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ADAPTATION NETWORK

EMERGING CLIMATE CHANGE ADAPTATION ISSUES IN THE ASIA-PACIFIC REGION

Edited by Puja Sawhney and Mary Ann Perkins

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Asia Pacific Adaptation Network (APAN)
APAN Regional Hub at the IGES Regional Centre
604 SG Tower, 6th Floor
161/1 Soi Mahadlek Luang 3
Rajdamri Road, Patumwan
Bangkok 10330, Thailand

Telephone: +66 2 651 8794 • Facsimile: +66 2 651 8798 • Website: www.asiapacificadapt.net

For general queries, feedback or comments, contact: info@asiapacificadapt.net

Preface

Throughout Asia and the Pacific, consequences of climate change are already impacting nations and communities across many different sectors. Rising sea levels, intensifying winters, prolonged droughts and increased risk of floods are but some of the impacts of climate change in Asia and the Pacific. In the midst of a changing environmental context, Governments strive to achieve and maintain water, food and energy security, while the people adapt day-to-day to preserve their livelihoods, homes and ways of life. As the struggle for access to natural resources intensifies, the need for trans-boundary and regional management of resources will also increase.

Efforts to adapt in the region are as diverse as the region itself. Many stakeholders such as government, civil society and the international community are engaged in adaptation from the national to the local level. Through its regional and thematic nodes, the Asia Pacific Adaptation Network (APAN) conducts activities related to knowledge management, and supports governments and other organizations working on climate change adaptation. This publication is a direct result of those efforts. *Emerging Climate Change Adaptation Issues in the Asia-Pacific Region* features a broad range of current research, innovative approaches and case studies in local, national and transnational adaptation drawn from the APAN regional and thematic nodes.

By sharing knowledge and experience from around the region, APAN aims to enhance capacities of decision-makers to assess technologies, access finance and design and implement adaptation initiatives. It is our hope that this report will add to the knowledge base on adaptation in Asia and the Pacific and strengthen the ability of policymakers to integrate climate change adaptation into development policies, strategies and plans.

I would like to take this opportunity to thank each of the authors who contributed to this volume and commend them for their ongoing efforts throughout the region to promote knowledge on climate change and the use of credible data, science and technology in adaptation efforts.

Masataka Watanabe

Chair of the Asia Pacific Adaptation Network

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The chapter authors include Mr. Brian Harding (consultant) (chapters 1 and 11); Mr. Raman Mehta and Mr. Sanjay Vashist of the Climate Action Network South Asia (CANSA) (chapter 2); Dr. Rico Ancog and Dr. Mariliza V. Ticsay of the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) (chapter 3); Dr. SVRK Prabhakar of the Institute for Global Environmental studies (IGES) (chapter 4); Ms. Priyanka Dissanayake of the Global Water Partnership South Asia (GWP–SAS) (chapter 5); Dr. Netatua Pelesikoti, Mr. Peniamina Levai and Mr. Espen Ronneberg of the Secretariat of the Pacific Regional Environment Programme (SPREP) (chapter 6); Ms. Nailya Mustaeva and Mr. Rustam Arstanov of the Regional Environmental Centre for Central Asia (CAREC) (chapter 7); Prof. Wanglin Yan of the Research Centre for Climate Change Adaptation at Keio University (RCCCA) (chapter 8); Mr. Anmol Jain (consultant), Dr. Dhrupad Choudhury and Ms. Neera Shrestha Pradhan of the International Centre for Integrated Mountain Development (ICIMOD) (chapter 9); and Ms. Catherine B. Diomampo of the Local Governments for Sustainability Southeast Asia Secretariat (ICLEI SEAS) (chapter 10).

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Abbreviations and acronyms

ADB	Asian Development Bank
CANSA	Climate Action Network South Asia
CAREC	Regional Environment Centre for Central Asia
CBA	community based adaptation
CCA	climate change adaptation
CSA	climate-smart agriculture
DRR	disaster risk reduction
ENSO	El Niño Southern Oscillation
GDP	gross domestic product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ICIMOD	International Centre for Integrated Mountain Development
IPCC	Intergovernmental Panel on Climate Change
JNAP	Joint National Action Plan
LAPA	Local Adaptation Plan of Action
LDCs	least developed countries
M&E	monitoring and evaluation
MDBs	multi-lateral development banks
NAP	national adaptation plan
NAPAs	National Adaptation Programmes of Action
NCCAP	National Climate Change Action Plan (Philppines)
NGOs	non-governmental organizations
OECD	Organisation for Economic Co-operation and Development
RBMES	results-based monitoring and evaluation system (Philippines)
REDD+	reducing carbon emissions from deforestation and degradation of forests
Rio+20	United Nations Conference on Sustainable Development
SAPCC	State Action Plans on Climate Change
SIDS	Small Island Developing States
SPREP	Secretariat of the Pacific Regional Environment Programme
TANGO	Technical Assistance to Non-Governmental Organizations
UNFCCC	United Nations Framework Convention on Climate Change
UKCIP	United Kingdom Climate Impacts Programmes
V&A	vulnerability and adaptation
WII	Weather Index Insurance
WTO	World Trade Organization

Executive summary

This report aims to fill a need for the latest thinking on climate change adaptation (CCA) in the Asia-Pacific region, thus the members of the Asia Pacific Adaptation Network (APAN)* produced this report titled *Emerging Climate Change Adaptation Issues in the Asia-Pacific Region* to address pertinent and relevant issues in the region and sub-regions. This report aims to raising awareness and building the capacity of policymakers to deal with CCA.

APAN is a regional network for managing and applying adaptation knowledge in the Asia-Pacific region and supports governments and other organisations working on adaptation, with emphases on knowledge management and capacity building. APAN operates through its regional hub in Bangkok and through its sub-regional and thematic nodes located in Central Asia, South Asia, Southeast Asia, Northeast Asia and the Pacific.

For the publication, each APAN node identified challenges, gaps and recent trends in CCA in their region. They have highlighted emerging priority issues at the national and sub-regional levels in addition to major developments, the latest policies and strategies, new institutional support frameworks and analysis of key studies within APAN. The nodes have provided practical examples of mainstreaming adaptation into national development in each sub-region.

The chapters of this report address aspect of planning climate adaptation projects, seeking and mobilising funds and implementing adaptations APAN sub-region or within climate sensitive sectors. New terminologies and trends in climate change policy and strategy development are described along with the strengths and weaknesses of the institutional frameworks underpinning project implementation.

The research undertaken has aimed to keep track of recent concepts and relevant issues in the region and factor in the latest scientific consensus from the Intergovernmental Panel on Climate Change (IPCC). Emerging and priority issues in climate adaptation are highlighted at the national and sub-regional levels and across different thematic areas.

Each chapter contains examples of good practices and case studies in the use of technologies and tools to deal with CCA. The chapters also provide general recommendations and possible future actions that are relevant to all Asia-Pacific countries.

The APAN nodes have gained valuable knowledge in carrying out their work. As CCA will be an essential pillar within the future climate regime and United Nations sustainable development agenda, the lessons drawn from their work offer valuable insight for others. The new agreement (currently being negotiated for adoption in 2015) will shape the approach to adaptation under the United Nations Framework Convention on Climate Change beyond 2020. Within the Copenhagen and Cancun agreements, developed countries pledged $30 billion in climate finance from 2010 through 2012 (the “fast start” period) and agreed to mobilise $100 billion a year in public and private finance for developing countries by 2020. Many opportunities lie ahead for APAN members to strengthen their institutions and play a part in implementing actions in the region.

* www.asiapacificadapt.net

I. Introduction

BRIAN HARDING[2]

The changing narrative of climate change adaptation

Humans and their activities are presently the main cause of changes in earth's atmospheric composition and the principal driver for future climate change (IPCC, 2007; IPCC 2014). The trend of long-term global warming is predominantly a forced climate change caused by increased human-made atmospheric gases, mainly CO_2. The latest science indicates that a significant reduction in emissions is essential to stabilize climate and avoid potentially disastrous impacts on the most vulnerable, on future generations and on biodiversity.

It is clear, that enormous and rapid emissions reductions are required to restore Earth's energy balance and avoid ocean heat uptake. Continuation of high fossil fuel emissions, given current knowledge of the consequences has been described as an "act of extraordinary intergenerational injustice" (Hansen et al. 2013).

According to the recently released fifth assessment report of Working Group I of the Intergovernmental Panel on Climate Change (IPCC), the atmosphere and ocean have warmed, the amount of snow and ice has diminished, the global mean sea level has risen and the concentrations of greenhouse gases have increased. In Asia and the Pacific there have been observed increases in temperature of 0.4°C–1°C. Temperatures are predicted to increase on average by 1.5°C–2°C by 2046–2065, with the greatest warming in the north-western areas of the region including Thailand, Myanmar, Lao PDR, Cambodia and Vietnam. The majority of countries in the Asia-Pacific region currently suffer from low levels of water security, according to the Asian Development Bank (ADB) and the Asia-Pacific Water Forum (ADB 2013).

Adaptation is crucial to combat the adverse impacts of climate change that are happening now, to increase resilience to future impacts and to enable climate-resilient socio-economic development. Countries, regions and communities are beginning to adapt to present and future impacts, undertaking processes to deal with the problem. Assessing such adaptation options is not easy. With multiple priorities within governments and communities, it can be difficult to emphasize that an adaptation approach is needed. New tools in cost-benefit analysis and better science help in framing the debate for those tasked with integrating adaptation into national planning.

The first chapter in this edited volume deals with the complex linkages between development and climate change adaptation (CCA). The Climate Action Network South Asia (CANSA) outlines concepts, policies or tools for adaptation, the need to link them to the overall development process and the need to create an enabling environment for climate-resilient

[2] Independent consultant

socio-economic development. The need for adaptation is explained and how it can assist in combatting the adverse impacts of climate change that are happening now. Countries, regions and communities adapting to present and future impacts are beginning to undertake processes to deal with the adaptation problem. This chapter discusses initial efforts to increase awareness of climate change at senior levels of power and how this is beginning to filter down (a topic covered in greater detail in chapter 5). Some of the challenges that this poses for governments are outlined. In analysing the crossover between climate change and the development agenda, CANSA uses a sector-based approach to demonstrate the need for linkages between these interconnected areas. Specifically, it provides a detailed analysis of agriculture and food security; water conservation and its efficient use; forestry, coastal and marine zones; fragile ecosystems; disasters and climate resilient infrastructure in the context of the Asia-Pacific region.

Multiple forums are now being developed to complement the work of the secretariat of the United Nations Framework Convention on Climate Change (UNFCCC). A world summit on climate change recently held at United Nations headquarters in September 2014 was a preliminary step towards the negotiation of a new climate treaty that will take place in Paris in late 2015. The World Economic Forum also allotted much time to CCA in 2014 and 2015. The broadening of narratives around CCA means there are now many voices contributing to the area in Asia and the Pacific.

Countries are beginning to adjust to this new strengthened interest in adaptation at multiple levels. The emergence of the Adaptation Committee within the UNFCCC secretariat has led to the establishment of a new national adaptation plan (NAP) process to facilitate effective adaptation planning in the least developed countries (LDCs) and other developing countries. The NAP process aims to reduce vulnerability to climate change impacts by building adaptive capacity and resilience, and to help integrate adaptation into relevant policies, programmes and activities, especially in the context of development. The *Technical Guidelines for the National Adaptation Plan Process,* produced by the LDC Expert Group in December 2012, details a series of steps for producing NAPs. As countries begin to develop NAPs, there will be a need for many voices to be heard in the implementation of actions at the national level. Organizations that assist countries with CCA will have an important role in shaping thinking both regionally and nationally.

One such emerging area where climate change is beginning to be integrated into national development is within agriculture and chapter 2 explains climate-smart agriculture (CSA), the evolution of the concept and its different components. It looks in depth at CSA needs in the context of South-East Asia and focuses on how improving food security and CCA should go hand in hand. The chapter gives details on reducing vulnerability and managing risk in agriculture and presents emerging policy responses. The chapter outlines how CSA responses will be shaped by specific country contexts and capacities and by the particular social, economic and environmental situation of each country.

Chapter 3 complements chapter 2 in looking at several risk insurance initiatives that have been implemented over the years at the grassroots level in Asia and the Pacific for reducing the vulnerability of communities to disasters. It outlines efforts to increase the penetration of risk insurance in developing countries in the region and considers barriers that this sector is

facing. This chapter assesses the benefits accrued through experience with community-level risk insurance in some developing countries, evaluates barriers limiting the penetration of crop insurance, and identifies interventions for greater risk insurance penetration to adapt to CCA and reduce disaster risk.

Water is another key sector threatened by climate change. Chapter 4 considers water security in South Asia in the context of a changed climate. This chapter is set against the backdrop of understanding how hydro-meteorological disasters will occur more frequently, have a higher intensity and create a high level of uncertainty in the coming years. The chapter details barriers to better trans-boundary water management, including the lack of regional data-sharing on flood, tsunami, cyclone forecasting. The chapter emphasizes the need to initiate data-sharing programmes for forecasting and early warning for floods and other climate induced disasters. A number of good practices are outlined from specific countries in the region. Furthermore, a section on how countries can better integrate indigenous knowledge and modern technology into development planning and policy and institutional responses adds fresh insights.

