singapore.

Mann M.E., WoodruffJ.D., Donnelly, J.P. and Zhang, Z. 2009, Atlantic hurricanes and climate over the past 1500 years.Nature, 460, 880-885.

Rowland, M. J., and Ulm, S. (2012) Key issues in the conservation of the Australian coastal archaeological record: natural and human impacts. Journal of Coastal Conservation, 16 (2). 159-171.

Switzer A.D. and Yu, F. 2012. Using geology as a tool for assessing coastal risk in Asia. In Typhoon Impacts and Crisis ManagementSpringer, Beijing accepted.

Syvitski, J.P.M., Kettner, A.J., Overeem, I., Hutton, E.W.H., Hannon, M.T., Brakenridge, G.R., Day, Vörösmarty, C., Saito, Y., Giosan, L. and Nicholls, R.J. 2009. Sinking deltas due to human activities
Nature Geoscience (10) 681-686

Woodruff J.D., Donnelly J.P. and Okusu A. 2009, Exploring typhoon variability over the mid-to-late Holocene: Evidence of extreme coastal flooding from Kamikoshiki, Japan. Quaternary Science Reviews, 28, 1774-1785.

Yu K.-F., Zhao, J.-X., Shi, Q. and Meng, Q., 2009. Reconstruction of storm/tsunami records over the last 4000 years using transported coral blocks and lagoon sediments in the southern South China Sea. Quaternary International, 195(1-2), pp. 128-137.

THEME 2

POLICY AND PRACTICE OF DISASTER PREPAREDNESS

ASEAN REGIONAL POLICY FRAMEWORK AND INITIATIVES ON CLIMATE CHANGE

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The ASEAN Heads of State/Government have proactively led ASEAN's efforts to address climate change issues in the region and beyond. They have consistently issued their ASEAN Leaders' Declaration/Statement on Climate Change to UNFCCC COP17/CMP7, UNFCCC COP16/CMP6, and UNFCCC COP15/CMP5 in 2012, 2011, and 2010 respectively, articulating ASEAN's common position for and expectations of the global climate change negotiations. The Roadmap for an ASEAN Community 2009-2015 adopted by the Leaders situates the ASEAN climate change agenda in the context of sustainable development outlining strategies and actions in the ASEAN Socio-cultural Community Blueprint, ASEAN Economic Community Blueprint, ASEAN Political-Security Community Blueprint, and 2nd Work Plan for the Initiative for ASEAN Integration. ASEAN is therefore addressing climate change, not just through a policy on climate change, but through the framework of ASEAN Community building, with strategies and actions rooted in the various development and sectoral areas. The presentation highlights the ASEAN climate change agenda and actions planned to address climate change.

THE GRANDEST CHALLENGE: ENABLING POLICY AND PRACTICE THROUGH NETWORKS AND PLATFORMS

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Since 2009 the Humanitarian Futures Programme, King's College London, has been supporting an exchange between a group of climate scientists, meteorologists and humanitarian organisations. The exchange includes two demonstration studies – one in Senegal and one in Kenya – as well as dialogue activities within a Natural Environment Research Council Knowledge Exchange Fellowship.

Learning from the exchange has made clear that, to effectively support those most at risk, climate information needs to be contextualised within the multi-hazard environments in which these communities live. The process of making climate science useful requires the development of dialogue approaches which challenge existing assumptions on the part of both the providers and users of science about how information can best support different levels of decision making and demonstrate value in the shorter-term. This process encompasses (1) strengthening levels of scientific literacy within communities at risk, as well as amongst the wide range of humanitarian and development agencies which seek to support them; (2) enabling scientists to develop understanding of the contexts in which scientific information is to be applied; and (3) creating approaches which support direct, two-way dialogue and identifying resources to enable more systematic, sustained provider-user frameworks for engagement.

How can the lessons be applied to the Asian context and what are the networks available for this? One mechanism would be to take advantage of the ASEAN Agreement on Disaster Management and Emergency Response (AADMER) ratified by its 10 member states and using the available academic and civil society networks in the region.

CLIMATE DISASTERS AND CLIMATE CHANGE IN VIETNAM: TASKS, STRATEGIES AND ACTION PLANS

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Vietnam is situated in South East Asia, stretching from 8o27 to 23o23N and from 102o08 to 109o30E. The coastal line of about 3,260 km covers the East and the South. Three-fourth Vietnam territory is covered by mountains and hills with the elevation typically from 100 to 1000 m. The plains concentrate in the down streams of two big rivers: the Red and Mekong Rivers. As a peninsula in the monsoon tropical area of Southeast Asia, Vietnam is particulared as one among nations with a high potential of being influenced by negative influences of climate change. In fact, Vietnam has already been experiencing manifestations of climate change in terms of basic climatic elements as well as extreme weather and climate events such as tropical storms, floods, heavy rains, and droughts. In recent years, under the influences of climate change, the frequency and intensity of climate disasters is increasing, causing enormous losses of human lives, property, infrastructure, economic, cultural and social impact on the environment. Only in the last 10 years (2001-2010), the types of climate and weather related disasters such as tropical storms, floods, flash floods, droughts, salinity and other natural disasters have done significant damage of life and property. More than 9,500 people had been killed and missed during this time, and the value of property damage estimated at around 1.5% GDP / year (Nguyen, T. H., 2008). This review has three main points, including (i) Climate disaster tendency in Vietnam, (ii) Strategic tasks for climate change and climate disaster reduction, and (iii) Action plans for climate change and climate disaster risk reduction.

In the first place, climate disasters in Vietnam such as floods, flash floods, droughts, heavy rainfall will increase in quantity and intensity where as drizzling rain, cold front; cold days significant decrease; frequency of tropical cyclones is not clear trend but strong typhoons increase in both frequency and intensity. Although cold days and damaging cold days decrease, extremes cold fronts are appeared more frequency (MONRE, 2012).

Secondly, this review shows teen strategic tasks for climate change as follows (Socialist Republic of Vietnam, 2011):

1. Proactively responed to natural disasters and climate monitoring
2. Food and water security
3. Positive response to sea level rise consistent vulnerable areas
4. Protection and sustainable development of forest, increasing carbon absorbabilities and biodiversity conservation
5. GHG emission reduction to protect global climate system
6. Strengthen the leading role of the Government in response to climate change
7. Community capacity development to effective respond to climate change
8. Scientific and technological development for climate change response
9. Strenthening international cooperation and integration to enhance the country's status in climate change issues.
10. Diversification of financial resources and investment focus effectively.

In terms of climate disaster risk reduction, general strategic tasks and specific strategic tasks for two biggest river deltas (Red and Mekong river deltas) in Vietnam are presented. The general tasks are (Socialist Republic of Vietnam, 2007):

1. Consolidate the system of laws, policies and mechanisms
2. Consolidate organizational structure
3. Socialization of disaster prevention, response and mitigation and human resource development
4. Ensure financial resources for natural disaster prevention, response and mitigation
5. Community awareness raising
6. Develop science and technologies on the natural disaster prevention, response and mitigation.
7. Ensure safety for dyke, reservoir and dam systems
8. Capacity building for salvage and rescue:
9. Promote international cooperation and integration

Finally, this review shows priority programmes for 2011-2015 for climate change response (Socialist Republic of Vietnam, 2008) as well as focus to implement the National Target Programs up to 2020 for climate disaster risk reduction.

References

MONRE, 2008. Vietnam Assessment Report on Climate Change. Ha Noi, Vietnam.
MONRE, 2012: Climate change scenario, sea level rise for Vietnam. Ha Noi, Vietnam.
Socialist Republic of Vietnam, 2007: National Strategy for Natural Disaster Prevention, Response and Mitigation to 2020. Issued with the Decision No. 172/2007/QĐ-TTg dated 16 November 2007 of the Prime Minister.
Socialist Republic of Vietnam, 2008. Decision No: 158/2008/QĐ-TTg dated 02 December 2008 of the Prime Minister, on approval of the National Target Program to respond to climate change.
Socialist Republic of Vietnam, 2011: National Climate Change Strategy. Issued with the Decision No. 2139/QD-TTg dated 05 December 2011 of the Prime Minister.

DOES ADAPTIVE POLICIES MEAN EFFECTIVE POLICIES? IMPLICATIONS FOR CLIMATE CHANGE ADAPTATION AND DISASTER RISK REDUCTION

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It has been widely regarded that policies that are adaptive in nature are better able to deal with dynamic and uncertain issues such as environmental degradation and climate change adaptation. However, verifying the veracity of this hypothesis is difficult in the field of climate change often due to absence of long experience of policy making for climate change adaptation in most countries in general. Hence, this study, which is based on a country study of natural resource management policies in Japan, looks into how various natural resource management and disaster risk reduction related policies have evolved over the years along with the evolving issues that they are designed to address and tries to answer questions such as how adaptive policies are in Japan, does adaptive policies relate to the effectiveness of policies and problem solving, and what are the political, institutional, economic and social factors that will lead to adaptive but effective policies. This paper is derived from a set of consultations and questionnaire surveys conducted in Japan. While addressing the above research questions, this study aims to draw lessons for developing countries which often lookup towards developed countries for solutions including those in policy successes. One of the interesting outcome of this study has been that indicators such as 'timeliness' of introduction of policies and 'regular updating' of policies may not necessarily translate into effective policies since other factors such as how different stakeholders understand the issue that policy intends to address, understanding on the part of the governments and institutions on how a policy works on the ground after it is designed and implemented, and most importantly the driving forces that are behind policy formulation and implementation determines the effectiveness of any policy.