Post 2015 adaptation

The adaptation agenda under UNFCCC has evolved greatly during the past 15 years. Initial focus on vulnerability and adaptation assessments determined the need for adaptation and the first steps in project planning and pilot implementation. There is now a greater understanding of how to undertake and scale up adaptation in the context of national planning. Monitoring and evaluation (M&E) of adaptation activities and supports to building such systems into national planning is only just beginning.

Developing countries have communicated their adaptation needs through national communications, National Adaptation Programmes of Action (NAPAs) and now NAPs. This created political impetus and direction to other United Nations agencies, multilateral development banks (MDB) and regional organizations, which in turn established programmes to address those needs. Many United Nations agencies such as the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) as well as multi-lateral development banks (MDBs) such as the World Bank have created adaptation portfolios providing support to parties to UNFCCC (Adaptation Committee 2013).

The experience gained and lessons learned so far indicate that adaptation to climate change will be an essential pillar within future climate regime. This new agreement (currently being negotiated for adoption in 2015) will shape the approach to adaptation under UNFCCC beyond 2020. These actions will support and extend the sustainable development framework that was resulted from the 2012 United Nations Conference on Sustainable Development (Rio+20) and the upcoming United Nations development agenda beyond 2015.

Chapter 5 looks at linkages between disaster risk reduction (DRR) and CCA in the context of the Pacific. The Secretariat of the Pacific Regional Environment Programme (SPREP) details how the Joint National Action Plan (JNAP) process is increasing understanding about the relationship between disasters, environment and climate change and their effects on

sustainable development and resilience. It describes the integrated development and risk management frameworks behind these concepts and it puts forward possible measures to address these across the continuum of development-risk reduction and risk management. The chapter advocates for an integrated development and risk management framework which reflects globally accepted principles and JNAPs may be the first step toward that objective. Further examples from the Pacific region outline multiple ongoing initiatives in Small Island Developing States (SIDS).

Chapter 6 looks at the challenging environment of mainstreaming and combining CCA approaches and DRR in Central Asia. The Regional Environment Centre for Central Asia (CAREC) presents ways in which governments have undertaken policy, strategic planning and institutional development in the light of CCA at the regional and national levels. CAREC raises awareness among the public and decision-makers through trainings and involving target groups in adaptation and DRR activities. CAREC is beginning to develop and implement adaptation technologies in economic sectors that are vulnerable to climate risks.

Within the Copenhagen and Cancun agreements, developed countries pledged $30 billion in climate finance from 2010 through 2012 (the “fast start” period) and pledged to mobilize $100 billion a year in public and private finance for developing countries by 2020.

The UNFCCC lays out adaptation as the strategic action to address the impacts of climate change. Developed countries have committed to mobilize resources to help developing countries address such impacts. The global economic crisis has greatly affected developed economies, caused great political upheaval and influenced the views of citizens on financial commitments to the developing world.

Although there has been huge turmoil in the past few years, a portfolio of projects and programmes has increased since the creation of funds which support climate adaptation. In fact, financing adaptation has become an incredibly complex area and many organizations struggle to find expertise, as well to find the ability to manoeuvre around the esoteric governance of such funds.

Just as financing has become more complex, climate change policies and laws in the Asia and Pacific region have also become more complicated. Chapter 7 explores the interface between science and government policies related to adaptation. Nepal’s climate change policy preceded the publication of its policy on its Local Adaptation Plans of Action (LAPA). This trend continues as governments begin to find ways to include climate change thinking in national policy regimes. In the Pacific, JNAPs have brought many benefits including increased understanding among stakeholders about the close relationship between disaster risk management and risks associated with climate change; and the need for a collaborative whole of government and country-based approach to development and risk management. Such initiatives are the first step in upscaling successful programmes.

With regards to the law, there are many legal tools that can support CCA. Some will need to be developed and others can be built into existing legal frameworks. For example, the present lack of clear definition on climate refugees will continue to demand a legal response, and each country in Asia and the Pacific takes a different approach. For example, South

Korea has a legal regime, which established and successfully supports a corridor with national spiritual, ecological and adaptation significance. Conditions for community-based adaptation in the Pacific Islands are conducive, featuring strong traditions of local governance, management of natural commons and traditional and local ecological knowledge.

Knowledge management

CCA stakeholders are increasingly engaged through multiple communications methods. For example, Twitter users can actively engage in discussions on technology and long-term finance. The *Adaptation Exchange* page of UNFCCC on Facebook, which aims to provide a space for dialogue on adaptation to the impacts of climate change at all stages of adaptation planning and implementation, has greatly grown.

The Asia Pacific Adaptation Network (APAN) portal has also seen a growth in interest. Many groups are trying to find ways to engage new audiences while also managing the vast collection of knowledge that is being developed at the moment. In Chapter 8, the International Centre for Integrated Mountain Development (ICIMOD) addresses the issue of communications in the Hindu Kush Himalaya. The chapter examines key stakeholders in the region and reports on an online survey that was carried out as part of the research. The chapter describes the growing realization in the region that climate change communication is essential for CCA, for increasing awareness and understanding and for engaging policymakers and the general public.

The specific example of the Hindu Kush Himalaya is used where the challenges of geo-physical inaccessibility and socio-economic diversities among mountain communities pose challenges for effective communication between different stakeholders, particularly between state actors at local, sub-national and national levels. This chapter highlights good practices and examples and outlines some policy and institutional frameworks, including a recently developed Adaptation Learning Highway that could be employed to overcome barriers to communicating on climate change.

Monitoring and evaluation

It is telling that the Adaptation Committee's first UNFCCC workshop focused on adaptation M&E. This gave the group an opportunity to elaborate on the definition of success, on aligning different project and national-level assessments, and on ways to encourage learning as a core objective of M&E. This core part of project preparation and implementation has been very challenging. Chapter 7 deals with some of the latest thinking on this specific overarching issue. It is clear that climate change practitioners need to find ways to clearly validate their impacts and find better ways to measure if they have actually improved community resilience, reduced individual and household vulnerability and contributed overall to a society's ability to adapt to a changed climate.

Chapter 9 provides a regional overview of how M&E for CCA has taken place in recent years. Again, examples of good practices are put forward and the continuing gaps and challenges in this particular area are described. When it comes to CCA initiatives, M&E is still seen as an emerging field. The chapter describes new frameworks, tools and approaches that have been developed and are still being developed to address challenges

inherent to evaluating and monitoring adaptation initiatives. How South-East Asian countries are beginning to recognise the importance of M&E but they differ in terms of developing M&E systems for CCA initiatives at the national level is described. Examples of some, which are in the final stages are given while several countries are still in the initial or conceptual stages, their M&E systems are described. It is highlighted that no comprehensive M&E system has been put in place in the region for CCA.

The establishment of an M&E system for CCA is closely linked with each country's progress in adapting to climate change. However, barriers which include lack of coordination among ministries, poor execution of written plans/strategies and a lack of resources (e.g. financial and technical) is being found in all countries. The need for further information on countries' efforts to monitor and evaluate their CCA programmes and projects is very limited. There remains a high potential for augmenting knowledge transfer and exchange on CCA M&E in the region and this is elaborated in this chapter.

A final conclusion chapter makes the case for further research and more consolidation of lessons learned for APAN members and makes a rallying call for great understanding of CCA at the policy level and the real need to allow the finance to be present to test and innovate in this area on the ground in the Asia-Pacific region.

II. Linkage between development goals and climate change adaptation

RAMAN MEHTA AND SANJAY VASHIST[3]

Introduction

The South Asian region is varied and thus the situation of different countries along with their responses vis-à-vis climate adaptation differs. There are, however, some similarities as well as patterns across the South Asian sub-regions and countries that show some degree of congruence.

There is a growing body of evidence within South Asia about the linkages between development and climate change adaptation (CCA) and a slow recognition that both are intertwined challenges. However, long-term vision documents and national planning documents of governments in the region generally don't explicitly identify such linkages. Instead there has been a growing body of literature by governments on the challenges of climate change within sectoral plans and strategies. This chapter provides a brief analysis of the various national plans and policies for this sub-region, taking examples from India, Bangladesh, Afghanistan, the Maldives, Pakistan and Nepal.

The analysis includes national development plans that were available in the public domain of the countries in South Asia. This has been done from the perspective of how comprehensively climate change is addressed in the relevant sectoral planning strategies such as agriculture, water, forestry etc. The comprehensiveness of dealing with climate change has been done on the basis of both level of recognition of the phenomenon of climate change, as well as relevant policy responses to deal with the expected challenges and threats

India

Climate change is not listed as a priority within India's 12th Five Year Plan entitled *Faster, More Inclusive and Sustainable Growth* lists several challenges and priorities for India's development. Consistent with the title of the plan, the key section on sustainability focuses on enhancing electricity production and the strategic choices that India needs to make in the future.

One could argue that some aspects of managing natural resources and the environment especially those relating to soil health, land use and water management are a pathway to climate adaptation, but this linkage is not clearly set out within the document. Key policy initiatives that are needed to be taken, does not feature climate change, however there is an emergence of the linkages between agriculture and a changed climate with vulnerabilities of the sector being explicitly identified in the detailed chapter on agriculture later on in the plan document.

[3] Raman Mehta and Sanjay Vashist are affiliated with the Climate Action Network South Asia (CANSA).

Bangladesh

The Sixth Five Year Plan of Bangladesh does however explicitly identify the threats that the impacts of climate change pose for the country. However, the overall developmental policy thrust in the plan mostly excludes CCA. The plan strategy mostly focuses on growth and employment, while dealing with CCA peripherally at best.

Nepal

Nepal's 13th Plan Approach Paper (2013) identifies the protection of natural resources and the environment as a priority, but like other national plans of the region, does not integrate CCA into its overall development strategy or goal.

Maldives

The Seventh National Development Plan of Maldives also does not deal with climate change adequately within the overall framework of its development goals. This, despite being perhaps the most vulnerable country in the region to the impacts of climate change, with the possible exception of Bangladesh.

Afghanistan

Afghanistan's National Development Strategy is completely silent on CCA.

Pakistan

While Pakistan's Annual Plan 2013–2014 admits, "Due to financial crunch as well as devolution process, environment sector could not receive desired resources and focus".

CCA and its linkages with overall development goals in the region is in its infancy. This is exacerbated by two key problems. Typically, CCA is the responsibility of the Ministries or Departments of Environment, while other line departments deal with climate sensitive sectors such as agriculture. This creates silos and a disconnect between climate adaptation and national development. On the other hand, climate change requires an integrated and holistic approach and is hampered by the manner in which ministries communicate efficiently or effectively with each other. This governance challenge is the primary hurdle why climate change concerns have not been effectively addressed under overall development strategies in the region.

In the context of sustainable development and many of the priorities that national governments have identified, to not integrate CCA into sectoral and national development strategies appears problematic and looks set to continue. Broad planning documents, such as national plans should be clearer in how climate change can set back national development and contribute to low emission development pathways. This integrated approach to climate change, as evidenced by this brief review of regional documents shows evidence that this is currently not the case.

The following sections look at key climate related sectors (e.g. agriculture, forestry, disaster management) in the region and identify areas where there is evidence of adaptation being more fully integrated and areas where more work is needed.

Emerging and critical issues on climate adaptation

A reading of the various national development plans and climate policies draws attention to the following sectors in which the criticality of adaptation to climate change is becoming clear at the official level.

Agriculture and food security

Agriculture is a sector that is crucial to achieve many of the goals of poverty alleviation and social empowerment in South Asia. In addition, it is also a part of ensuring food security of the countries of the region. A climate sensitive sector, such as this does need to have adequate long term planning around a changing climate any benefits that may have accrued on poverty alleviation, social empowerment and food security could be eroded.

Agriculture continues to make a significant contribution to the economies of South Asian nations compared to the rest of the world. In addition, agriculture provides employment to a majority of the South Asian work force.

As this sector is one of the most vulnerable to climate change and to a large extent determines the economic health and social wellbeing of the people of South Asia, it remains an important focus for planners in adaptation programming. The 12th Five Year Plan of India identifies risks such as loss of productivity of crops, especially wheat, variability of sowing and harvesting calendars due to variability of temperatures and precipitation, resource use efficiency and management and conservation and the use of appropriate seeds and associated technological shifts and changes as priorities for climate adaptation (India 2012, closses due to flooding, salinity and drought and how these associated impacts on livelihoods and subsistence agriculture must be priority areas for adaptation in agriculture (Bangladesh 2011, 205). Pakistan's National Climate Change Policy of 2012 highlights the vulnerability of agriculture to enhanced heat and water stress in the semi-arid areas of the country, saline water intrusion in the Indus river delta and possible changes to sowing and harvesting activities as adaptation areas to be focused on (Pakistan 2012, 2 and 6).

Water conservation and efficient use

South Asia's water resources are relatively limited. Relevant data on the availability of water indicates that per capita availability of water in South Asia is 1,217.27 m^3, which is low when compared with the rest of the world (6,122.56 m^3).[4] At the same time, utilization of water is relatively much higher in the region since reportedly, South Asia utilizes 51.64 per cent of its annual internal resources of fresh water. This is very high when compared with the rest of the world that reportedly uses 9.19 per cent of the annual freshwater resources available globally.[5]

Furthermore, due to the structure of the South Asian economy, utilization of water for agriculture is much higher than for the more developed economies of the world. Agricultural water use in South Asia is as high as 91.15 per cent of total consumption of water while among OECD countries water use for agriculture is only 44.1 per cent of total consumption.

[4] Renewable internal freshwater resources per capita (cubic metres), derived from World Bank databank.
[5] Annual freshwater withdrawals, total (percentage of internal resources), derived from World Bank databank.

Even the global average water use for agriculture is lower at 70 per cent.[6] As water use rises for industrial purposes, stress on this natural resource could be a major impediment for future economic growth and job creation in a sustainable manner. The impacts of climate change on availability of water could further squeeze the prospects of sustainable economic growth.

Moreover, regionally aggregated data on water hide the fact that many of the sub-regions of South Asia already suffer from an acute water shortage, both for domestic use as well as for agriculture and industry. Policymakers of the region are fully aware thus, water conservation and its efficient use is a major area of focus in many recent policy statements. India has thus enacted a National Water Mission under its National Action Plan on Climate Change. The 12th Five Year Plan of Government of India has highlighted several aspects of traditional water management that need to be modified due to impacts of climate change as well as the changing and growing demand patterns of the country. In addition, the 12th Five Year Plan also focuses on the aspects of specific impacts of climate change – such as receding glaciers in the Himalayas – that need to be studied further. In addition, demand management and efficient use of water is also focused on. Pakistan's National Climate Change Policy identifies water as a major sector to be focused on and goes onto state that there will be "significant impact on the spatial and temporal distribution of water resources on both annual and inter-annual basis in the country. This will further exacerbate the already difficult situation of a water-stressed country facing demand increases due to population growth and increasing economic activity" (Pakistan 2012, 3).

Forestry

Forests occupy around 17 per cent of the landmass of South Asia, which is around half of the percentage of land that is under forest cover (around 30 per cent) globally. However, these ecosystems are important repositories that support diverse natural systems and life forms. They provide ecosystem services that support livelihoods and are critically important for economic sectors such as agriculture, water and forests In addition, forests also support many poor communities with their food requirements. In view of this and given that forests are themselves threatened because of climate change, they are an important focus of adaptation.

In addition, many of the adaptive measures that need to be undertaken have an additional co-benefit of mitigation since these ecosystems are an important means of carbon sequestration. Given this congruence of priorities, it is no surprise that many official initiatives on climate change focus on forests.

One of the missions of the National Action Plan on Climate Change titled Green India Mission focuses on forest adaptation and mitigation. Further, the 12th Five Year Plan of India specifically mentions:

> "the forestry sector helps in mitigation by sequestering carbon, and helps in adaptation by increasing resilience of the system through ecological services of water retention, reduction in soil erosion, enhanced provision of renewable resources and so on. The forestry sector can make a positive contribution both in the numerator and

[6] Annual freshwater withdrawals, agriculture (percentage of total freshwater withdrawal), derived from World Bank databank.

the denominator, first, by increasing the forest carbon sink, and second, by increasing the gross domestic product. Local livelihoods depending on forests are most likely to be impacted adversely not only because of climate change, but also due to continued pressure of land use change for development and other purposes."

Nepal's 13th Plan Approach Paper lists forests as a major focus of attention since forest-dependent communities of Nepal are both poor and vulnerable. Furthermore, the immediate wellbeing of these forest-dependent communities is related to the health and productivity of its forests, which need to be managed keeping in mind not just productivity, but also the impacts of climate change on forest ecosystems (Nepal 2013).

The Pakistan National Climate Change policy states:

> "Climate change is likely to have multi-faceted adverse effects on the ecosystem as a whole, particularly on the already vulnerable forestry sector in Pakistan. The most likely impacts of climate change will be decreased productivity, changes in species composition, reduced forest area, unfavourable conditions for biodiversity and higher flood risks, as portrayed in the Planning Commission Task Force on Climate Change Report (Pakistan 2010). Adaptation in the forestry sector entails the need to restore and enhance Pakistan's forests under sustainable forest management, with particular focus on how these are affected by climate change. This will not only benefit state forests but forest dependent communities and society as a whole" (Pakistan 2012, 9).

Coastal zones and marine areas

South Asia has a densely populated coast along with many large and small urban clusters that are vulnerable to a rise in sea level. Many of the economically critical assets such as ports are similarly vulnerable. In addition, South Asian coasts are also rich in biodiversity and commercially important coastal and marine species of fish and other important coastal and marine life forms that need to be protected for both ecological as well as social and economic reasons. These ecosystems are now beginning to receive increasing attention from planners and policymakers.

India's 12th Five Year Plan states that so far:

> "Protection and management of coastal areas is not specifically covered under any of existing programmes. During the Twelfth Plan, this gap needs to be filled by according priority to the Integrated Coastal Zone Management (ICZM). The ICZM policies should be designed to afford protection against coastal vulnerabilities. Coastal zone regulations concerning construction activities have recently been modified to take into account the likely prospect of long-term rise in sea levels. Infrastructure development near the coast also needs to take these risks into account. Climate Change Impact Assessment needs to be integrated into the existing practice of cumulative impact assessment of the environment. Comprehensive modelling of the coastal processes incorporating all necessary parameters is essential for planning mitigation and adaptation strategies."

Maldives, an island nation that is heavily dependent on its coastal and marine natural wealth is also focused on this issue. The Seventh National Development Plan of Maldives clearly states:

> "Global warming and the associated sea level rise threaten the fragile ecosystems of the Maldives where 80 per cent of islands are less than 1 m above mean sea level. The tsunami of 26 December 2004 truly exposed the vulnerability of the Maldives. Most of the islands that suffered damage had little or no coastal protection. The islands are fully exposed to the dangers of wave action, erosion and flooding. While a tsunami of the magnitude experienced in December 2004 is an extremely rare event, with the predicted sea level rise, flooding may become a more frequent phenomenon" (Maldives 2007, 9).

Pakistan's National Climate Change policy also describes the challenges to its coastal ecosystems in this manner:

> "Coastal areas in Pakistan are already exposed to a number of natural hazards due to climate change. Tropical cyclones, severe storms, floods, shoreline erosion and other hazards all affect our coastal areas, causing loss of life and damage to property and infrastructure. Possible impacts of projected sea level rise in Pakistan could be erosion of beaches, flooding and inundation of wetlands and lowlands, salinization of ground and surface waters, and increased intrusion of seawater into the Indus deltaic region (IDR) as well as the increased risk of cyclones originating in the Arabian Sea. Similarly, Pakistan's marine coastal ecosystems are likely to be severely impacted by climate change: change in seawater temperature and acidification; cyclones; relocation and movement of marine fish and mammals; and heat induced drying of deltaic areas" (Pakistan 2012, 16).

Other fragile ecosystems

The Himalayas and its associated mountain ranges are the lifeline of much of South Asia since most of the major rivers of the region including the Indus, the Ganga and the Brahmaputra originate here and provide water to the plains for agriculture, industry and domestic use. As such, the impact of climate change on glaciers that feed these river systems will in turn have a major impact on natural and human modified ecosystems as well as economic and social life in most of the plains of the region.

Primarily in response to this, there are initiatives already underway. India, for example, has a mission on Sustainable Himalayan Ecosystems as part of its National Action Plan on Climate Change. "The four key issues to be addressed by the mission are (i) Himalayan glaciers and the associated hydrological consequences, (ii) biodiversity conservation and protection, (iii) wildlife conservation and protection, and (iv) traditional knowledge societies and their livelihood" (India 2012, 227).

Pakistan's National Climate Change Policy has a focus on mountains and identifies that the risks to mountains will include:

> "Increase in frequency and intensity of precipitation, resulting in more frequent flash floods and landslides; Increase in intensity of wind storms and lightning, resulting in top soil erosion and forest fires; Increase in temperature, resulting in rapid glacier melting and glacial lake outburst floods and change in cropping patterns" (Pakistan 2012, 13).

Disasters

Bangladesh is globally recognized as one of the most vulnerable nations to the impacts of climate change. It has vulnerabilities along its coasts, as well as flooding due to its location as a lower riparian region of major Himalayan Rivers such as Ganga and Brahmaputra. As such, it is one of the most disaster-affected countries of the world. Disaster risk reduction as well as emergency response to disasters are both integrated in the official strategy of development in Bangladesh (2011).

There is increasing focus in India on management of floods due to recognition of their rising frequency and intensity. In addition, early warning systems have already being implement (e.g. Tsunami, warning) or are being initiated (India 2012). Nepal's 13th Plan Approach Paper (2013) that there is a need to integrate climate change concerns into disaster management. The National Climate Change Policy of Pakistan states:

> "Climate change is likely to increase climate-related natural disasters with the projected increase in the frequency and intensity of extreme weather events, including floods, droughts, cyclones, landslides triggered by heavy rains and urban flooding due to congestion of storm drainage. Climate change projections are scenario-based and hence have some degree of uncertainty. Nonetheless, there are strong indications that in South Asia, particularly in Pakistan, climate change is intensifying the above-mentioned hazards. Pakistan is already experiencing climate change impacts, which are too visible to ignore. Most disasters or hazards that lead to destruction cannot be prevented; their impact however, can be minimized by adaptation and preparedness measures" (Pakistan 2012, 18).

Climate resilient infrastructure

One of the limiting factors in South Asia's economic growth and development is lack of adequate infrastructure. Infrastructure needs to be expanded quickly, for which investments are needed. However, with the impacts of climate change manifesting themselves in the region and imposing a significant cost (India 2012, 299),[7] there is a need to ensure that infrastructure development is climate resilient, so that valuable investments are not wasted due to climate impacts in the future. It is in this context that at least some of the policymakers of South Asia are beginning to look at how to go about investing in infrastructure from the point of view of climate resilience. The 12th Five Year Plan of India mentions:

> "Infrastructure plays a pivotal role in development. Hence, the large investments planned for future have to be protected against climate-change induced risks. This includes the infrastructure related to energy resources. An integrated climate change risks management framework for infrastructures should include market and policy induced enforcements and adaptation strategies. The key to manage risks lies in identifying them and initiating appropriate risk management and adaptation initiatives" (India 2012, 226).

Apart from incorporating climate resilience in all investment decisions holistically, there is also awareness that infrastructure needs to be created specifically to be able to deal with disasters, especially in those locations where climate vulnerability is high. This is reflected in

[7] Loss and damage due to disasters are estimated to be up to 2 per cent of India's GDP.

most of the national plans and policies that were looked at. For example, the Bangladesh Five Year Plan states that there are plans to "ensure that existing assets (e.g. coastal and river embankments) are well-maintained and fit-for-purpose and that urgently needed infrastructure (e.g. cyclone shelters and urban drainage) is put in place to deal with the likely impacts of climate change" (Bangladesh 2011, 204).

Science, technology, research and development

There is growing awareness in the region that technological fixes from elsewhere do not always work appropriately. There is also awareness that the region must find indigenous technological solutions for which its own scientific community must engage on research at all levels and in all aspects of climate change. This is illustrated by a statement of intent in the 12th Five Year Plan of India as follows:

> "national capacity on climate change science needs to be developed over wider cross section of scientists and R&D professionals. Accordingly, under the National Action Plan for Climate Change, Department of Science and Technology (DST) shall coordinate two missions under which formation of knowledge networks and thematic centres has been proposed by DST. These actions are focused on stimulating the latent and inherent capacities of the universities and research institutions. Public Private Partnership for R&D for adaptation and mitigation of climate change will be another tool to be used. R&D sector may need to develop technology plans for solving the environment-related challenges of such sectors in association with the relevant line Ministry, and accordingly efforts of all the players need to be significantly synergized in the area of R&D on environment during the Twelfth Plan period" (India 2010, 241).

This is further reinforced by the following statement:

> "Considering the importance of scientific assistance to policymaking, we need to create a more systematic and credible institutional arrangement that would enable us to continuously enhance the understanding of the 'science' of climate change. It should make a regular assessment of the impacts due to changes in the climate system and also assess the extent and nature of key vulnerabilities. It should include systematic preparation and publication of Green House Gas inventory, preparation of National Communications (NATCOMs) as per international obligations, and facilitate mainstreaming of climate change related studies" (India 2012, 230).

Similarly, Bangladesh has identified several initiatives that it plans to take during the Sixth Five Year Plan period that are specifically focused on research and knowledge management (Bangladesh 2011, 208). The National Climate Change Policy of Pakistan also recognizes that there are deficits in the domain of climate science and research as well as technology deployment for which it has suggested measures for capacity building and institutional strengthening (Pakistan 2012, 30).

Conclusions and recommendations

There is a realization in many quarters, though the level of this realization could certainly be much higher, that CCA must be a crucial element of any sensible, sustainable development strategy. While this may already be happening in many ways, certain critical and explicit

steps must be taken to begin dealing effectively with the emerging climate change impacts. Some of these immediate steps are highlighted in the sections below.

Integrate CCA into national development strategies

National development strategies of South Asian nations continue to be heavily focused on GDP growth. This is problematic from two points of view. One, it is based on an assumption that growth will automatically result in more jobs and thus higher prosperity and lower vulnerability. This, however, is not supported empirically, at least in the South Asian region, to the extent that growth of jobs has not corresponded to growth rates of GDP. Second, the focus on GDP growth tends to translate into focus on higher production in sectors such as agriculture and manufacturing, without ensuring that the higher production is being achieved in a sustainable and climate resilient manner. While there is an ongoing, albeit peripheral debate, on examining the sustainability of the current rates of relatively higher growth and their costs in the region,[8] it has not found its way into strategic planning for economic development. Only when CCA and environmental and social concerns are truly integrated into economic growth planning, will there be a material difference in the situation on the ground that is significant and at scale. Perhaps one way to start could be for all national budgets to indicate how much a programme or scheme for a relevant sector has spent on integrating CCA. This would allow for a useful way of monitoring how much money, apart from the allocations for CCA-specific programmes, is being spent on integrating adaptation into overall national development priorities.