IMPLEMENTATION OF GLOBAL RISK MANAGEMENT STRATEGIES FROM A MACRO - GOVERNMENTAL PERSPECTIVE

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In essence, the scientific discipline of Risk Management as a structured response to risk centres upon the body of knowledge and desired skills in managing systematically all potential risk exposures including the risk of natural disasters continually faced by individuals, companies, organizations and countries worldwide. Despite various attempts and efforts (including programs and related activities) carried out from time to time, total integration and coordination continue to be an issue of concern. Total integration of systems and processes (including databases), and also the effective coordination of various programs and activities from the Holistic Risk Management perspective urgently needs serious attention for successful implementation of global strategies. On a brighter note however, there are positive signs of better preparedness and resilience by all parties concerned. That includes active participation and continued engagement of various parties and stakeholders in recent years. In addition, the holistic approach of risk mitigation in relation to the immediate implementation of Global Risk Management Strategies would certainly contribute to effective management of risks and natural disasters from time to time. For overall efficiency therefore, the eventual implementation of Global Risk Management Strategies for effective Disaster Risk Reduction (DRR) (including Contingency Planning) and Climate Change Adaptation (CCA) requires the full support, total commitment and ultimate endorsement of all Governmental Leaders who are expected to be driving all initiatives and task-related activites for their respective countries.

Keywords: Risk Management, Holistic Risk Management, Disaster Management and/or Contingency Planning

VULNERABILITY ANALYSIS OF LOW INCOME SYSTEMS TO THE CLIMATE CHANGE THREAT

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Introduction

Global warming affects the behavioral patterns of regional atmospheric, oceanic and hydrological process- response systems and in the long term the regional and local climate of Southeast Asia. Recent studies have shown that there are marked changes in the behavioral patterns of Southeast Asia's Monsoons and its adjoining Oceanic Circulation Systems (such as the effects on the behavioral patterns Indian Dipole and El Nino Southern Oscillation Cycle (IDO and ENSO). These changes would affect regional and local weather patterns, river basin hydro-meteorological and geomorphological processes and with an impending threat of sea level rise, and associated effects of coastal degradation, saltwater intrusion and ground water contamination, flooding, and the destruction of habitats and ecosystems would pose serious threats on local population welfare and their livelihood activities. Southeast Asia's coastal regions are especially vulnerable as most of the coastal population livelihoods are dependent on coastal resources exploitation. The rural coastal populations of countries such as the Philippines, Vietnam, Thailand, Indonesia, Myanmar, Brunei and Malaysia are still very much involved with inshore and offshore fishing and rural – cottage industries that utilizes the fish products. Other than fishing, small – scale agricultural cultivation which is usually a family enterprise also dominates most of Southeast Asia coastal zones today. Apart from fishing and agriculture, tourism related activities also dominates the economy of the rural coastal populations such as in fabric and handicraft manufacturing and those associated with small scale enterprises in the provision of accommodation and food for the tourists. Any change to the onset, duration, frequency and intensity of weather events and the local and regional climate would severely affects the operation of these activities as they are not only climate governed but also climate dependent. Most Southeast Asian countries coastal populations could be categorized belonging to the low income group and many are near or below the poverty threshold line as identified based on an individual country's poverty threshold formulae. Regional climate change would severely affect the rural coastal population livelihood activities thus pushing them towards poverty or below the poverty threshold values. When this happens, it would compromise on the respective countries efforts to achieve the Millennium Development Goals (MDGs) targets of poverty eradication. The rural coastal populations' vulnerability to climate change is a function of their physical exposure and the ability to adapt to changing weather and climate conditions. Thus, vulnerability recognizes the role of societal systems in adjusting to and moderating the impacts of climate change and emphasizes the degree to which the risks of disaster can be cushioned or ameliorated by adaptive actions that can be brought within the reach of populations at risk. The significance of climate variation or change depends on the change itself and the characteristics of society exposed to it .These characteristics determine its adaptive capacity and its adaptability. Adaptive capacity refers to the ability to prepare for hazards and opportunities in advance (as in anticipatory action) and to respond or cope with the effects (as in reactive adaptation). This paper discusses the findings of a study that was conducted on the rural coastal populations of the coastal regions of Northeastern Peninsular Malaysia. The study region was chosen as it is categorized as one of the most vulnerable regions in Malaysia because of the existence of predominantly low income populations and potential threats from changing regimes of the Northeast Monsoon and Low Oceanic Pressure Cells of the South China Seas. Vulnerability analysis shows that the coastal populations are exposed to potential threats of climate change induced stresses. The populations too are dependent on livelihood activities which are mainly environment driven where income generated hovers about the national poverty threshold/line. These makes the coastal populations to be at low resilience and high vulnerability with very limited inherent coping mechanisms to manage the impending threats of climate change induced stresses.

Theoretical Framework – Vulnerability Model

Vulnerability can be defined in many ways. Vulnerability of a system to a threat (sometimes refer to stresses) describes its susceptibility to be harmed by that threat. Social scientists and climate scientists have different interpretations of the term "vulnerability". Social scientists views vulnerability as representing the set of internal and external factors that determine a system's resilience to impending threats and its ability to cope with the threats (Allen, 2003), whereas, climate scientists views vulnerability as the likelihood of impacts from threats attributed changing -

behavior of weather and climate events or climate induced hazards on a particular system (Nicholls et al., 1999; IPCC FAR 2007). Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity". Adaptive capacity is "The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences". This combined vulnerability, a function of hazard, exposure and sensitivity, is sometimes referred to as physical or biophysical vulnerability (O'Brien et al., 2003). In this formulation, vulnerability is something that exists within systems independently of external threats or hazards. For many systems, vulnerability is viewed as an inherent property of that system arising from its internal characteristics. Inherent vulnerability is determined by the type of system under threat. In this formulation, it is the interaction of threat with inherent vulnerability that produces an outcome, generally measured in terms of the impacts on the system's activities and sustenance (Brooks and Adger, 2003). The nature of a system's inherent vulnerability will depend on the nature of the hazard to which the system is exposed; certain properties of a system will make it more vulnerable to certain types of hazard than to others. The integration of the risk-based and vulnerability-based approaches is desirable if we are to address the numerous threats that human systems will face in the future as a result of climate variability and change, and also from non-climate hazards. As stated by Kasperson et al. (2001), "What is essential is to assess vulnerability as an integral part of the causal chain of risk and to appreciate that altering vulnerability is one effective risk management strategy." The discussion above paved the way towards developing a conceptual framework of vulnerability and risk analysis of systems under imposing threats or stresses as a result of climate change. In this study the vulnerability model adopted consists of 3 main components – (1) threat, (2) system's at risks, and (3) adaption. The threat component examines the type of threats that are affecting a system and their changing behavior from baseline conditions. The systems at risks are the low income systems exposed to the threats. Risks are define by external and internal indicators of vulnerabilities that are associated with the systems and also include inherent adaptive capacities that the systems posses. Whereas the adaptation component describes the need for the systems' at risks to adapt to the immediate, short term and long term future towards sustainable habitation and continuing livelihood activities.

The Study Region – Coastal Zone of the Northeast Region of Peninsular Malaysia

The Northeast Region of Peninsular Malaysia was chosen as the study region because of the following reasons, (1) a coastal zone which is becoming more exposed to changing environmental conditions, (2) low income economic systems which are highly dependent on the development of environmental resources available, and (3) rural communities whose income are below the poverty threshold value of RM760.00 and many whose income hovers just above this poverty threshold value.

Methods & Materials

The study involves a number of phases. In phase 1 the study examines the low income economies of the coastal zone of the state of Kelantan and Terengganu. Data acquisition involves identification and mapping of the coastal morphogenetic zone. This was followed with identification and mapping of the low income populations that dominates the coastal zone. Information on the total number of poverty driven population was derived from secondary sources. A representative sample of 600 poverty driven low income population was selected to examine the relationships between threats, systems at risks and adaptation. Data on the vulnerability model was primarily derived in the field through observations and interviews.

Results & Interpretations

Poverty driven populations of the coastal zones of the Northeast Peninsular Malaysia can be classified as those belonging to the following low income economic systems, (1) fishing and associated activities, (2) fabric printing enterprises, (3) agriculture and associated activities, (4) tourism and associated activities, and (5) household retail enterprises. These low income economic systems are directly or indirectly affected by the state of environmental conditions which affects the availability and quality of resources and the ability to sustain an activity associated with the practices of the low income economic systems. For example, availability and quality of fish products to be processed in the rural cottage food industries and also the influence of the state of environmental conditions on the practices of dyeing, printing and drying associated with the fabric printing enterprises. There are generic as well as specific characteristics of the low income economic systems of the coastal regions that describe their vulnerability. The main generic vulnerability indicator is their income. Income here is defined by the total remuneration a family received in a day, which could then be translated to monthly or yearly earnings (this is because in general the source of income is not fixed and consistent). However, for low income economic systems, daily income is much more important as the daily activities of the household unit are defined and governed by its daily income, with limited savings available.