Improve governance and coordination

All national plans and strategies of South Asian nations identify improved governance as a major priority. This is in the context of achieving greater efficiency of administration generally, as well as for more efficient natural resources management. There are three aspects that need to be addressed. First, there is a need to build awareness and the capacity of administrative and line department functionaries at all levels to formulate plans and execute them. Though not specific to CCA, the second aspect is proper auditing and monitoring of such programmes. Social audits, especially, are a very useful tool to make an assessment of the efficacy of a programme or scheme, as they directly involve the beneficiaries in auditing and monitoring processes. While social audits are being used to monitor some schemes such as those under the National Rural Employment Guarantee Act, they are not deployed for monitoring of all schemes. Third, there is a need to breakdown departmental silos. One of the major weaknesses of administration in all South Asian countries is weak or non-existent coordination among departments. There is a need to significantly improve this aspect of governance. One way in which this could be done would be to have an empowered group or committee, with representation of relevant line departments, along with eminent individuals and experts from outside the government. Such a group or committee would look at sectoral plans and integrate relevant aspects that relate to multiple sectors into each of these plans. In order to make such a committee or group more effective, governments could consider making it mandatory to accept, or at the very

[8] For example, India's Planning Commission has tasked an expert group under Professor Partha Dasgupta to prepare a template for estimating green national accounts that would measure national production while allowing for negative effects on natural resources.

least, respond to the recommendations or advice of such a group or committee regarding the planning and implementation of departmental policies and programmes.

There are additional aspects of effective governance with specific reference to CCA, as well as efficient delivery of official development initiatives in general. There is already recognition that decentralization of decision-making powers and greater public participation in official decision-making are an essential ingredient of achieving efficiency. As such, many initiatives have been taken by several governments in the region to provide frameworks for decentralization and public participation in governance and administration. However, many of these initiatives have not been fully utilized due to inadequate financial devolution of powers. Thus, while on paper decentralization may have been achieved, it is not yet fully operational on the ground. These issues must be addressed urgently at the political level to create effective adaptation responses that work for the people on the ground.

Ideally, a fully operational and decentralized governance and administrative mechanism would also lead to strong local institutions and empowered communities that would be able to effectively integrate CCA into ongoing development efforts in the region. Local level institutions would be best placed to identify the best adaptation strategies that would work effectively on the ground and respond to people's needs and concerns. Further, enhanced institutional capacities at the local level would also enable more financing to be deployed explicitly for CCA, since strengthened local institutions would also be able to utilize available financing more effectively. This may also have the added advantage of enhancing confidence for more national governments to develop budget codes and headings that explicitly address CCA at all levels of governance.

Deploy additional resources

While there is a lot of climate adaptation action that does not necessarily require deployment of financial resources, it cannot be claimed that adequate budgets are being allocated in South Asia for adaptation planning. This is required to be done domestically even as international financial transfers are being sought through negotiations at the United Nations Framework Convention on Climate Change. Recommendation 2 above discussed certain initiatives in decentralizing decision-making and meaningfully strengthening local institutions of governance and administration. If done, this process could create a bottom-up demand for climate financing and enhance the confidence of both national governments as well as the international community that there is a scope for enhanced deployment of financial resources as well as absorption capacity of such resources in the region.

Upscale promising community-based or other non-governmental organization initiatives

There are many small scale initiatives towards CCA being undertaken by communities either on their own or facilitated by NGOs. Many of these initiatives have gained global recognition. However, on their own, these initiatives are perhaps insignificant and while pointing towards a direction that is promising, do not make an impact that would make a material difference at scale. There is a need to draw lessons from these initiatives and examine how they can be scaled up and implemented nationally, or perhaps, even regionally.

Promote regional cooperation for trans-boundary adaptation initiatives

There are many aspects of CCA, such as trans-boundary river basin management, that need to be dealt with regionally. There are, at present, many water sharing arrangements between different countries in South Asia. While they may have served a useful purpose, the problem of climate change requires a new approach towards holistic river basin management for which a beginning must be made at a regional level.

In general, it appears that while countries of South Asia are beginning to respond to the challenges of climate change, there is a long way to go before one could consider that the response at the policy, institutional or fiscal level is adequate to meet these challenges. Greater integration of climate concerns into the development process as well as greater resources human, material and financial need to be deployed to meaningfully address climate challenges that will only become more daunting as with the passage of time.

III. Challenges and Issues for Promoting Climate-Smart Agriculture in South-East Asia

RICO ANCOG[9] AND MARILIZA V. TICSAY[10]

Introduction

Agriculture remains a key growth area in South-East Asia. It contributes to reducing poverty, achieving food security and can contribute to decreased emissions of greenhouse gases (GHGs). Despite the decreasing contribution of the agriculture sector to the total output in many South-East Asian countries, the average share of agricultural labour to the total population remains significant, employing about 37.2 per cent of the combined population in South-East Asia (FAO 2014). Agriculture remains a key sector for food and nutrition security, improving incomes and employment.

The share of the total labour force working in the agriculture sector for their primary livelihood from 35–76.3 per cent South-East Asian countries, excluding Singapore and Malaysia. With an average GDP per capita of $3,105 as of 2010, the agriculture sector is in a strategic position to continue to contribute to poverty reduction. From 2007 to 2011, the reduction in the incidence of poverty in South-East Asia was computed at around 2.4 per cent annually (2007–2011) (FAO 2013a).

The estimated world population of 7 billion in the middle of 2012 is projected to be around 9 billion by 2050. Trends show that developing countries account for 97 per cent of the population growth, while developed countries as a whole will experience little or no population growth in this century (PRB 2012). In 2010, about 74 million out of the 578 million considered as undernourished in Asia were from South-East Asia, many of whom are women and people living in marginal areas most vulnerable to food insecurity (FAO 2010). If current population, income and consumption growth continue, the Food and Agriculture Organization of the United Nations (FAO) (2013a) estimates that agricultural production will have to increase by 60 per cent by 2050 to satisfy the expected demands for food.

The importance of the agriculture sector in South-East Asia provides a strong impetus for the urgent need to strengthen its potential for further reducing poverty and in achieving food security. Agriculture is one factor in meeting the challenges related to a growing population, especially in emerging urbanizing land areas. Agriculture is crucial for attaining food security, diversified rural incomes and the continued provision of other essential products, such as energy, fibre, feed stocks and other ecosystem services.

Feeding a growing global population enjoying strong economic growth is made complicated by the onset of climate change (FAO 2013a). The increased unpredictability and prevalence

[9] Dr. Rico Ancog, Assistant Professor at the School of Environmental Science and Management (SESAM), University of the Philippines Los Banos (UPLB).
[10] Dr. Mariliza V. Ticsay, Unit Head in the Knowledge Resources - Knowledge Management Department (KMD), Coordinator, Knowledge Center for Climate Change Adaptation and Natural Resources Management in Southeast Asia (KC3), and Focal Person, Sub-regional Thematic Node for Agriculture of the Asia-Pacific Adaptation Network (APAN), Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).

of extreme weather events threaten the achievement of improved agricultural yield. As a result, agricultural production could diminish resulting in significant lowering of incomes in vulnerable areas. Climatic events can contribute to global food prices and, thereby, affect the global and regional economy.

The urgent challenge lies in the need to improve the resilience of the South-East Asian agriculture sector to climate change, with visible improvements in technical and financial mechanisms. The types and severity of the risks confronting farmers vary by farming system, agro-climatic region, local policy and institutional settings, but agricultural risks (including climate change) are particularly burdensome to small-scale farmers in the developing world. For agricultural systems, Howden et al. (2007) demonstrated that undertaking adaptation is to effectively manage potential risks as a result of climatic changes through time.

A number of adaptation measures to combat impacts on agriculture are related to food production, food security and in the maintenance of safety nets that protect the farmers in adverse years (Reilly and Schimmelpfennig 2000). A significant transformation in agriculture is therefore needed if it is to provide food to a growing global population under the scenario of climate change; all the more if it is to provide the basis for economic growth and poverty alleviation (FAO 2014). Recent global initiatives have clearly engendered the need of climate-smart concepts to be applied in agriculture as viable options to address food security issues in the future and in cementing its role in CCA. Implementing climate-smart agriculture (CSA) at the local level contributes to meeting global objectives, primarily those of the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD) and the World Summit on Food Security (WSFS), leading to a sustainable development landscape (Meybeck et al. 2012).

Making the agriculture sector climate-smart is a key component in advancing CCA in the South-East Asian region. This has been clearly highlighted in several analyses, jointly done by the Asia Pacific Adaptation Network (APAN) and the South-East Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), on the trends in CCA in agriculture. These analyses were supplemented with a review on the issues and challenges in CCA (APAN-SEARCA 2012; 2013). As such, this chapter aims to highlight the need to make the agriculture sector climate-smart as part of the overall agenda of making the South-East Asian region adapted to the impacts of climate change.

Climate-Smart Agriculture (CSA)

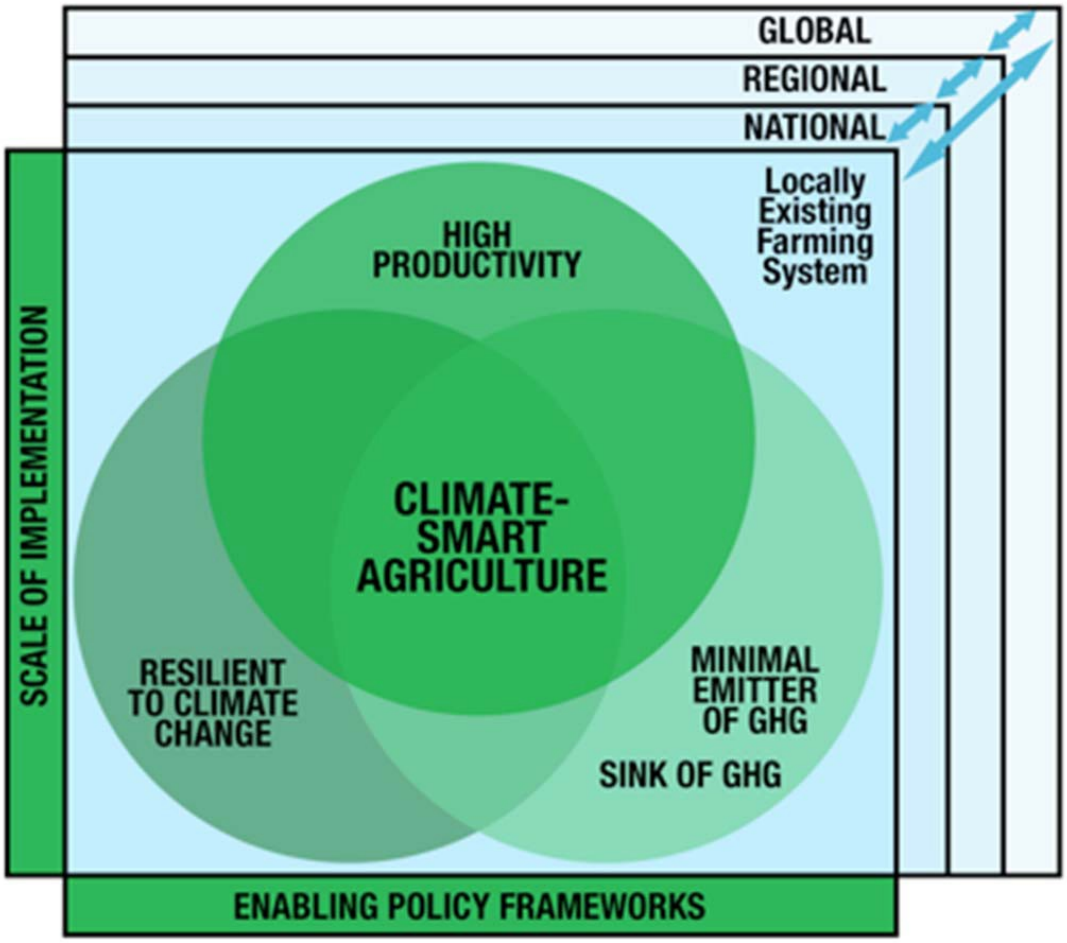
A precursor to the definition of CSA was conceptualized during the African Conference on Agriculture, Food Security and Climate Change held in September 2010. Furthermore, the term “climate-smart agriculture” was operationally defined and presented by FAO during The Hague Conference on Agriculture, Food Security and Climate Change in November 2010. The conference was the first global conference of its kind to integrate the three different themes of agriculture, food security and climate change into one (FAO 2010). These agenda were set against the need of feeding 9 billion people in 2050 in the face of climate change. In addition, food security should be strengthened in the growing competition for the use of natural resources, as well as in achieving the other Millennium Development Goals

(Thornton and Cramer 2012). In essence, CSA is at the core of sustainable development, combining interventions relevant to economy, society and environment.

CSA is an approach for responding to climate variability and change, while providing food security and CCA and mitigation. As shown in Figure 1, CSA generally aims to achieve three main objectives, namely: (1) sustainably increasing agricultural productivity and incomes; (2) adapting and building resilience to climate change; and (3) reducing and/or removing GHG emissions, where possible. CSA employs specific strategies across various farming system scales, from farm-lots to more overarching systems such as at the global agro-ecosystems. Coherent policy frameworks across these various scales of farming systems aid implementation of such strategies.