Whatever limited savings that are available would be used for other social obligations inherent in the culture systems of the society which includes providing for their children education, religious obligations and needs associated with increasing the performance of their economic activities such as investing in better machineries and technologies and others. The more specific indicators of vulnerability are associated with the nature / behavior of the prevalent / impendent local environmental stress, the socio-demographic profile of the communities at risk, their external and living environment and availability of inherent cultural practices. To add to these indicators are the communities level of awareness, whether they perceived environmental stress as part of the normal cycle of man-environment relationships or whether the effect of environmental stress is actually changing and would influence their future relationships with the environment.

Discussions

Generally, in the study region, the vulnerability of the people associated with low income economic systems could be the function of many factors. These factors describes, (1) the population and demographic structure of the household members, (2) their economic livelihood activities, (3) the physical characteristic of the household unit (4) the immediate living environment, (5) the exposure to climate induced hazards, (6) inherent coping mechanisms and (7) the existence of infrastructure and support systems. In addition it could be added that (8) the nature of awareness (apathy, sympathy or empathy) to the climate change threat. Limited knowledge and awareness of climate change threat could hinder their immediate response) actions) to any form of climate change induced hazards which could be costly or fatal in the future. The failure and success of implementing early warning systems for climate change induced hazards (floods, droughts, outbreak of vector borne diseases, heat waves etc.) would be dependent on the level of the system's awareness on the nature of the threat that they are exposed to. People develop coping strategies to deal with climate variability as with other shocks or stresses. These include building social networks as forms of insurance, traditional forecasting in order to be prepared for climatic changes and ingenious means of protecting assets. However, the poor's range of coping strategies is naturally more restricted by their lack of assets and by the other stresses on their livelihoods. Adaptation is very important amongst the poor because they are more vulnerable to the impacts of environmental change.

Conclusions

Broadly speaking, there are two reasons why the low income economic systems are vulnerable to environmental change. One is the very low inherent adaptive capacity — high levels of poverty and a relative lack of the financial capability, institutional strength, skills, infrastructure, technology and other elements needed to cope with the effects of climatic shifts. The other is geographic location: large numbers of poor people live in areas such as coastal zones of the Northeast of Peninsular Malaysia which are exposed to multidimensional impacts of threats. In terms of livelihood and employment vulnerability, there is not much effort in adaptation. There are very little evidences of alternative livelihood and employment strategies taken by the population themselves as well as by the authorities. As far as infrastructure and physical adaptation, in terms of their houses and properties, the population seems to be taking small, ad hoc strategies, very much inhibited by their low income. However, the state government through the department of Irrigation and Drainage has taken various Curative and Preventive Actions, which includes:

1. Construction of erosion control structures, including: Groin, Offshore Breakwater Revetment - rock revetment and Labuan Block revetment, beach nourishment and beach management system.
2. Coastal Zone Land use Planning and Development Management with priority to natural coastal processes. Various instruments towards such planning efforts includes: a general Guidelines for development of coastal areas by the department of Irrigation and drainage, preparation of the Integrated Beach Management Plan- involving various adjoining states.

However these efforts are more focus on the mitigation of vulnerability of the environmental/ecological, not the social vulnerability which covers the community. This is especially true in terms of education and awareness towards the hazards and threats of environmental degradation especially the impending threats as a result of climate change. The climate is becoming more variable and creating additional risks so that the poor are becoming more vulnerable. As climate extremes are 'covariant risks' (i.e. simultaneously affecting a wide range of people), current safety nets are likely to be overwhelmed. This includes both formal systems (e.g. social assistance), and informal systems (e.g. social networks). Whatever the response, it should be an integral part of development planning. Responding to climate variability requires development agencies and governments to work on the development of strategic planning systems, which take account of current and projected climate patterns. There are two types of responses to the threat of climate change. The first, mitigation, involves reducing emissions of greenhouse gases as a way of slowing or stopping climate change. The second, adaptation, is learning to cope with temperature increases, floods and the higher sea level associated with climate change.

Adaptive responses can be technological (such as sea defense construction), behavioral (such as altered food and recreational choices), managerial (such as altered farm Adaptation to climate change needs to be mainstreamed into development policy and practice at national, international and regional levels. Particular attention needs to be paid to supporting community-based approaches to adaptation. Building on the considerable body of knowledge already possessed by poor people is essential. Governments can, however, attempt to increase the resilience of their growth strategies to the impacts of increasing climate variability and climate change. Unfortunately there is, as yet, little experience of best practice of adaptation to climate change on which to draw, but experience of more general adaptive economic policies offers some pointers.

References

1. Adger & W.Neil (1999).Social Vulnerability to Climate Change and Extremes in Coastal Vietnam. World Development 27 (2):249-269
2. Blaikie, Piers, Terry Cannon et al. (1994). At Risk: Natural Hazards, People's Vulnerability and Disasters. New York, NY: Routledge
3. Bohle, et al Vulnerability and Criticality. Perspectives from Social Geography. IHDP Update (2) (2001) (1)3-5.
4. Clark et al. (1998). Assessing the Vulnerability of Coastal Communities to extreme Storms: the case of Revere, MA., USA. Mitigation and adaptation Strategies for Global Change 3:59-82.
5. Downing et al. (2001).Climate Change Vulnerability: Linking Impacts and Adaptation, University of Oxford.
6. Dwyer, A. Zoppou, C. et al (2004).Quantifying Social Vulnerability: A methodology for identifying those at risk to natural hazards. Australian Government, GeoScience Australia.
7. Kasperson et al. (2001), International Workshop on Vulnerability and Global Environmental Change, Stockholm, May 17-19 2001.In a Workshop summary,Stockholm Environmental Institute,Stockholm,Sweden,2001.
8. IPCC.2001.IPCC Synthesis report on TAR (draft).Geneva:!PCC
9. Downing t. E. And a. Patwardhan 2007. Assessing Vulnerability for Climate Adaptation. Technical Paper 3: Assessing Vulnerability for Climate Adaptation.
10. B. L. Turner II, et al., 2003 "A framework for vulnerability analysis in sustainability science," PNAS, vol. 100 (14), p.p. 8074-8079.
11. Vogel, Coleen. (1998). Vulnerability and Global Environmental Change. LUCC Newsletter (3):15-19.

HIGHER EDUCATION IN ENVIRONMENT AND DISASTER MANAGEMENT THROUGH UNIVERSITY NETWORK

Juan M. Pulhin, Rajib Shaw and Joy Pereira

The Asian University Network of Environment and Disaster Management (AUEDM)AUEDM is a unique initiative of prominent Asian universities that come together to share knowledge resources related to environment and disaster risk management among themselves and with the larger group of stakeholders working on these issues, in addition to conventional national and thematic boundaries. AUEDM members work in close collaboration to conduct education and research, share findings, and find ways forward in a region that is increasingly threatened by climate change impacts. AUEDM also works closely with governments, international agencies, and corporate and civil society organizations to establish collaborations that eventually lead to resilient communities. It reflects each member's commitment to implementation-oriented education and research in the field of environment and disaster risk reduction. Among AUEDM's specific objectives are:

1. To share and work together (bilaterally or multilaterally) in promoting environment and disaster risk reduction in higher education (focusing on, but not restricted to, post-graduate education);
2. To collaborate on field-based and policy-oriented research focusing on different aspects of disaster risk reduction and environmental management;
3. To broaden the scope of education and learning in the environment and disaster risk reduction field through collaboration with diverse stakeholders including NGOs and local governments;
4. To document, develop, and disseminate knowledge products in the field of environment and disaster risk reduction;
5. To provide a forum for consultation, information sharing, and cooperation among universities on matters and themes of common interest; and
6. To enhance recognition of the vital role of universities in implementation-oriented education and research in environment and disaster risk reduction

One of the specific features of the AUEDM is close cooperation with the civil society organizations. Non-government organizations (NGOs) have direct field access, and experiences in grass-root project implementation. However, these experiences are not properly reflected in the educational curriculum. Thus, the network aims at bridging academic research, education and field practice.

AUEDM has come about from needs that appear to be crucial for the survival of millions of poor and vulnerable men, women, and children living on the margins of society in Asia. Its member institutions come together for reasons of educational, research, and networking imperatives.

1. Educational imperative: To discuss the status and scope of environment and/or disaster risk reduction curriculum in the higher studies in each university.Each country has its own perspective. Some countries have a full 2-year DRR master's program. Some universities have some modules of DRR in the postgraduate programs. Therefore, the attempt is not to standardize the program, but to learn and understand the process in DRR. The challenge is how effective the process can be customized into each context.
2. Research imperative: To discuss the possibility of climate change adaptation as the key entry point of collaborative research. Each country has a high prevalence of impacts of climate change beingborne by the most vulnerable communities. Impacts are most visible oncoastal, mountain, urban poor, and migrant communities. Becauseadaptation is a relatively new subject, heavy investments need to be madein research on effective local adaptation as a means for coping withimminent climate change impacts and linked disasters.
3. Network imperative: To discuss the establishment of the Asian Universities Network. While there are integral commonalities in the vulnerability context and thenature of impacts, the local setting and contextual nuances are highly variedacross Asian countries. Networking is the only way to share knowledge andexperiences, and to draw lessons based on principles derived from practices.The network is thus expected to go a long way in the development of aregional knowledge base, making it accessible for practitioners, and using itto influence the policy environment.

Initiated through a workshop held on July 28-29 at the Kyoto University, AUDM now composed of 25 Universities representing 17 countries in Asia. Its key activities include the following: 1) developing higher education essentials for DRR; 2) developing implementation research guidelines; 3) bilateral and/or trilateral projects under AUEDM framework; 4) exchange of students and faculty members; 5) student internships; organize workshops and focused meetings; and publish research papers, journals, books. Among its research priority activities are: 1) linking higher education to research and its implementation; 2) field based action research; identifying gaps and opportunities for regional research; 3) regional policy directions on DRR and CCA; 4) bilateral collaboration with multilateral application; 5) Sharing of experience and capacity building for research; and 6) publication and information dissemination. AUEDM publishes the Asian Journal of Environment and Disaster Management (AJEDM), an interdisciplinary journal that has started to gain wide readership among academics, practitioners and students working in the field of environment and DRR.

METRICS FOR MAINSTREAMING ADAPTATION IN AGRICULTURE AND WATER SECTORS: INSIGHTS FROM A FARM-HOUSEHOLD LEVEL SURVEY IN TAMIL NADU, INDIA

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Both agriculture and water sectors are highly vulnerable to climate change, and hence basic livelihoods of majority of people are at risk. Increasingly, adaptation is becoming critical to rural livelihoods. In fact, vulnerable farmers are implementing different adaptation measures to counteract negative climatic impacts, though it varies temporally and spatially. Thus, it is imperative to understand current adaptive practices for successful implementation of adaptation options in the future. A few studies have emerged in this light investigating issues associated with micro-level adaptation separately (e.g. output and cost effective, and constraints related to farm, household and institutional level). The present study has attempted to develop an adaptation metrics in the context of agriculture and water sectors covering all the above issues. For empirical assessment, about 146 farmers are being interviewed from different agro-ecological zones of Tamil Nadu state of India in the perspective of seven commonly practiced adaptation measures, e.g. micro-irrigation, rain water harvesting, resistant crop, use of bio-fertilizers, crop insurance, income diversification, and community based efforts. These adaptation measures were evaluated through Analytical Hierarchy Process (AHP) using four criteria: (i) effective awareness, (ii) economic viability, (iii) individual and institutional compatibility and (iv) flexibility and independent benefits. More importantly, this study provides a methodology to evaluate different adaptation measures in order to find out the constraints, to enable target oriented policy measures to promote adaptation measures at local scale.

Key Words: adaptation metrics, agriculture, water, multi-criteria analysis, Tamil Nadu

ASIA PACIFIC ADAPTATION NETWORK

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Adaptation is a knowledge-intensive undertaking, and access to relevant and usable knowledge is an important prerequisite for successful adaptation efforts. The need for information and knowledge spans the interlinked stages of adaptation actions, from climate change impact assessment and vulnerability analysis, through policy making and planning, to piloting, demonstrating, and full-scale implementation. Huge knowledge gaps are observed in many critical areas for adaptation such as autonomous adaptation processes, management of critical ecosystems, migration, human health, water management and financing mechanisms for risk management. In particular, due to the fragmentation of knowledge under different disciplines, knowledge in a packaged and ready-to-use form, integrating the different stages of adaptation, is rarely available. In addition, knowledge about adapting to climate change lies at an international level and is failing to reach those in the developing world who need it the most.

The Subsidiary Body for Scientific and Technological Advice (SBSTA) of the United Nations Framework Convention on Climate Change (UNFCCC) recognized at its 28th Session that "regional centres and networks undertaking work relevant to climate change play an important role in enhancing adaptation" and "agreed to promote existing networks for studying the impacts, vulnerability and adaptation and encourage the establishment of new networks". The discussion of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA) at the 15th Conference of the Parties (COP) proposed regional centres and networks such as those for adaptation, technology and capacity.

Since 2008, United Nations Environment Programme (UNEP) in partnership with key UN agencies and international organisations has been facilitating the development of a Global Adaptation Network (GAN). The Asia Pacific Adaptation Network (APAN) is the first network under GAN and was launced in Bangkok in October 2009.

Aims and objectives
The Network aims to help build climate resilience of vulnerable human systems, ecosystems and economies through mobilisation of knowledge and technologies to support adaptation capacity building, policy-setting, planning and best practices.
Specific objectives of APAN include the (i) generation and share knowledge and information on adaptation to enhance adaptation actions; (ii) facilitatation application of appropriate knowledge to adaptation programmes/projects;(iii) facilitation access to adaptation finance mechanisms; and (iv) development of capacity of national and local planners, communities, development partners and the private sector in adaptation.

Network Activities
APAN aims to fulfil its objective through the mobilization and sharing of knowledge and technologies to support adaptation capacity building, policy-setting, planning and practices primarily to the policy makers and national institutions in order to contribute to climate policies at the national level.

The activities of APAN are organized around a framework of knowledge management, capacity development, and adaptation integration. Adaptation knowledge management fills gaps when adaptation domains need improved understanding, such as in identifying ways to better manage risk and uncertainty or build resilience, overcome limits etc to adapt, or where there is a need for improved dissemination of existing knowledge. Capacity development recognizes the need for both strengthening the knowledge and skills of different actors at different levels to plan, design, implement, and evaluate appropriate adaptation measures, and to acquire financing and technologies for implementation as well as for integrating adaptation into development planning at different levels and in different adaptation domains. Adaptation integration covers different adaptation domains or areas of particular concern such as agriculture and food security, water resources, health and sanitation, disaster management, coastal and islands, and mountains etc, and the need for integrating adaptation into policies, strategies, plans and actions.

APAN has established a database on good adaptation practices to climate change which also includes practices on loss and damage. The database comprises of good practices from across the region outlining different approaches to climate adaptation and loss and damage to climate change. A total of a 135 are currently included in the database. The purpose of the database is to enhance exchange of good practices, help in possible replication of the good practices and ideally, be useful to policy makers.

Structure of APAN
To be able to effectively coordinate across such a large region, APAN works through a regional hub in collaboration with implementing sub-regional nodes (SRNs) and partner institutions in the Asia Pacific region building upon existing networks and initiatives. Sub-regional nodes designated under APAN coordinate activities with national partner institutes in each sub-region. APAN has five Sub-Regional Nodes covering five sub-regions in Asia-Pacific. SRNs are organisations whose key functions are to lead the implementation of the sub-regional activities of the Network in collaboration with the regional hub and national implementing partners. APAN also has three Thematic Nodes (TNs) on water, agriculture and mountains reflect the current priorities of the region and are composed of organizations with specific expertise on their respective thematic areas.

NOTES

About SEADPRI-UKM

The Southeast Asia Disaster Prevention Research Institute, Universiti Kebangsaan Malaysia (SEADPRI-UKM) was established in June 2008 at Universiti Kebangsaan Malaysia. The Institute addresses crucial challenges on disaster risk reduction in the Southeast Asian region. The importance of having a research focal point in this region was felt when Malaysia and neighbouring countries grappled with various issues related to science and governance in facing the 26.12.04 tsunami disaster. SEADPRI-UKM was created to provide basic solutions for disaster prevention through multi– and inter–disciplinary research on risk management to bridge the science-governance interface. The focus of research is on climatic hazards, geological hazards and technological hazards. The emphasis is on capacity building, mainly through postgraduate programmes and specialised training.

Mengenai SEADPRI-UKM

Institut Kajian Bencana Asia Tenggara, Universiti Kebangsaan Malaysia (SEADPRI-UKM) telah ditubuhkan pada bulan Jun 2008 di Universiti Kebangsaan Malaysia. Institut ini merupakan jawapan di dalam menangani cabaran penting kepada pengurangan risiko bencana di rantau Asia Tenggara. Kepentingan mempunyai takat penyelidikan tumpuan di rantau ini telah dirasai apabila Malaysia dan negara-negara jiran bergelut dengan pelbagai isu yang berkaitan dengan sains dan tadbir urus dalam menghadapi bencana tsunami 26.12.04. SEADPRI-UKM telah diwujudkan untuk menyediakan penyelesaian asas untuk pencegahan bencana melalui penyelidikan pelbagai dan antara disiplin mengenai pengurusan risiko untuk merapatkan ahli sains-pentadbir. Tumpuan penyelidikan adalah mengenai bencana iklim, bencana geologi dan bencana teknologi. Penekanan adalah pada pembinaan keupayaan, terutamanya melalui program-program pascasiswazah dan latihan khusus.