CSA therefore relies on different components. First, is the quality of the agricultural inputs and outputs, which are resilient to climate change, ensures high productivity and aids in mitigating climate change through reduced GHG emissions. Second, is that the capacity of farmers – the main actor in applying and implementing CSA practices – must be duly supported. This requires a more specific analysis and customized CSA intervention mechanism since farming is typically site and context-specific. Lastly, sustaining these different components should be provided by policy frameworks that support the integrative functioning of each component.

Figure 1. The objectives of climate-smart agriculture (CSA)



Elisabeth and Minh Ha (2011) explain that CSA resembles sustainable agriculture and conservation agriculture practices but puts additional stress on low-carbon agriculture (mitigation aspects) and the use of plants that can reduce vulnerability to climate change (adaptation aspects). The World Bank, a key partner in the Hague Conference on Agriculture, Food Security and Climate Change, has identified proven practical farming techniques such as mulching, intercropping, conservation agriculture, crop rotation, integrated crop-livestock management, agroforestry, improved grazing and improved water management, as examples of CSA technology and practices.

At the outset, the novelty of CSA as a concept can also be considered as a reaction to the slow progress on including agriculture in the UNFCCC negotiations (Elisabeth and Minh Ha 2011). Additionally, FAO (2013b) cautions that CSA is not a single specific agricultural concept that can be universally applied. Site-specific assessments must be conducted to identify suitable agricultural production technologies and practices and, thereby, apply CSA. The following approaches should be considered in order to implement climate-smart agricultural systems:

1. Address the complex interrelated challenges of food security, development and climate change, and identify integrated options that create synergies and benefits and reduce trade-offs;
2. Recognize that these options will be shaped by specific country contexts and capacities and by the particular social, economic and environmental situation where it will be applied;
3. Assess the interactions between sectors and the needs of different involved stakeholders;
4. Identify barriers to adoption, especially among farmers and provide appropriate solutions in terms of policies, strategies, actions and incentives;
5. Seek to create enabling environments through a greater alignment of policies, financial investments and institutional arrangements;
6. Strive to achieve multiple objectives with the understanding that priorities need to be set and collective decisions made on different benefits and trade-offs;
7. Prioritize the strengthening of livelihoods, especially those of smallholders, by improving access to services, knowledge, resources (including genetic resources), financial products and markets;
8. Address adaptation and build resilience to shocks, especially those related to climate change, as the magnitude of the impacts of climate change has major implications for agricultural and rural development;
9. Consider climate change mitigation as a potential secondary co-benefit, especially in low-income, agricultural-based populations; and
10. Seek to identify opportunities to access climate-related financing and integrate it with traditional sources of agricultural investment finance.

Assessment of CSA needs

In as much as the South-East Asian region is varied particularly in terms of its geographic characteristics and socioeconomic conditions, the impacts of climate change-related hazards and risks are expected to be felt differently as well. Given that the majority of the countries' economies in the region are agriculture-based, strengthening their adaptive capacity to climate change is necessary. Analyses of the current level of adaptation efforts in the

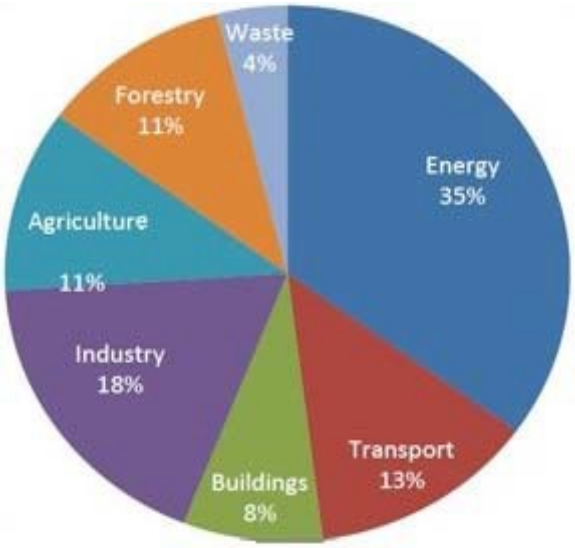
agriculture sector in South-East Asia in contrast to the observed and projected impacts clearly show the need for strengthening CCA especially in the agriculture sector.

Current adaptation measures in the agriculture sector in response to climate change impacts in South-East Asia are sporadic and far from being integrated (APAN-SEARCA 2012). Though both autonomous and planned adaptation measures have been implemented all across South-East Asia, a systemic improvement that would make the adaptation efforts proactive, particularly on governments' fiscal support to adaptation, is required given the projected increase in severity of climate change impacts in the region. Of prime consideration is the observation that coping mechanism and autonomous adaptation at the small farm level and in the farming households have their own limits.

Adaptation measures implemented in small farming units could be considered to be a country's or a region's building blocks for CCA. A well-adapted agriculture sector to climate change could be accomplished by working on climate-smart smaller farming systems. So far, these kinds of farm-specific adaptation measures are often implemented without the appropriate intervention of an external support. As such, planned adaptation programmes, formulated and implemented by the government, must endeavour for autonomous adaptation options (particularly at the farming system-level and at the farming-community levels) to be strengthened.

According to IPCC, the Agriculture, Forestry and Other Land Use sector accounts for about a quarter (approx. 10–12 $GtCO_2$ equivalent per year) of net anthropogenic GHG emissions mainly from deforestation, agricultural emissions from soil and nutrient management and livestock. The agriculture sector alone accounts for 11 per cent of the total share of global GHG emissions in 2010 (figure 2).

Figure 2. Shares of Sources of Global GHG Emissions in 2010 by main sector, MTCO2



Source: European Commission Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL), Emission Database for Global Atmospheric Research (EDGAR).

A comparison of the GHG emissions per country, as presented in table 2, revealed that China is the top GHG emitter with an average GHG emissions of 7,666 $MtCO_2$ and a global share of 17.15 per cent. In South-East Asia, Indonesia remains the highest emitter with an average of 1,912 $MtCO_2$ and with a global share of 4.28 per cent. Other South-East Asian countries comprise a total of 1,679 $MtCO_2$ which is 233 $MtCO_2$ less of the average emission of Indonesia. From 1990 to 2010, GHG annual emissions of Brunei, Cambodia, the Philippines and Singapore remained below 200 $MtCO_2$ for the past 20 years. In the case of the Philippines, the country ranked sixth in the region with a share of only 0.31 per cent.

It is primarily the governments' role to ensure that appropriate policy and infrastructure mechanisms are well-placed to achieve sustainable agriculture. Under the CSA framework, such government-driven planned adaptation programmes could lead to the establishment of several community-based partnerships and cooperative undertakings with legitimate organizations to enhance the absorptive capacity of farmers for development interventions. To enhance productivity and ensure zero-to-minimal GHGs emissions, technology and knowledge transfer are required so farmers can implement robust farm management practices. Local governments, being at the forefront of the development agenda, could also work with private organizations to allow cost-sharing and improved financial literacy of farmers, among others.

While significant efforts have been implemented in relation to climate change, its analysis vis-à-vis food security concerns, as the basis for the formulation of adaptive and responsive policy and developmental actions, remains a critical platform that warrants immediate attention. FAO (2008) has claimed that there have been less systematic attempts to explore threats posed by climate change to food resources and biodiversity. Thus, the development of CCA strategies, particularly in agriculture, needs to be made responsive both to their ability to contribute to increasing resilience and in achieving food and nutrition security across sectors.

There are five broad categories of costs/barriers identified in the literature associated with the adoption, which include climate smart sustainable land management practices and investments; investment costs, variable and maintenance costs, opportunity costs, transaction costs and risk costs (McCarthy, Lipper and Branca 2011). While there have been a number of factors identified which hinder adoption of sustainable land management techniques yielding both CCA and mitigation benefits, a few stand out for all techniques.

Firstly, since the point of most of these techniques is to improve soil quality (structure, fertility, water regulation), the benefits are often not appreciable for at least five years, yet costs are borne immediately. These costs include opportunity costs of labour and land, as well as up-front cash outlays that many poor farmers simply cannot afford given thin credit markets and limited results available suggest they are the group facing the highest opportunity costs. Secondly, there is often limited information available about alternative techniques as well as limited local experience with such practices that hinders adoption. This increases uncertainty and risks associated with adoption, exacerbated by the fact that insurance markets are even more thin – or non-existent – than credit markets. Thirdly, even where farmers might invest in certain techniques, inputs are often not available in local markets. Fourthly, community norms and rules regarding livestock and bush fires often make

it much more costly to employ such techniques. And finally, communal forests and pastures require collective action both to provide public goods (e.g., agroforestry and investments in soil and water conservation) and to reduce negative externalities from overuse (overstocking, deforestation). When costs of collective action are high, both under-provision of public goods and overuse will result (McCarthy, Lipper and Branca 2011).

Smallholder farmers in ACP countries require considerable financial support if they are to adopt practices which reduce their ecological imprint and help them adapt to climate change. In particular, policymakers, both nationally and internationally, should consider establishing transition funds. It can take three years before conservation agriculture leads to higher yields; and many years before agroforestry practices offer a return on investment. Access to transition funds would help to cover the costs which farmers experience when adopting climate smart practices. Where upfront finance is not required, farmers can benefit from schemes which award payment for environmental services. These might involve planting trees to sequester carbon or restore degraded land, or refraining from certain cultivation practices in order to protect downstream water supply (Pye-Smith 2011).

For most climate smart agricultural production practices, there is an urgent need for research on which of the practices work best, where they have been successfully adopted by farmers, the barriers to adoption and lessons for scaling up the spread of successful practices (Excerpt from Pye-Smith 2011). Further, there is a need for the analysis of the gender dimension of adaptation efforts to ensure wider participation and ensure equity and success.

Addressing vulnerability and managing climate risk

South-East Asia is considered vulnerable to climate change due to the region's geographic location and climatic conditions (ADB 2009; Yusuf and Francisco 2009). All 11 South-East Asian countries have already identified the respective major climate-related hazards per country, including the initial understanding on how it is projected to change overtime. These hazards with their projections were incorporated in each country's respective national adaptation plans and climate change response frameworks relevant to agriculture.

As shown in table 1, these hazards include typhoons/cyclones, extreme rainfall, flooding and droughts that pose threats to key watershed, river ecosystems, groundwater and agricultural areas. Guided by the CSA framework, risks related to climate change could only be managed once both planned and autonomous adaptation options implemented by the government and the farmers, respectively, could be made more aligned and more responsive to each other. However, government support is far more critical because of farmers' ability to achieve sustained harvest relies on government interventions, such as the likes of automated weather systems linked in clear decision-support systems, good farming inputs with farmer-friendly financial incentives, if possible, such as crop insurance systems and enhanced knowledge on good agricultural practices.

Table 1. GHG emissions of the world, ASEAN countries and the Philippines (MtCO2), 1990-2010

Country	1990	1995	2000	2005	2008	2009	2010	Average	Average global share
World total	38,258	39,028	40,234	47,269	48,748	49,329	50,101	44,710	100.00
Top Country Emitters									
China	3,870	5,013	5,073	7,853	10,060	10,608	11,182	7,666	17.15
USA	6,115	6,342	6,983	7,082	6,923	6,515	6,715	6,668	14.91
Russia	3,582	2,637	2,647	2,585	2,605	2,481	2,510	2,721	6.09
India	1,376	1,637	1,873	2,128	2,434	2,584	2,692	2,103	4.70
Indonesia	1,161	1,312	1,445	2,884	2,015	2,620	1,946	1,912	4.28
South-East Asia									
Myanmar	875	943	562	511	340	344	362	562	1.26
Thailand	208	282	283	349	360	362	413	322	0.72
Malaysia	198	252	254	336	334	356	330	294	0.66
Vietnam	99	121	156	225	258	283	306	207	0.46
Philippines	96	125	140	146	153	154	159	139	0.31
Cambodia	20	21	22	61	172	138	192	89	0.20
Singapore	33	45	48	48	50	47	50	46	0.10
Brunei	18	21	17	23	19	20	20	20	0.04

Source: European Commission JRC/PBL, EDGAR.

Coherent policies and institutional framework

Since the discussion of critical adjustments needed for agriculture to be sustainable during the 1992 United Nations Conference on Environment and Development held in Rio de Janeiro, major conferences have been conducted consequently for the promotion of an environmentally sound agriculture. Subsequent recommendations for mainstreaming CSA followed, most significantly during the 1st Global Conference on Agriculture, Food Security and Climate Change in the Hague, Netherlands in 2010; and the follow up conference in Hanoi, Vietnam in 2012.

Table 2. South-East Asian countries and climate change related hazards and risks

Country	Intense rains and flood	Droughts	Cyclones/ typhoons	Sea level rise	Agriculture
Brunei Darussalam				X	
Cambodia	X	X	X		X
Indonesia	X	X		X	X
Lao PDR	X	X			X
Malaysia	X	X	X		
Myanmar	X	X	X	X	X
Philippines	X	X	X	X	X
Singapore				X	
Thailand	X	X		X	X
Timor Leste				X	X
Vietnam	X	X	X	X	X

Source: Yusuf and Francisco 2009; Snidvongs 2006; UNDP Oslo Governance Centre, 2007); Ho 2008; Cruz et al. 2007.

In the Roadmap to Action of the Hague conference, a number of policy measures were suggested for the effective implementation of CSA. These included creating an enabling an

environment for investing and financing sustainable agriculture and rural development and providing appropriate land tenure systems for private and communal land. Measures for efficient and sustainable use of land, water, energy and other inputs in CSA are also needed. These conclusions were then used for the follow up conference. Except for some additions, the 2nd Conference in Vietnam has similar policy recommendations and specific roles for various actors (table 2).