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Appendix 3: Funding sources outside the APN

Institution	In-Kind Support	Estimated Amount (USD)
M.S.Swaminathan Research Foundation, India	Time spent on the project by Dr. Arivudai A. Nambi, Project Director: about 75 days over three years.	15,000
Institute for Global Environmental Strategies, Japan	Time spent on the project by Dr. S.V.R.K. Prabhakar, Senior Policy Researcher and Dr Shinano Hayashi, Deputy Director: about 100 days over three years.	28,000
Institute for Environment and Development, Universiti Kebangsaan Malaysia	Time spent on the project by Prof. Dr. Joy Jacqueline Pereira, Project Leader: about 75 days over three years.	20,000
Southeast Asia Disaster Prevention Research Institute, Universiti Kebangsaan Malaysia	Time spent on the project by Mr. Tan Ching Tiong, Research Officer: about 120 days over three years.	10,000
Institute of Hydrology, Environment & Meteorology, Vietnam	Time spent on the project by Dr. Nguyen Van Thang, Director and Mr. Tran Dinh Trong, Head of Division: about 120 days over three years.	15,000

Appendix 4: List of Young Scientists

Name	Nature of involvement
India	
Ms. Nivya Sekhar Mr. Vamshi Gautham	Literature Survey, Assistance in preparation of status report, compilation and assessment of national documents/reports, compilation of relevant Policy notes (both federal and State) relevant to agriculture and water, Construction/modification of the questionnaire.
Japan	
Ms. Misa Aoki (misa_aoki8@hotmail.com)	Helped in conducting questionnaire survey on adaptive policies and measuring mainstreaming climate change concerns into institutional processes and in conducting a consultation meeting on resilience to extreme events in Japan. Translated the questionnaires and communicated with the respondents. Presented the findings in the Earth System Governance Conference in Tokyo representing the team.
Ms Reina Mashimo (reinamashimo@hotmail.com)	Helped in conducting the literature review on adaptive policies, tracking policies and changes over the time period and tabulating them and conducted initial round of pilot surveys on adaptive policies
Mr. Christopher Ilori (christopherilori@yahoo.co.uk)	Helped in conducting literature review on multi-criteria decision making and its role in climate change adaptation decision making
Dr. Takeshi Takama (ttak003@gmail.com)	Helped in conducting literature review on identifying barriers to mainstreaming climate change concerns into institutional processes in Japan
Ms. Izumi Tsurita (izumitsurita@gmail.com)	Helped in conducting field surveys to identify barriers to mainstreaming climate change into agriculture in Japan, helped in conducting a consultation meeting on adaptive policies and measuring mainstreaming climate change adaptation concerns into sectoral planning
Malaysia	
Mr. Mohd. Khairul Zain Ismail (tats_jengka2003@yahoo.com)	Organisation and preparation of report for inception workshop/meeting; collection of literature on adaptation policies, programs, and actions in Malaysia's agriculture sector; translation of literature into English; compilation of stakeholders' information; organisation of internal meetings; preliminary review of adaptation measures reported in national communication.
Dr. Abul Quasem Al-Amin (amin_cant@yahoo.com)	Review of adaptation responses in the agriculture sector; presentation in inception workshop; preparation of research paper on agriculture sector; editing of papers from inception workshop for publication purpose.
Ms. Sharifah Nur Eli Diyana (elidiyana@yahoo.com)	Collection of literature on adaptation policies, programs, and actions in Malaysia's water sector; translation of literature into English; compilation of stakeholders' information; organisation of internal meetings; review of existing regional networks; preparation of ARPNAP charter.
Vietnam	
Mr. Vu Van Thang Mr. Truong Ba Kien	Data and document collecting; review on climate change studies; determine the climate change issues in Vietnam; elementary Assessment of climate change impacts on water resources and agriculture

Appendix 5: Glossary of terms

AJEDM	Asian Journal for Environment and Disaster Management
AHP	Analytical hierarchy process
APAN	Asia Pacific Adaptation Network
AUEDM	Asian University Network for Environment and Disaster Management
IGES	Institute for Global Environmental Strategies, Japan
IMHEN	Institute of Meteorology, Hydrology and Environment, Vietnam
IPCC	Intergovernmental Panel on Climate Change
LESTARI	Institute for Environment and Development, Universiti Kebangsaan Malaysia
MSSRF	M.S. Swaminathan Research Foundation, India
SEADPRI-UKM	Southeast Asia Disaster Prevention Research Institute, Universiti Kebangsaan Malaysia
UNFCCC	United Nations Framework Convention on Climate Change

Appendix 6: Questionnaires

1. Survey on Farm-Level Adaptation Measures in India

2. Questionnaire Survey on How Adaptive Policies and Institutions are in Japan? A Case Study of Agriculture and Related Natural Resources Management Policies in Japan

3. Questionnaire for Assessing the Level of Mainstreaming Climate Change Adaptation (CCA) into Organizations

4. Questionnaire on Adaptive Capacity of Water Institutions in a Changing Climate

APPENDIX 2

Revised questionnaire for farmers

1. Name:

2. Village /
Locality:

3. District:

4. What are the five most important problems due to sudden change in climate and weather observed by you in your region?

1.

2.

3.

4.

5.

6. Kindly provide the following details for the adaptation options in Table A 2.2.

Table A2.2 List of adaptation measures for farmers to respond

Adaptation options	**Currently in practice (Yes / No)**	**Self-implemented or introduced through policy**	**Bene-ficial (Yes/No)**	**Problems faced**	**Cost**	**Rank the top 5 adaptation options in terms of effective-ness**
(A) Adaptation options in Agriculture:						
Improved soil management (organic matter / mulching, conservation tillage)						
Adopt heat & drought resistant / tolerant crops and varieties						
Crop diversifica-tion and cropping systems (e.g. water logging tolerant crops)						
Better crop management practices (adjusting planting dates, crop calendar, nutrient management etc.)						
Use of biofertilisers						
Integrated Pest						

Management						
Land use planning (e.g. restrictions on some industries in water scarce areas)						
Planned use of land						
Crop area changes						
Protecting livestock						
Agroforestry						
Income diversifica-tion (non-farm income sources)						
Credit facilities (e.g. micro-financing)						
Comprehen-sive insurance (crops, houses, livestock etc.)						
Information sharing						
Community oriented efforts, if any (as a group)						
Improved forecasting and early warning systems						
Others						

(B) Adaptation options in Water:						
Enhanced water storage (reservoir capacity, check dams)						
Improved irrigation systems						
Water harvesting structures						
Watershed management programmes						
Use saline and fresh water, or groundwater and surface water in combination						
Effectiveness of forecasting and information						
Crop based water budgetary						
Protection from floods during rainy season						
Formation of community based water management groups						
Introducing water pricing system & other water conservation/allocation policies						
Others						

Questionnaire Survey, Adaptation Team, IGES, Hayama, Japan

How adaptive policies and institutions are in Japan? A case study of agriculture and related NRM policies in Japan

This Delphi questionnaire survey is designed to get your informed opinion on various aspects of policy making and role of institutions behind policy making to address the question of how responsive (or non-responsive) the policies and institutions are to the emerging issues in the field of agriculture (and related sectors including water for agriculture) in Japan. All views expressed in this survey will be used only for academic purposes, no personal information is being collected for this survey, and responses will not be shared with other respondents. This survey will be conducted in three rounds with each round of questionnaire survey is based on the responses received on the previous round of questionnaire. Overlaps in questions between rounds may be possible to update the memory of the respondent.

1. Round 1: This questionnaire. to identify important issues and related policies in Japanese agriculture and related sectors
2. Round II: Based on responses received in Round I, will assess the effectiveness of the policy responses of the government
3. Round III: Based on responses received in Round II, will seek your rating of the overall adaptive nature of policies and institutions behind these policies on a scale of 1-5 and identify the reasons for the same.

I. About the interviewee

1. Experience in agricultural and NRM related policies in Japan

☐1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16-20 years ☐ > 21year

2. Your exact role in terms of agricultural and NRM related policies in Japan

☐ Researcher ☐ Government Administrator ☐ NGO representative ☐ Others (Specify:_____)

(e.g. JA, donor etc)

3. Have you been directly involved in government policy making in agriculture sector?

☐ Yes ☐ No

4. Your field of specialization (in the highest degree you received):_____, you are representing in this survey as an expert of: _____

II. Identifying Important policy issues and policies in Agriculture and related NRM sectors including water in Japan

3. What are three important policy issues in the past five decades in Japan that continue to be an issue today

	Policy Issue	Rank (only tick one in each row, total three boxes)		
I1	Declining number of farmers	☐1	☐2	☐3
I2	Declining role of agriculture in Japan	☐1	☐2	☐3

I3	Declining global competitiveness of Japanese agri.	☐1	☐2	☐3
I4	Increasing income gap between rural and urban areas	☐1	☐2	☐3
I5	Land use changes (agriculture land to non-agriculture)	☐1	☐2	☐3
I6	Others (Specify):	☐1	☐2	☐3
I7	Others (Specify):	☐1	☐2	☐3

4. List one important policy that government of Japan has introduced in the past 5 decades to tackle the above identified top three policy problems

Policy issue No. from above table (e.g. I5)	Policies introduced	Policy tag (do not fill this column)
		Policy I
		Policy II
		Policy III

III. Your opinion on the above selected policies

5. Provide your opinion on the above policies by rating them on 1-5 scale (1 least and 5 high) for four indicators?

Policy tag (do not fill this column)	Timely*	Adaptive**	Effective@	Strategic#
Policy I	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5
Policy II	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5
Policy III	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5	☐1 ☐2 ☐3 ☐4 ☐5

* Policies are said to be timely if they are introduced at a time when they are needed the most (or soon the issue has been identified); 1 means very delayed, 2 means delayed, 3 means timely, 4 means very timely, 5 means in advance.
** Policies have been modified with changing circumstances or changing nature of the issue,
@ policies are effective when they have achieved the goals set by them
# Policies are said to be strategic if their design is based on future projected changes in the issue they plan to address

<<<<Thank you for your valuable time! Please e-mail this form to **survey-ad@iges.or.jp**>>>>>

QUESTIONNAIRE FOR ASSESSING THE LEVEL OF MAINSTREAMING CLIMATE CHANGE ADAPTATION (CCA) INTO ORGANIZATIONS

Dear respondent, Your participation in this survey on assessing the level of mainstreaming climate change adaptation (CCA) into key organizations is valuable for us to provide better policy recommendations for CCA. This survey takes about 15 min, the results are strictly for research and the metadata will not be shared with any 3rd party. Respecting your privacy, we will group results into categories of governments, NGOs, and private sector etc. Your feedback on this survey will be highly appreciated and valued. This research is funded by the Asia-Pacific Network for Global Change Research. Contact for further clarification: *Name, Designation, Contact (Email/Tel no), Institute*. Please see the follow-up section at the end and confirm before returning this survey form.

1. About your organization

NOTE: Tick multiple options in the same question if necessary

1.1 Do you want us to keep your organization name as anonymous: ☐Yes ☐No

1.2 Name of your organization (for our reference if you chose Yes above): _____

1.3 Your organization is: ☐ Government ☐ Quasigovernment ☐ Fully Non-Government
☐ Non-profit ☐ Organization for profit ☐ Private sector

1.4 Your organization work involves: ☐ Research ☐ Development ☐ Education
☐ Production of consumer goods ☐ Production of consumer services ☐ Donor agency
☐ Others:_____

1.5 Total staff in your organization: ☐ <100 ☐ 100-1000 ☐ 1000-10,000 ☐ 10,000-100,000
☐ >100,000

1.6 Total budget of your organization (USD): ☐ <10,000 ☐ 10,000-50,000 ☐ 50-000-100,000
☐ 500,000-1000,000 ☐ >1000,000

2. About yourself

2.1 Age: ☐ <25 ☐ 25-35☐ 35-45☐ 45-55☐ >55

2.2 Education: ☐ Bachelors ☐ Masters ☐ Doctoral

2.3 Gender: ☐ Male ☐ Female

2.4 Length of working in the current organization: ☐ <2 years ☐ 2-5 ☐ 5-10 ☐ 10-15 ☐ >15 years

2.5 Your role in the organization can be broadly categorized as: ☐ Researcher ☐ Professor ☐ Manager ☐ Professional staff ☐ Others (_____)

2.6 Your overall understanding of your organization on 1-5 scale (1 is least and 5 is best):

<<Least>>☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 <<Best>>

3. Rate the level of mainstreaming climate change adaptation into your organizational processes

NOTE:

- This section[1] is divided into six Areas (policy, strategy, planning, project cycle management, external relations and organizational capacity) and each Area has four levels of achievement, level I is lowest and level IV is highest.
- **IMPORTANT NOTE:** Please fill all six Areas, please chose only one Level that closely represents your organization and you can select multiple boxes within each Level.

3.1 Policy (Area I)

Level I	Level II	Level III	Level IV
☐ **A** Your organization has little or no understanding of the relevance and importance of CCA for its policy and practice.	☐ **A** There is general awareness within your organization of the significance of CCA for its work, including the extent of the threat that climate change pose to your organization's long-term goals and objectives. ☐ **B** Your organization recognizes the need for CCA to be linked in a coordinated approach to reduce climate change risks.	☐ **A** Your organization has a conceptual framework for CCA which recognizes vulnerability as contributing to the risk of climate change. ☐ **B** A wide cross-section of staff are engaged in a consultative process to either: ☐ inform the development of a policy which commits your organization to mainstreaming CCA within your organization's operations. OR ☐ incorporate CCA mainstreaming into your organization's existing policy structure.	☐ **A** Your organization has a 'policy' on CCA with realistic and achievable goals for mainstreaming. This is understood and accepted across your organization. ☐ **B** Your organization's CCA 'policy' commits it to addressing following critical issues: ☐ ensuring that programmes/projects supported by your organization are protected through CCA elements. ☐ ensuring that CCA programmes/ projects are managed in a 'developmental manner' ☐ ensuring that programmes/projects do not increase people's vulnerability to climate change. ☐ **C** The CCA 'policy' is fully endorsed by our senior management. ☐ **D** The CCA 'policy' is reflected in internal and external documents.

[1] Developed based TearFund, 2005. Mainstreaming disaster risk reduction: A tool for development organizations.

3.2 Strategy (Area II)

Level I	Level II	Level III	Level IV
☐ **A** Where your organization undertakes CCA, it is done on an ad hoc basis and there is little or no recognition of the need for a strategic approach to CCA.	☐ **A** Your organization recognizes that ad hoc decision-making for CCA is inadequate. ☐ **B** There is widespread awareness of the need to develop a strategic approach to CCA across your organization, in response to policy directives.	☐ **A** A wide cross-section of staff are engaged in a consultative process to EITHER: ☐ develop a strategy which mainstreams CCA within your organization's operations OR ☐ ensure that mainstreaming CCA is a component of your organization's existing strategy framework.	☐ **A** Your organization has a comprehensive mainstreaming strategy based on the conceptual framework and policy (see Area I: Policy). ☐ **B** The strategy is fully endorsed by senior management. ☐ **C** The strategy is reflected in internal and external documents.

3.3 Planning (Area III)

Level I	Level II	Level III	Level IV
☐ **A** Your organization has little or no awareness of the need to consider climate change risks within its planning of research, development, public/consumer relations including CSR activities.	☐ **A** There is widespread understanding of the climate change-vulnerability relationship at relevant levels, and of the impact of climate change on the organization's work in a given geographical area. ☐ **B** There is widespread understanding of the need to apply policy commitment to CCA within planning (including direct budgetary support mechanisms). ☐ **C** Your organization is considering how existing planning tools can be (re)designed to take account of climate hazards, risks and vulnerabilities.	☐ **A** Your organization is developing a process to ensure that all planning include CCA (in order that planning is undertaken as outlined in Level 4).	☐ **A** There is ongoing analysis of the climate change (ie: assessment of hazards, climate change impact, vulnerabilities and risks) in any given location. This analysis involves the perspectives of local communities, governments, NGOs, private sector and other stakeholders. ☐ **B** Appropriate climate risk reduction strategies are developed on the basis of the above and integrated into new plans as a matter of course. ☐ **C** Where your organization focuses on Direct Budgetary Support, it seeks the inclusion of climate change risk assessment and risk reduction in the planning of climate change impacts-prone regions, sectors, divisions etc.

3.4 Project cycle management (Area IV)

Level I	Level II	Level III	Level IV
☐ **A** Your organization has little or no understanding of the importance of addressing CCA within project cycle management.	☐ **A** The organization recognizes a need for reducing climate change risks within every aspect of project cycle management, for the purpose of: ☐ protecting projects from climate change impacts ☐ ensuring that new projects do not increase climate change risks or enhance vulnerability. ☐ **B** Your organization is considering how existing project cycle management tools can be (re)designed to take account of climate hazards, risks and vulnerabilities.	☐ Your organization is developing an approach to ensure climate hazards, risks and vulnerabilities are addressed within project planning, implementation and evaluation according to the local context.	☐ **A** Project cycles routinely incorporate CCA in planning, implementation and evaluation, for the dual purpose outlined in Level 2. ☐ **B** Recommendations arising from monitoring and evaluation inform project (re)design. ☐ **C** Where explicit CCA programmes are established, these are linked to your organization's other programmes.

3.5 External relations (Area V)

Level I	Level II	Level III	Level IV
☐ **A** Where your organization undertakes CCA, it works independently and has little or no awareness of the need to collaborate with others.	☐ **A** Your organization recognizes that it cannot act alone in the field of CCA.	☐ **A** All relevant stakeholders, including implementing partners and collaborating bodies, are being identified through a 'stakeholder analysis': ☐ Stakeholders in our organization work include direct engagement with local communities (farmers, artisans, common citizens etc). ☐ **B** Linkages are being made with key stakeholders at local, national and international levels to raise awareness of your organization's climate risk reduction policy and strategy; to develop collaborative work; and to learn from others' approaches/research.	☐ **A** Your organization supports, enables and invests in capacity development for climate risk reduction within its implementing partners. ☐ **B** Your organization collaborates with other key players and relevant regional or global coordinating or networking bodies, and information, expertise and resources are shared as required. Common policies and shared strategies may be developed. ☐ **C** The 'public face' of your organization reflects its CCA policy and strategy.

3.6 Orgnizational capacity (Area VI)

Level I	Level II	Level III	Level IV
☐ **A** Your organization has little or no capacity to mainstream CCA, and little or no recognition of the need to increase/develop its financial or human resources for this purpose.	**A** Your organization recognizes that it must develop appropriate capacity including sufficient financial and human resources to support the process of mainstreaming CCA.	**A** Plans are being made to develop a supportive organizational environment for mainstreaming CCA. **B** Tools are being developed to assess your organization's progress with mainstreaming.	☐ **A** Organizational capacity is sufficient to support all the processes outlined in Areas 1–5, ie: ☐ Financial resources. ☐ Skills and knowledge (eg: staff training and development, materials and appropriate technical support). ☐ Strong cross-organizational commitment and ownership of climate risk reduction policy and strategy at all levels. ☐ **B** There are strong links between the head quarters and field staff, who have access to services and exchange of information. ☐ **C** Tools are routinely used independently and comprehensively to assess your organization's progress with mainstreaming.