These frameworks could easily fit in the climate change adaptation (CCA) and mitigation agenda of the ASEAN member states. Each of the eleven countries comprising South-East Asia have already identified their respective major climate related hazards which could pose threats to key watershed, river ecosystems, groundwater and agricultural areas (Ancog and Ticsay 2013). In addition, related policies concerning agriculture, specifically organic agriculture, which may comprise parts of the CSA framework, are in place in almost all South-East Asian countries (table 3). To be consistent with CSA aspirations, these existing interventions in South-East Asia require additional financial and technological support to ensure that the agriculture sector will also take into consideration GHG emissions reduction, alongside the maintenance of productivity.

Table 3. Policy recommendations from the recent Global Conferences on Agriculture, Food Security and Climate Change

Venue (year)	Policy recommendations
The Hague (2010)	• Enabling environment for investment in sustainable agriculture and rural development • Inclusive and secure access to finance • Appropriate land tenure systems for private and communal land • Active engagement of all actors • Measures for efficient and sustainable use of land, water, energy and other inputs • Adding value to food production and supply chain
Hanoi (2012)	• Enabling environment for investment in sustainable agriculture and rural development • Harmonized and coordinated implementation • Enhance integrated systems-based approaches, strategies and institutional arrangements • Reduce losses to food production and supply chain • Promote and upscale sustainable food production practices, including those based on local and indigenous knowledge • Engage youth in the agricultural sector • Enhance economic, social and ecological performance of ocean and marine ecosystems • Restore degraded land and address drought issues

Enforcing CSA policies would not be sufficient if it is not supported by evidence-based information. This means constant and sustained research that would help refine CSA-related policies to be relevant and practical for specific regions and territories is needed. Given that existing frameworks regarding climate change and/or agriculture are present in South-East

Asia, applying scientific concepts of CCA should now be expedited to improve policy and development plan frameworks.

Recommendations

Adapting farming systems to climate change contributes to sustained productivity and the achievement of food and nutritional security. Countries in South-East Asia must prioritize CCA for farming. At the current rate, this could be done through the following: (1) instituting enabling policies as a bedrock for CSA to flourish; (2) solving the problem of scale in farm operations; (3) harnessing the multiple gains of CCA in agriculture; (4) identifying and supporting champions of CSA; (5) making agriculture gender-sensitive; (6) clarifying how CSA could help achieve far-improved CCA in the agriculture sector; (7) clarifying metrics of success in implementing CSA; and (8) compiling case studies relevant to CSA across South-East Asia.

Instituting enabling policies as a bedrock for CSA to flourish

All South-East Asian countries need to make explicit policy pronouncements to institutionalize CSA so it will have concrete and substantial policy and financial support (see table 4).

Table 4. Recent CSA-pertinent agriculture policies in South-East Asian countries

Country	Recent agriculture policy frameworks related to CSA objectives	Notes/ Sources
Brunei Darussalam	Scanty online data	
Cambodia	• Promotion of organic agriculture by the Ministry of Agriculture, Forestry and Fisheries (MAFF) and the Ministry of Commerce (MoC). • Sub-decree 69 (1998) on Management of Agricultural Materials and MAFF • Circular No. 345 (2002) (banning of GMOs) • MAFF recommendation (2006) of prohibiting chemical agriculture advertisements in mass media	Cheattho 2010
Indonesia	SNI6729-2010: Organic Food System	Prawoto and Noorjanah 2012
Lao PDR	Development of the Agricultural Development Strategy for 2020 by the Ministry of Agriculture and Forestry in 2011	Panyakul 2012
Malaysia	Malaysian Organic Scheme MS 1529: 2001	Department of Agriculture 2007
Myanmar	No current policies	Green Net (n.d.)
Philippines	Organic Agriculture Act of 2010 (RA 10068)	
Singapore	No current policies, although there are agriculture-related policies	
Thailand	Organic Agriculture Certification Thailand or ACT (1995)	Panyakul 2003
Timor Leste	Scanty online data	
Vietnam	Establishment of Vietnam Organic Agriculture Association	Ngo 2012

This must then be mainstreamed in each country's plans for CCA and mitigation. For example, the Philippine economy remains largely agriculture-based (18 per cent of GDP; directly employs a third of the population) and such sector is the second major source of

carbon emissions in the country (29 per cent of total CO_2 emissions in the Philippines amounting to 37,003 Gg as per 2000 GHG data). Thus, achieving CSA in an agricultural country by providing policy options for local government units to achieve low-carbon agricultural systems with sustainable agricultural yield is indispensable.

The following are the important commitments and actions that were suggested to be undertaken by the ASEAN member states to tackle the challenges of food and water security, nutrition, poverty, climate change, sustainable development, environmental sustainability and CSA (table 5).

Table 5. ASEAN commitments and actions for food security

Components	Recommendations
Policy Reforms	**(1)** Enhance integrated, systems based approaches, strategies and institutional arrangements that span across different sectors, ministries and intergovernmental organizations; **(2)** Address the sustainable management of oceans for food security and livelihoods, including addressing illegal, unreported and unregulated fishing; **(3)** Promote international cooperation and avoid unilateral measures, such as export bans; **(4)** Encourage private sector investment by reducing or insuring gain-risk (for example, through funding transitional programmes that enable eventual private sector investment. **(5)** Support low income food importing countries, with particular attention for vulnerable families and children.
Research and Development	**(1)** Address the scientific, technical and socio economic aspects of adaptation and mitigation in agriculture and their synergies, within international food security and climate change processes, for example through further work under the UNFCCC SBSTA. **(2)** Investing in the research and development of non-proprietary plant varieties and breed with the required nutritional, productivity and diseases and climate resistant traits needed by different producers; **(3)** Partnerships between the private sector and farmers/farmer groups and cooperative to promote the production of high quality products. Partnership that can enhance knowledge sharing between stakeholders, including scientists, farmers, private sector, civil society and governments, with participatory agenda setting, for example, through initiatives such as the Global Research Alliance.
Extension and Education	**(1)** Strengthen the knowledge base on sustainable practices, as well as on financial and policy options that would enable countries and communities to meet their food, water and nutritional security and development goals; **(2)** Improve farmers' access to and awareness of knowledge services, finance, agricultural inputs, rights (for example, land tenure rights) as well as increase the availability of these resources. **(3)** Implement and scale-up innovative successful programmes and best practices that combine sustainable agriculture and land use, forestry and sustainable fisheries and aquaculture, through local, regional, sub-regional and national programmes and institutions, as a matter of priority; **(4)** Sharing existing technologies off the shelf and into the hands of (small holder) farmers, thereby improving their access to information, technical knowledge, for example ICT options; **(5)** Creating platforms/learning hubs (such as CSA knowledge platforms) and bringing together farmer groups/associations at the grassroots level to facilitate dialogue and knowledge sharing and to building capacity to innovate and adopt CSA practices.

Source: Rudinas et al. 2013

Solving the problem of scale in farm operations

For CSA to take-off and eventually flourish, there is an urgent need to solve the concern on problem of scale. Among other possible solutions, this primarily requires reorganizing farm operations, possibly into industry clusters to be organized with substantial government support. This concern clearly points to each of the South-East Asian countries to open up discussion on the need to change land use patterns that must be supportive to the achievement of CSA and a low-carbon economy overall.

At the macro level, as most of the South-East Asian countries remain agriculture-based, making it climate smart is the way forward Given that most of the mitigation efforts are too expensive to implement for developing countries, such as the majority of South-East Asian countries, carbon emission reduction at the agriculture sector could be a cost-effective way. At the farm-level, implementing CSA shows strong potential in reducing the impacts of climate change and thus would help sustain farm productivity. With the right financial support, primarily from the government, such conditions would still allow farmers to sustain farm productivity and achieve substantial income so they could gain capital that may enable them to invest in farm management options and infrastructure that would make them fully adapted to climate change.

Harnessing multiple gains of climate change adaptation in agriculture

Lessons show that climate change adaptation in the agriculture sector must be done in a way that would ensure sustained productivity of the farming sectors, while ensuring reduced emission of GHGs. Government planned adaptation programmes need to include provision of mechanisms that would improve farmers' access to lesser input costs, good agricultural practices, improved post-harvest technologies and opportunities to diversify income and livelihood sources, among others. On the other hand, better farming technologies that would be supportive for reduced GHG emissions need to be supported and, if possible, initially financed by the government. Incentive systems should be instituted by the government to further encourage farming systems to align with the CSA agenda.

Identifying and supporting champions of CSA

For CSA to fully take-off in South-East Asia, champions for its implementation need to be identified and supported. Here, farmers play a central role, being the main actors of agriculture implementation. However, the necessary roles of technocrats at national and local levels need to be enhanced, particularly in their capacity to support farmers to engage in CSA. Particularly in the case of South-East Asia, there clearly is a need to invest in soft-technologies as part of social preparation activities that would enhance gender roles and the empowerment of stakeholders, which underpin the success of any policy interventions.

To realize this, government therefore must offer a good incentive system by, among other things: (a) providing financial support to farmers implementing farm management practices and in utilizing technologies that help reduce GHG emissions; (b) increasing support to research and development to identify better farm management options that would reduce carbon-emissions and specific farm practices aligned with CSA; (c) assisting farmers making the transition to CSA; and (d) rewarding and recognizing farmers supportive of climate change objectives, particularly those who operate under CSA goals.

Making agriculture gender sensitive

Understanding gender difference in access to climate-smart agricultural interventions and opportunities is essential to responding effectively to climate change (CGIAR, CCAFS and FAO 2011). Based on the latest internationally comparable data, women comprise an average of 43 per cent of the agricultural labour force of developing countries (FAO 2011). The female share of the agricultural labour force ranges from about 20 per cent in Latin America to almost 50 per cent in East and South-East Asia and sub-Saharan Africa

Evidence suggests that women farmers have a higher exposure to climate risks and less adaptive capacity because women farmers are poorer than their male counterparts and have insufficient assets (financial, technological, knowledge, natural and physical capital), fewer entitlements (rights, voice and access to institutions) and less mobility to help them with climate change effects (El-Fattal 2012). CSA should contribute to food security, adapt to and mitigate climate change and promote equality between men and women in a changing climate. The following are five concrete policy recommendations to make CSA gender-smart:

- Conduct gender analysis within all CSA projects, programmes and policies to assess the implications and benefits of CSA technologies and practices on men and women.
- Identify women's groups and provide them with training and support for leadership, negotiation and communication skills, as well as business skills.
- Support women's participation in decision-making related to climate change, particularly at the local level.
- Provide training to both men and women on CSA technologies and practices and gender awareness.
- Facilitate women's access to land and credit through transforming laws and local practices (El-Fattal 2012).

Clarifying contributions of CSA in CCA

Applying CSA is indeed a critical strategy in adapting to future climate change scenarios. However, due to the novelty of the concept, more effort should be done to introduce CSA as a cross-cutting concept applicable and related to various concerns such as in the environment, social and economic sectors. For example, CSA could be related to water security, since water is an essential component of agriculture. Another example would be disaster risk management, monitoring and planning and CSA, as agriculture is not only at risk from extreme weather events but can also be a component for mitigating disasters through CSA, particularly in terms of reducing GHG emissions. Once an enabling environment clarifies and then mainstreams CSA to the overall agricultural production process, barriers to the fully maximized role of agriculture in climate change could be overcome.

In practical aspect, aspirations of achieving the goals of CSA could be mainstreamed in the countries' National adaptation programme of action (NAPAs), particularly in countries such as Lao PDR and Cambodia. Making farm operations climate smart is critically a priority action to respond to the need of adapting to climate change while also achieving poverty reduction and food security objectives. Furthermore, CSA needs to be introduced in mainstream consciousness through efficient information dissemination. This could be achieved by analysing climate change communication needs in various regions and adopting

good strategies for communicating CSA to concerned stakeholders and institutions. At the current rate, the growing vocabulary of related concepts in agriculture such as sustainable agriculture, sustainable agro ecosystems, conservation agriculture, etc., needs to be clearly differentiated to avoid confusion.

Clarifying metrics of success in implementing CSA

CSA as defined indicates climate resilience, mitigation of GHG emissions and high productivity. Unfortunately, what is clearly lacking is a unified metric to measure levels of success on each of the three components in achieving climate-smart agricultural systems. A robust quantitative approach that empirically measures the baseline levels on climate mitigation, climate resiliency and crop productivity of agricultural systems at various scales is still needed, which would be used as basis for future monitoring and evaluation.

Compilation of case studies relevant to CSA across South-East Asia

Lastly, a knowledge data base for CSA is important and there is a need for a compilation of case studies in the region in practising CSA, CSA-related policies and other related topics. International development organizations with South-East Asian coverage (i.e., ASEAN, APAN, SEARCA, etc.) and with knowledge centres on CCA readily accessible online (i.e., SEARCA's KC3 or APAN's asiapacificadapt.net) could be tapped and supported by governments to provide such service. Universities and public and private research institutions across the region must also be encouraged to help build a solid foundation for CSA to flourish in South-East Asia. This is a prime area for research, needs to be backed by high quality publications and must encourage knowledge-sharing among CCA practitioners.