Follow-up

IMPORTANT NOTE: As a follow up to this survey, we may contact you for clarification on this survey (e.g. to discus reasons, limitations faced in mainstreaming etc). The follow-up may be through a telephonic conversation or any other means that are comfortable for you (please see below). Your cooperation in this regard would be highly appreciated and valued.

Yes, I am willing to provide follow-up ☐

Preferred mode for follow-up: ☐Phone number: ☐ Email ID: ------- Thank you very much for your valuable time and cooperation-------

Questionnaire on Adaptive Capacity of Water Institutions in a Changing Climate

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Note to Respondent:
In this questionnaire, we would like to ask your opinion regarding the adaptive capacity of water institutions using a set of criteria and indicators (see page 2 for details). We focus on the **institutions managing the water resources of Sungai Selangor regarding their ability to ensure water availability under a changing climate**. Your answers will help in a research work on identifying feasible approaches for facilitating adaptation to climate change. All information given by you will remain confidential and it will be used solely for scientific purposes. The answers to the questionnaire will be considered exclusively as personal opinions and they will not be taken as the position of your organisation.

We value your expertise and thank you in advance for your time and input in completing the questionnaire!

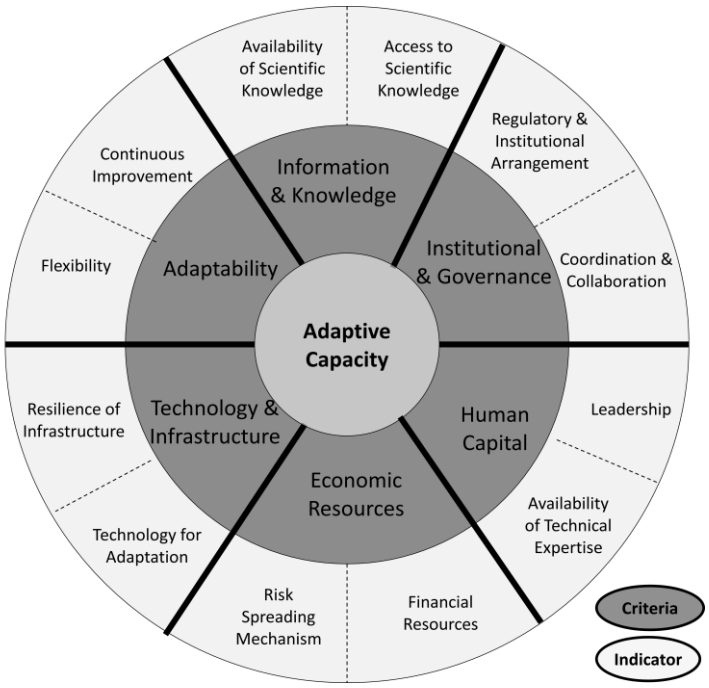
Contacts:
Tan Ching Tiong, PhD Student (Tel: 017-2652547; Email: tctiong@gmail.com)
Prof. Dr. Joy Jacqueline Pereira, Principal Fellow (Email: joy@ukm.my)
Institute for Environment & Development (LESTARI)
Universiti Kebangsaan Malaysia

General Information (Please tick as appropriate):

Category		Government (Federal Level)		Research Institute
		Government (State Level)		NGO
		Government (Local Level)		Academic
		Private Business		Intergovernmental Organisation
		Other (please specify):		
Specialisation (you may tick more than one)		Regulatory & Policy		Financial Management
		Development		Environmental Management
		Technical Research		Consultancy
		Other (please specify):		

Experience on water related issues (you may tick more than one)	a) at the Federal level		< 5 years		5-10 years		> 10 years
	b) at the State level		< 5 years		5-10 years		> 10 years
	c) at the Local level		< 5 years		5-10 years		> 10 years
	d) in the Selangor Basin		< 5 years		5-10 years		> 10 years

Criteria and Indicators for Assessing Adaptive Capacity of the Water Institutions in a Changing Climate



Criteria	Indicator	Representation
1. Information & Knowledge	1.1 Availability of scientific knowledge	Institutional knowledge of the current vulnerabilities and potential impacts of climate change.
	1.2 Access to scientific knowledge	Access to scientific knowledge and effective communication with experts, including scientific results.
2. Institutional & Governance	2.1 Regulatory & Institutional arrangement	Governance structure that facilitate rapid and innovative decision-making as well as effective actions by the institution.
	2.2 Coordination & collaboration	Cooperation with various stakeholders outside the institution's hierarchy and access to networks at various scales.
3. Human Capital	3.1 Leadership	Recognition by higher governance level and proactive and take ownership of adaptation.
	3.2 Availability of technical expertise	Availability of in-house human resources with relevant technical skills, knowledge and experience.
4. Economic Resources	4.1 Financial resources	Availability of or access to sufficient income or the ability to generate resources to support policy measures and financial incentives for adaptation.
	4.2 Risk spreading mechanism	Ability to access and subscribe to relevant mechanism to spread or reduce the risks of climate change.
5. Technology & Infrastructure	5.1 Technology for adaptation	New technologies or revival of old ones in response to new conditions under uncertain future climate conditions.
	5.2 Resilience of infrastructure	Existing infrastructure and future investments integrate climate change factor and are climate-proved.
6. Adaptability	6.1 Flexibility	Openness towards uncertainties patterns and ability to update or adjust in a non-stationary climate.
	6.2 Continuous improvement	Ability to find innovative solutions and make changes to policies, processes, practices and behaviour that will lead to better performance.

Part 1: The objective is to determine the weight to be assigned to each criteria. Please assess the relative importance between the criteria by selecting the number in the tables to indicate to what extent one criteria is more important than the other one. An illustrative example is given below:

Example:

Information & Knowledge	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Institutional & Governance
						x												

The interpretation is that "Information & Knowledge" is 4 times more important than "Institutional & Governance" when considering the criteria affecting the adaptive capacity of the water institution; hence "Information & Knowledge" should be given higher weight.

1.1 Between "Information & Knowledge" and other criteria

	More important ←							Equally Important		→ More important								
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Information & Knowledge																		Institutional & Governance
																		Human Capital
																		Economic Resources
																		Technology & Infrastructure
																		Adaptability

1.2 Between "Institutional & Governance" and other criteria

	More important ←							Equally Important		→ More important								
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Institutional & Governance																		Human Capital
																		Economic Resources
																		Technology & Infrastructure
																		Adaptability

1.3 Between "Human Capital" and other criteria

	More important ←								Equally Important								→ More important	
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Human Capital																		Economic Resources
																		Technology & Infrastructure
																		Adaptability

1.4 Between "Economic Resources" and other criteria

	More important ←								Equally Important								→ More important	
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Economic Resources																		Technology & Infrastructure
																		Adaptability

1.5 Between "Technology & Infrastructure" and other criteria

	More important ←								Equally Important								→ More important	
	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	
Technology & Infrastructure																		Adaptability

Part 2: The objective is to assess the extent of which the activities below are being practised by the institutions as an indication to the capacity to adapt to climate change. Please add other activities that also contribute each indicator. Please tick or circle your answer in accordance to the following scale:

1	2	3	4
Never practised	Rarely practised	Practised	Frequently practised

1.1 Availability of scientific knowledge

a)	Perform research with in-house personnel.	1	2	3	4
b)	Collect/Assess data on current vulnerabilities and potential impacts of climate change.	1	2	3	4
c)	Apply scientific information in problem evaluation and decision making.	1	2	3	4
d)	Update data repository and/or knowledge management system.	1	2	3	4
e)	Others (please specify):	1	2	3	4

1.2 Access to scientific knowledge

a)	Identify relevant sources and establish communication to obtain external data/ knowledge/information.	1	2	3	4
b)	Use data from external sources for assessment and planning processes.	1	2	3	4
c)	Maintain directory of expertise.	1	2	3	4
d)	Others (please specify):	1	2	3	4

2.1 Regulatory and institutional arrangement

a)	Recognise the need for adaptation to a changing climate.	1	2	3	4
b)	Institutionalise adaptation in the mandate and decision-making processes.	1	2	3	4
c)	Adopt formalised procedure(s) to consider a wide range of alternatives for adaptation.	1	2	3	4
d)	Adopt decision criteria to prioritise adaptation options (e.g. benefits, costs, effectiveness, efficiency, feasibility, etc).	1	2	3	4
e)	Others (please specify):	1	2	3	4

1	2	3	4
Never practised	Rarely practised	Practised	Frequently practised

2.2 Coordination and collaboration

a)	Maintain access to networks at various levels (federal/state/local).	1	2	3	4
b)	Engage and build consensus among stakeholders.	1	2	3	4
c)	Others (please specify):	1	2	3	4

3.1 Leadership

a)	Top level of the institution advocates adaptation to climate change.	1	2	3	4
b)	Take ownership of the processes of climate change impact assessment and strategic adaptation planning.	1	2	3	4
c)	Proactively influence the decision- and policy-making on adaptation both within and outside the institution.	1	2	3	4
d)	Others (please specify):	1	2	3	4

3.2 Technical expertise

a)	Retain staff capable of working with complex data and making assessment.	1	2	3	4
b)	Use of appropriate tools to assess options for adapting to a changing climate conditions.	1	2	3	4
c)	Provide opportunities for training and continuous learning.	1	2	3	4
d)	Others (please specify):	1	2	3	4