Conclusion

Strengthened agricultural systems are the key to achieving CCA in the South-East Asian region; and CSA is a way to do it. CSA calls for making the agricultural farming systems both responsive to climate change mitigation and adaptation goals, by ensuring agriculture that is resilient to climate change, minimal in GHG emissions and strongly contributing to livelihood and food security. Ensuring the practice of CSA, however, needs the build-up of the current knowledge base on CSA, not only in South-East Asia, but worldwide, with case studies, science and policy interfacing and field experiments.

IV. What Ails the Effectiveness of Crop Insurance? Emerging Bottom-up Issues and Solutions

SIVAPURAM V.R.K. PRABHAKAR,[11] ARPAH ABU-BAKAR,[12] CORA P.B. CLAUDIO,[13] HOANG V. HUNG[14] AND DIVYA S. SOLOMON[15]

Introduction

There is a growing consensus among the development community that the insurance can provide an effective risk management tool for climatic and non-climatic disasters. Several insurance initiatives have been implemented at grassroots level for reducing the vulnerability of communities to disasters in most of the countries in Asia and the Pacific over the years. Despite these grassroots efforts, insurance penetration is poor in the developing Asia-Pacific compared to many developed countries in the region due to several barriers that this sector is facing. Keeping this in mind, this chapter assesses the benefits accrued through community level insurance experiences in some of the developing countries. It evaluates barriers limiting the penetration of crop insurance and identifies interventions for greater insurance penetration leading to climate change adaptation (CCA) and disaster risk reduction (DRR). It is evident from the chapter that countries are at different stages of developing agriculture insurance programmes and institutional mechanisms, with the Philippines at the fore front followed by Vietnam and Malaysia. Growing disaster losses and related burden on government have been the clear driver of insurance in the study countries.

Cost appeared to be the single most important determinant of buying insurance. The majority of respondents, whether currently participating in insurance or not, prefer insurance to be fully subsidized. The insurance payments were mostly either timely or timely enough to recover, and most farmers were unsure of damage assessment procedures adopted by the insurance companies and were overwhelmed by the claim procedures. In areas where insurance is present, insurance helped farmers to recover but the respondents felt that the insurance did not completely compensate their loss. Insurance did not completely stop most farmers borrowing from a formal lending institution or from family and friends after a disaster.

Background

It is a widely accepted fact that the countries of Asia and the Pacific are among the most at risk of natural disasters. On average they suffer from 40 per cent of worldwide disasters each year, a rate that has increased over the last two decades. Although loses in terms of human lives has decreased in some regions the ability to adapt and build resilience is not keeping pace with the increasing frequency and intensity of disasters. There have been nearly 900 natural hazards reported since 1970 (Stigler et al. 2012). As a result of climate

[11] Dr. Sivapuram V.R.K. Prabhakar, Institute for Global Environmental Strategies, Hayama, Japan.
[12] Prof. Arpah Abu-Bakar, School of Economics Finance and Banking, College of Business, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[13] Dr. Cora P.B. Claudio, EARTH Institute Asia, Inc., Manila, Philippines.
[14] Dr. Hoang V. Hung, Faculty of Urban Management, Hanoi Architectural University, Hanoi, Vietnam.
[15] Ms. Divya S. Solomon, Ashoka Trust for Research in Ecology and Environment, Bangalore, India.

change, the frequency and intensity of shocks is changing. Most of the disaster management mechanisms in this area is an ex ante models depending largely upon aid and humanitarian efforts from governments and donor agencies. Oftentimes this aid is delayed, insufficient and badly targeted, and ultimately fails to reach the communities that require it most.

The poor and those dependent upon agriculture are more susceptible to the risks posed by natural hazards because of their dependence on natural resources. Disasters have a huge impact not only upon the livelihood opportunities of people but also on their ability to cope with further stresses. Thus, disasters can lead to even deeper poverty and greater future risk. The poor are unable to cope with existing vulnerabilities, additional vulnerabilities due to climate change could lead to an 'adaptation deficit'; a condition where people are unable to deal with additional stresses due to climate change (Burton 2004).

Climate change is projected to exacerbate the impacts of natural hazards in the future (Field et al. 2012) creating a need to reassess and reframe the current risk reduction strategies in the farming sector in the Asia-Pacific region. One particular risk reduction strategy is using crop insurance (Arnold 2008; Swiss Re 2010a). Crop insurance is a pre-loss risk strategy. Farmers benefit from compensation from an insurer in an exchange for a premium paid before loss occurs. It provides a cost-effective way of coping with financial impacts of climate- and weather-induced hazards, supports CCA by covering the residual risks not covered by other risk mitigation mechanisms such as irrigation systems and best management practices. In that way crop insurance reduces adverse effects on income fluctuation and socio-economic development. It is also known to provide opportunities for public-private partnerships, reduce the burden on government resources for post-disaster relief and reconstruction, help communities and individuals to quickly renew and restore livelihood activity and address a wide variety of risks emanating from climatic and non-climatic origin, depending on the way the insurance products are designed.

Despite the known advantages of insurance, insurance in general and crop insurance in particular is not widely used in Asia and the Pacific. Statistics available from Swiss Re suggest that South and East Asia stand third among world regions in terms of non-life insurance premiums (Swiss Re, 2010b). Motor insurance and insurances for industrial and commercial establishments are among the dominant forms of non-life insurances in the region. Within Asia, non-life insurance penetration is highest in Japan followed by China, South Korea, Taiwan and India. Agriculture crop and livestock insurance accounts for only a fraction of the total premiums issued despite the majority of population occupied in agriculture sector in the region. In 2009, agriculture insurance constituted only 0.38 per cent of the total insurance premiums and 0.58 per cent of the total non-life insurance premiums sold in Asia (FAO 2011 and Swiss Re 2010b). Hence, promoting crop insurance by understanding factors limiting its spread in Asia and the Pacific is an important area of policy research.

Risk insurance as a tool for reducing vulnerability

Vulnerability is both a condition and determinant of poverty and microfinance is a tool which can be used to reduce vulnerability in the poor and help in promoting CCA. Among the many measures identified in the Hyogo Framework; financial risk sharing mechanisms in particular

insurance has been suggested as one of the effective measures for DRR (Warner et al. 2009). Microfinance serves to provide financial services; credits and savings to low-income households, in turn helping in asset building and increased livelihood stability (Thomas 2005). The initiatives that come under the purview of most microfinance programmes include insurance products, risk pooling schemes and consumption smoothing arrangements. It serves as a means to provide basic financial services to the poor. When a crisis occurs the poor normally resort to informal methods of credit, usually borrowing from a relative or neighbour or selling of assets. The result of this is that their trajectory of poverty follows a zigzag effect: advances are marked by times of asset building and livelihood growth and the declines are marked by crisis situations. As a result they remain locked within the poverty-vulnerability cycle. Insurance is an effective risk management strategy which helps to temper these fluctuations and allow for a smooth transition out of poverty (Munich Climate Insurance Initiative 2012). The Swiss Re report entitled "The economics of Climate Change" (2009) clearly demonstrates the benefits and complementary nature of insurance as a risk transfer mechanism along with risk control and risk retention approaches. Currently insurance covers only around 3 per cent of disaster losses in developing countries as compared to nearly 40 per cent in developed countries (Höppe and Gurenko 2006). Despite the emerging importance of the sector the penetration is quite low; the premiums from this sector contribute to 0.01 per cent of GDP in developing countries (Swiss Re 2007). Recent studies have shown that the potential for the growth of insurance particularly insurance for climate change related risks in developing countries is immense. Micro insurance is currently being offered to low income households, farmers and businessmen in the Asia-Pacific region. Currently there are two forms of insurance being offered under disaster micro insurance schemes: the classic indemnity based schemed and the newer Index based schemes (Linnerooth-Bayer and Mechler 2007).[16] Index based insurance is measured depending on an objective and independent parameter that is highly correlated to the crop yield (GFDRR 2011). The risks insured can be shortfalls in a weather-based, area yield or satellite-based plant growth index. Despite the fact that index-based insurance can reduce the moral hazard prevalent in the indemnity based insurance, basis risk[17] is a major challenge (Miranda 1991).

The agricultural sector in developing countries is highly vulnerable to hazards. Reports from IPCC suggest that droughts, heavy precipitation, increased temperatures as well as increase in the frequency of extreme events will have a tremendous impact upon agriculture. It can be said with near certainty that these events will further increase in the future. Adaptation towards climate change in agriculture depends upon various factors such as natural resource endowment and associated social political and cultural and political conditions. Sustainable agriculture and CCA are co-aligned and often times co-dependent (Wall and Smith, 2005). According to World Bank estimates from 2010, agricultural insurance is well developed in nearly 100 countries throughout the world. However it still remains largely underserviced in middle income and lower income countries. The post-Hyogo framework is expected to scale up the insurance based risk management approaches. Insurance could lend itself as a useful safety net that will allow people to make productive yet high-risk livelihood choices. It is of crucial importance to establish a framework in quantify the benefits of risk insurance in order to modify and prioritize its importance.

[16] In indemnity based insurance, insurance payments are linked to the crop yield of individual or group of farmers while pay out of an index based insurance is attached to threshold levels of highly correlated parameters such as rainfall and temperature.
[17] The index is imperfectly correlated with the farm yield.

Objectives and methodology

In view of the background discussed in the introduction, this chapter presents the findings of a study that was carried out with the objective of understanding factors limiting the spread of insurance in agriculture sector with case studies in Malaysia, the Philippines and Vietnam. There are three reasons for selecting these countries. Malaysia is an economy in transition and does not have a government driven crop insurance programme for arable crops such as paddy. The Philippines represent one of the most innovative forms of crop insurance in this region both at the national and local levels. Vietnam stands in between these two countries in terms of advances made in crop insurance both in policy and institutional processes.

The methodology included literature reviews and interviews with national level institutions such as government ministries, financial agencies (both government and private) and NGOs. While national level interviews were aimed at understanding the policy environment in these countries, detailed structured questionnaire surveys were implemented at the community level to understand needs and perception issues to be considered for formulating effective insurance programmes at local level. The structured questionnaires consisted of questions on the demographic background of the respondent, the past crop loss experience, opinion on the crop insurance currently enrolled (in case of insured) and on the available insurance options (in case of non-insured and in Malaysia where there is no crop insurance in place).

A generic questionnaire was developed based on the literature review and expert consultations by the authors (Prabhakar et al. 2013). This questionnaire was further modified before implementing the survey by the respective country partners taking into consideration the individual country contexts. For example, the questionnaire surveys in Vietnam and the Philippines was targeted to obtain opinions on the ongoing crop insurance programmes while in Malaysia the survey was prospective seeking opinions on the newly announced crop insurance policy by the Malaysian government. The questions slightly differed for both beneficiary and non-beneficiary categories where the emphasis for the beneficiary category was to obtain insights on their insurance experience while the non-beneficiary was to know barriers in enrolling into an insurance programme and what they think about the value of insurance. The questionnaires also obtained a comparison of advantages between traditional crop loss compensation (relief) schemes and insurance. The elicited responses were analysed for specific preferences among communities for certain form of risk reduction based on self-evaluation of their experience in crop insurance and presented as per cent of responses.

Institutional and policy environment

Malaysia

Malaysia being an economy in transition represents unique position for crop insurance among the study countries. Malaysia has large proportion of plantation crops, one of the highest in Asia, and most of these plantation crops have sufficient crop insurance coverage for major natural hazards. Most of this support comes from private insurance companies. Due to competition among private insurance companies, there is a certain price advantage given to plantation owners. However, the same doesn't hold true for agriculture insurance

(arable crops and animal husbandry). Though a major proportion of land and people are occupied with agriculture, the access to arable crop insurance is non-existent in Malaysia and hence is the focus of this case study. The impact of natural disaster to Malaysian farmers calls for some practical financing support in particular to the food and cash crops.

Currently, the plantation crop insurance in Malaysia is offered by the private insurance sector. However, the plantation crop insurance policy or better known as the insurance for growing trees is only an extension of a fire insurance policy and mainly covers industrial crops such as rubber and palm oil. Thus, the majority of the policyholders are large-scale plantation companies. Among the insurance companies that offer the plantation crop insurance are Lonpac Insurance and Syarikat Takaful Malaysia Berhad. The coverage provided by the private insurance sector is not sufficient as Malaysian farmers face various loss exposures associated with natural perils such as drought, crop disease, floods, hail, changes in weather, pest outbreak and windstorm (Zuriah and Heizal 2002). The United Nations Office for Disaster Risk Reduction (UNISDR) confirms that Malaysia is exposed to natural perils such as storms, landslides, tsunamis and floods (UNISDR 2011). In the past 30 years, floods have caused the worst damage to the Malaysian economy. In 2007, the economic damage caused by floods amounted to 0.1 per cent of the country's gross domestic product (GDP).

Currently, paddy producing farmers in Malaysia have access to bank loans offered by Agro Bank whose focus is financing the agricultural sector. A product called 'Paddy Scheme', allows paddy producing farmers to borrow money with a low interest rate. The total loan amount depends on the size of land and its location. Normally, farmers can get up to around $692 per ha and repayment period is per season. The payment can be made through deduction of the government subsidy or farmers can pay directly to Agro Bank by cash. If the farmers incur losses, the payment period will be extended. The availability of bank loans for paddy farmers provided a minimum financing support as the farmers have the obligation to repay the loan. In case of consecutive loss incidents, farmers may face serious debt. Under these circumstances, crop insurance can provide a better risk financing mechanism to paddy producing farmers.