4.1 Financial resources

a)	Allocation of financial resources for adaptation to climate change.	1	2	3	4
b)	Approach financial needs for adaptation in a strategic manner.	1	2	3	4
c)	Assess availability of resources in adaptation process.	1	2	3	4
d)	Appropriate use of financial resources.	1	2	3	4
e)	Others (please specify):	1	2	3	4

1	2	3	4
Never practised	Rarely practised	Practised	Frequently practised

4.2 Risk spreading mechanisms

a)	Recognise the need to address climate change risks.	1	2	3	4
b)	Identify appropriate risk spreading mechanisms (e.g. insurance, relief fund, guarantee fund, etc).	1	2	3	4
c)	Adopt mechanisms in distributing the costs of climate-related losses.	1	2	3	4
d)	Others (please specify):	1	2	3	4

5.1 Technology for adaptation

a)	Keep abreast of technological options for adaptation (e.g. newsletter, conference, etc).	1	2	3	4
b)	Support R&D programmes for development of technological adaptation (e.g. advisory services, financial assistance, workshops, etc).	1	2	3	4
c)	Revive existing technologies in response to new climate conditions (e.g. reduce water loss, rainwater harvesting, etc).	1	2	3	4
d)	Develop/Adopt new technologies in response to new climate conditions (e.g. desalination, etc).	1	2	3	4
e)	Adopt proper framework for assessment of and access to technology (e.g. collaborative R&D on technologies, decision framework for selection of technology, etc).	1	2	3	4
f)	Consider management solutions along with technology fixes (e.g. data gathering, monitoring, early warning system, etc).	1	2	3	4
g)	Others (please specify):	1	2	3	4

1	2	3	4
Never practised	Rarely practised	Practised	Frequently practised

5.2 Resilience of infrastructure

a)	Revise/Update guideline on infrastructure using the latest climate information (e.g. modify design code, etc).	1	2	3	4
b)	Integrate climate change risks assessment in planning new infrastructure (e.g. adopt appropriate risk assessment framework, etc).	1	2	3	4
c)	Incorporate climate change adaptation elements in infrastructural development (e.g. use of climate projection results, etc).	1	2	3	4
d)	Assess existing infrastructure on risks to climate change (e.g. review of resilience and performance, due diligence, etc).	1	2	3	4
e)	Rehabilitate/Upgrade existing infrastructure against climate change risks (e.g. elevation of elements of critical infrastructure, etc).	1	2	3	4
f)	Others (please specify):	1	2	3	4

6.1 Flexibility

a)	Operations automatically update or adjust to accommodate new climate information or conditions (e.g. procedures linked to climate projections or risk assessment, etc).	1	2	3	4
b)	Integrate uncertainty in climate change into adaptation planning and decision making (e.g. sources of uncertainty identified, communicated and properly addressed, etc).	1	2	3	4
c)	Improve functional and capacity flexibility to meet future needs (e.g. skill development, involvement in decision-making, performance of different tasks or job rotation, etc).	1	2	3	4
d)	Others (please specify):	1	2	3	4

1	2	3	4
Never practised	Rarely practised	Practised	Frequently practised

6.2 Continuous improvement

a)	Maintain system for monitoring performance on a continual basis (e.g. key performance indicators, independent advisory & auditing, permanent process or procedures to monitoring actions, etc).	1	2	3	4
b)	Implement self-correcting features to trigger timely institutional adjustments (e.g. pre-defined triggers, rules for own review or modification of implementation procedures, etc).	1	2	3	4
c)	Undertake interventions in response to poor performance as the climate changes (e.g. essential revisions or modifications of implementation procedures, etc).	1	2	3	4
d)	Perform ex post analysis of policies and projects (e.g. procedures and records of formal and systematic review, identification and learning from lessons, etc).	1	2	3	4
e)	Establish resources in aid of finding innovative solutions (e.g. R&D and innovation programme or investment, financing for innovation projects, professional development plan, supports to multi-stakeholder networking and collaboration, etc).	1	2	3	4
e)	Others (please specify):	1	2	3	4

Comment: _____

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--- THANK YOU FOR YOUR FEEDBACK ---

Appendix 7: Publications

A) Asian Journal on Environment and Disaster Management (AJEDM), Special Issue 2010, Volume 2, Issue 4

No.	Papers	Authors
1.	Mainstreaming Climate Change Adaptation in the Asia Pacific: Current Status and Way Forward for the Agriculture and Water Sectors	S.V.R.K Prabhakar & Kyoto Matsumoto
2.	Climate Change Adaptation: An Overview of Southeast Asia	C.T. Tan, Pereira, J.J.
3.	Climate Change Adaptation: An Overview of Research in South Asia	Rajib Shaw
4.	Climate Change Adaptation: An Overview of Financing Mechanisms in the Agriculture and Water Sectors	Ancha Srinivasan & Abul Quasem Al-Amin
5.	Monitoring the Progress of Adaptation to Climate Change: The Use of Adaptation Metrics	S.V.R.K Prabhakar & Takuro Kobashi
6.	Mainstreaming Adaptation to Climate Change in the Agriculture and Water Sectors in India: An Overview of the Challenges	Arivudai A. Nambi & S.V.R.K Prabhakar
7.	Adaptive Capacity to Climate Change: Concept and Approaches for the Water Sector in Malaysia	C.T. Tan, Pereira, J.J., Mazlin M., Ibrahim K.
8.	Climate Change Adaptation Policy for Agricultural Livelihood in Malaysia	Alam,M.M., Chamhuri, & Al-Amin
9.	Climate Change Adaptation in Water and Agricultural Sectors in the Philippines	Pulhin J.M., R.J.J. Peras & M.A. Tapia
10.	Climate Change Adaptation in the Agriculture and Water Sectors: An Overview of Vietnam	Nguyen Van Thang & Tran Dinh Trong

B) Asian Journal on Environment and Disaster Management (AJEDM), Special Issue 2012, Volume 4, Issue 3

No.	Papers	Authors
1.	Climate change and adaptation in the Lower Mekong Basin	Lucas Neo
2.	Application of an operational framework for identifying successful adaptation projects in the Lower Mekong Basin	Li Ding
3.	Governance issues in climate change adaptation in the Lower Mekong Basin: Perspectives from practitioners	Lucas Neo
4.	Climate Change Impacts and Adaptation in the Water Resources and Agriculture in Vietnam: Case Studies in Mekong and Red River Deltas	Tran, T, Thang, N.V. & Tran Dinh Trong
5.	Developing multi-scale adaptation strategies: a case study for farming communities in Cambodia and Laos	Roth, C.R. & Clemens M Grünbühel
6.	Climate resilience in rural Cambodia: Adaptation mainstreaming, water resource management and agricultural practice	Lay Khim
7.	Baseline assessments, vulnerability analysis and finding sustainable livelihood options: Designing a climate change adaptation project in Ben Tre Province, Vietnam	Provash Mondal
8.	The conservation and development of the Kien Giang Biosphere Reserve	Sharon M. Brown

9.	Climate change adaptation through agro-social enterprise: Green Net's experiences in Thailand	Vitoon R. Panyakul
10.	Strengthening the Adaptation Agenda in the Mekong River Basin	Andreas Schaffer
11.	Climate Disasters and Climate Change in Vietnam: Tendency, Strategic Tasks, and Action Plans	Tran, T, Thang, N.V. & Tran Dinh Trong
12.	National Policy on Climate Change: Towards An Integrated and Balanced Approach for Adaptation and Mitigation in Malaysia	C.T. Tan, Pereira J.J., Lian Kok Fei
13.	Mitigation Co-Benefits of Adaptation and Actions in Agriculture: An Opportunity for Promoting Climate Smart Agriculture in Indonesia	S.V.R.K Prabhakar, S. Suryahadi, Irsal Las, Astu Unadi, Prihasto Setyanto
14.	A Decision Support System to Deal with Contemporary Issues of Climate Change Induced Vulnerability and Human Security in Peninsular Malaysia	Mohammad Imam Hasan Reza, Sharifah Munirah Alatas
15.	Climate Change Adaptation and Freshwater Resource in Malaysia: Creating A Culture of Intellectualism	Sharifah Munirah Alatas

Appendix 8: Photos

Appendix 8: Photos

1. Inception Workshop on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors, held on 10 August 2009 in Kuala Lumpur, Malaysia.

2. Project Members participating in the Workshop on Scenarios Concerning Climate Change Adaptation in Asia and the Pacific by Year 2030, held on 26 June 2010 in Port Dickson, Malaysia.

3. Minister (center) and Secretary General (center-right) of the Ministry of Natural Resources and Environment Malaysia officiated the National Symposium on Climate Change Adaptation, held on 16-17 November 2011 in Putrajaya, Malaysia.

4. Participants in the National Symposium on Climate Change Adaptation.

5. Pro-Chancellor of Universiti Kebangsaan Malaysia addressed his remark in the Workshop on Natural Disasters and Climate Change in Asia, held on 5 to 7 November in Bangi, Malaysia.

6. Participants in the Workshop on Natural Disasters and Climate Change in Asia.

Inception Workshop on Mainstreaming Adaptation to Climate Change in Agriculture and Water Sectors, held on 10 August 2009 in Kuala Lumpur, Malaysia.

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