Interviews with national level institutions including with the Ministry of Agriculture has revealed that the growing burden on the government revenues, impacts on rural livelihoods and the unavailability of private insurance coverage for arable crops has led to several efforts by the Malaysian government to offer agriculture crop insurance. Several exploratory studies were carried out by the Ministry of Agriculture by recruiting consultants to assess the feasibility of insurance coverage for farmers in Malaysia and these studies were known to have proposed several recommendations for the consideration to the central agency Economic Planning Unit (these studies were not published and hence are not available in the public domain). Interviews indicated that most studies have reported high cost of implementing crop insurance (as much as approx. $275 million per annum) which was one of the major causes for the government not being able to introduce crop insurance programmes for farmers in Malaysia.

The Ministry of Agriculture did a scoping study to help plan and implement crop insurance in Malaysia according to which the best crop insurance policy for Malaysia will be the one

which integrates crops, livestock and other agriculture livelihoods under the same programme in an integrated manner. As a result of these efforts, the government has planned to allocate $0.99 billion for the implementation of the Project Initiation, of which $0.49 billion is planned to allocate for agricultural projects such as palms oil, rubber, high-value herbs and paddy (Belanjawan Malaysia 2013). In addition, $1.9 billion was allocated to the Ministry of Agriculture and Agro-based industry in order to boost national income and to ensure the sustainability of food security (The Star, 29 September 2012). A further $16.5 million may be dedicated for the development of agricultural programmes which include the application of technology, increase the supply of quality seeds, ensure price stability and to create and improve agricultural training institutions. Under the Third National Agricultural policy, the agriculture ministry worked closely with Bank Negara Malaysia and the insurance industry to detail out a National Agricultural Insurance scheme (Malaysia 2010). This proposed scheme is designed to protect farmers in the event of losses due to natural, economic, man-made disasters. The proposed crop insurance policy would increase chances to raise capital as financial institutions will be more confident in dealing with insured farmers.

The proposal to introduce crop insurance coverage for agriculture farmers was submitted to the Cabinet for approval (The Star, 26 June 2012). The basis of this scheme is to provide insurance coverage for farmers whose crops were destroyed by natural perils such as floods and droughts. In the early phase, the insurance is targeted and will be made available only to paddy farmers but it will be expanded to other agricultural crops eventually. In terms of the institutional architecture, the proposal has identified that the Ministry of Agriculture would implement the programme with the support from the Bank Negara Malaysia as a supporting financial agency. The policy states to cover a maximum loss of $4,283 per ha to paddy farmers. However, there is no detailed information accessible to authors on how the insurance programme will be managed and financed and if the policy has actually come into implementation by the time this chapter is being finalized.

Since the idea is new, the proposed plan has been discussed among the related ministries. The proposal has identified paddy crop as an important entry point for the penetration of insurance into arable farming community. The reasons for identifying paddy as entry point are: paddy is the staple food crop with maximum proportion of arable cropping under it, most paddy grown areas are vulnerable to floods and other forms of hydro-meteorological disasters and there is sufficient statistical data on the intensity of natural hazard and crop loss relationships to help design crop insurance. However, since the government has decided to introduce crop insurance only to cover paddy, the subsidy component was found to be affordable compared to the previous assessments carried out covering a wide range of arable crops.

Philippines

Agriculture and fishery contribute 15 per cent of the gross domestic product (GDP) of the Philippines and provide livelihood to one third of the total employed. Communities that depend on agriculture and fishery are the most vulnerable to climatic risks due to their dependence on livelihood options that are sensitive to climatic change. Losses in the major agricultural crops (paddy, corn, sugar cane, coconut and pineapple) due to climate-related events in recent years have been reaching several millions of dollars per year. During 2007–

2011, typhoons caused a total loss of $1.2 billion damage to paddy crop alone (PIDS 2012). In December 2012, typhoon Pablo caused an estimated damage of $0.4 billion to agriculture mostly in Davao province (Official Gazette 2012). As a result, economic damages due to natural disasters are estimated to reach more than 0.5 per cent of the country's GDP.

The above disaster profile of the Philippines has triggered the Government to invest in risk mitigation and risk spreading options as a result of which the country boasts the presence of one of the rich experiences in crop insurance today. With ever increasing crop losses due to typhoons and droughts, the Government has established the Philippine Crop Insurance Corporation (PCIC) with a mandate to implement agriculture insurance against crop losses due to natural hazards and non-crop losses due to different perils. An Interagency Committee for the Development of the Philippine Crop Insurance System was created in 1976. Subsequently, PCIC was established on 11 June 11 1989 under the Department of Agriculture promulgated through Presidential decree No. 1467 and started its nationwide implementation of crop insurance on 7 May 1981 covering only paddy and later on corn and other high valued crops. As a result of these efforts, 123,000 farmers were insured and 51,000 farmers were paid claims as of 2011 (PCIC 2011).

One of the most useful programmes offered by PCIC includes the insurance of agricultural assets against natural disasters and other perils with a premium rate at the prevailing industry rates. PCIC also has several traditional insurance plans tailored for farming community which include term insurance such as accident insurance, life insurance and loan repayment protection plan with variable premium rates decided based on set procedures. PCIC has also implemented some special insurance programmes, for example, programmes that support the food security and poverty alleviation programme of the government and others that cover aquaculture and fisheries, tobacco and hybrid paddy seed growers.

A new system that PCIC is currently pilot-testing is parametric insurance, the area-based yield index insurance. It uses yield of an area as index for determining pay out. The trigger for pay out or threshold yield index is established based on the historical average yield of an area over a long enough period of time, e.g., 20–30 years. PCIC is testing area-based yield index insurance in Southern Leyte in collaboration with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) in the Philippines through its Micro-insurance Programme for Social Security, which assists in developing national policy and regulatory frameworks and in promoting financial literacy on micro-insurance and weather index insurance (WII).

Both private and government offered insurance products are available in the Philippines, they both differ in various areas. In terms of triggers and risks covered, government (PCIC) and private sector crop insurance programmes are similar. However, in terms of premium, private sector charges high rate compared to PCIC because of the latter’s premium is subsidized by the government. Furthermore, private sectors are also subject to taxes which increase the premium.

In the private sector, numerous business organizations (i.e., agri-business and insurance companies) and several NGOs are involved in the agriculture and fishery insurance. As of 2012, there were 34 private companies in the Philippines providing life insurance, including

savings and investment/endowment fund management, hospitalization, accident and disability insurance. There were 84 non-life insurance companies offering insurance cover for fire and allied perils, marine and aviation, motor and machineries/equipment, travel accident and bond. There were also 26 mutual benefit associations. The private insurance industry has also been involved in crop insurance, particularly WII, through a micro-insurance distribution system. But the non-life insurance part of the industry, which is expected to be the main provider of crop insurance in the private sector, is observed to be fragmented, with members involved in fierce competition, with low capital base and with excessive dependence on international reinsurers (World Bank 2005). MicroEnsure Insurance Brokers Philippines, Inc., is a leading advocate of micro insurance in the private sector. It operates in partnership with various organizations, including microfinance institutions, cooperatives, rural banks, credit unions and humanitarian organizations that provide supportive non-financial services, e.g., housing for the poor.

According to the crop insurance experts the author interacted, the crop insurance in the Philippines faces at least three major issues: Lack of enabling environment for micro-insurance, scaling up WII to other commercial applications and developing regulatory framework for WII and parametric insurance. The main challenge appears to be reaching consensus on who will be responsible for what between the Insurance Commission and the Climate Change Commission. Four main recommendations seem to emerge from various stakeholders: a) to develop WII insurance as fundamental framework; b) joint memorandum circular between the Insurance Commission and the Climate Change Commission. The second option for the Climate Change Commission to make insurance more available by taking the role of coordinating body and advocate of WII; c) to promote individual out-of-pocket proactive participation in risk management which appears to be challenging since individuals are not willing to pay without subsidizing premium component; and d) to advocate local government units to act as risk insurance aggregator by which local governments will be able to reduce overheads in implementing a massive insurance programme.

Vietnam

Agriculture is an important sector of the Vietnam economy. With 70 per cent of Vietnam's population occupied in farming and living in rural areas, annual agricultural production contributes to a third of the country's GDP. Located in a tropical monsoon area of South East Asia, Vietnam's agriculture has been frequently suffering from natural hazards such as floods, droughts and storms as well as seasonal epidemics. The combination of exposure to natural hazards and poor adoption of improved agricultural practices have resulted in repeated crop losses. Over the past 20 years, natural disasters have caused a total loss of life of 13,035 persons (average of 652 lives per year), with damage to housing, public property, agriculture and infrastructure valued at $6.4 billion (an average $322 million per year). Excessive and extended flooding and tropical storms represent 95 per cent of the reported value of losses. The analysis of selected events shows that approximately one third of all the value of damage is incurred by agriculture, a quarter by private housing and the rest by public property in a catastrophic typhoon event. Preliminary catastrophe risk analysis indicates that a major disaster year in Vietnam, occurring once in every century, could cause losses in excess of $3.8 billion at 2008 GDP values (World Bank 2010). The rising concerns about the impact of climate change on the frequency and intensity of climatic hazards in Vietnam has significant implications for the farming sector. The country has been identified

as one of the five worst affected countries by climate change owing to the fact that a large proportion of the population, industry, infrastructure and agriculture are concentrated in the narrow coastal strip and low-lying Red River Basin and Mekong Delta.

According to the Vietnam Farmers Association, total value of loss in annual agricultural production in Vietnam was 8.2 per cent of GDP in 1994, 10.5 per cent in 1997, 4.8 per cent in 1999 and 4.57 per cent in 2000. In addition, Vietnamese farmers have to cope with seasonal epidemics which are potential risk for crops and livestock. Avian influenza, foot and mouth disease in pigs, disease in shrimp, fungi in coffee, insect pests in rice have been causing severe economic damage. Some of the significant damages reported are: (i) Three outbreaks of avian influenza in December 2003 have destroyed nearly 50 million poultry; (ii) In 2004, 38 million poultry, accounting for 15 per cent of the national flock, were destroyed causing a damage of $150 million and direct impact on daily life of millions of households; (iii) In 2007, porcine reproductive and respiratory syndrome in pigs caused damage of $10 million; and (iv) In 2008, the historic cold wave lasting 38 days led to the death of 65,802 cattle, damage to 104,000 ha of paddy and 9,500 ha of paddy seed plots in northern Vietnam with an estimated damage of $300 million.

Over the past several years, the annual costs of natural disasters have been equivalent to an average of 1.0–1.2 per cent of GDP with a peak loss of 3 per cent in 2006. In comparison, average annual expenditure made on disaster relief was 0.5–0.6 per cent of GDP (World Bank 2010). Despite the importance, the concept of agriculture insurance is still at nascent stages in Vietnam. According to the Department of Insurance, Ministry of Finance, the proportion of crop insurance in Vietnam stands at a low level. Less than 1 per cent of the cropped area, cattle, pigs and poultry were insured during the years 2001–2009.

Realizing the above potential for crop insurance in Vietnam, the Government of Vietnam has been encouraging enterprises, particularly the state-owned ones, to provide agriculture insurance services. However, there has been a bumpy road toward improving insurance market for agriculture. The first agriculture insurance was piloted in 1983. So far, there are two companies, Bao Viet and Groupama, providing agriculture insurance for crops and livestock. Two others, Bao Minh and Agriculture Bank's Insurance Company, have potential to provide insurance services.

Bao Viet, the Vietnam Insurance Corporation, has piloted its paddy insurance service in two districts of Vu Ban and Nam Ninh of Nam Ha province, before expanding this service to many other provinces in 1993. The service was expanded to 26 provinces after 15 years of deploying paddy insurance during 1983–1998. However, the insurance programme was not successful as the total covered area was only 1.16 per cent of the country's cultivated area in 1995 and 0.27 per cent in 1997. The insurance service for paddy then encountered difficulties leading to decrease of area covered and premium revenue with an increase in the rate of compensation. In 1999 Bao Viet stopped the paddy insurance with declining interest among farmers ($0.62 million premiums against $0.69 million compensations).

From 1996, Bao Viet agriculture insurance had focused on forest and rubber plantations but could only cover limited area. Premium revenues during 1996–1998 were $0.16 million

against 200 million compensation in Kien Giang area. Insurance for eucalyptus plantation was introduced for a joint venture plantation project in an area of 44,000 ha during1997–1998 with $0.72 million premiums earned. Livestock insurance was also deployed in some provinces from 1996 but was stopped soon due to insufficient demand. So far, Bao Viet agriculture insurance has been mainly implementing insurance for rubber in Binh Phuoc and Tay Ninh and for dairy cows in Kon Tum. However, business efficiency has been low as the rate of compensation (80 per cent of premium revenue) has been much higher than the rate of compensation of its other insurance services (50 per cent).

The experiences in Vietnam suggest that the implementation of agriculture insurance in Vietnam has not been effective. Annual revenue of agriculture insurance increased slowly, proportion of revenue of agriculture insurance was very small compared to the overall premium of non-life insurance: 0.069 per cent in 2004; 0.008 per cent in 2005; 0.012 per cent in 2006; and 0.01 per cent in 2007. The rate of compensation on the turnover was higher than 80 per cent. The implementation of agriculture insurance has been ineffective not only for insurance companies but also for the farmers. There is a potential to insure grain crops, fruit trees, industrial crops and the number of livestock and poultry but only a very small number of industrial plantations are covered under insurance. Paddy is a crucial crop but has not been covered by most insurance companies. The implementation of agriculture insurance neither met the industry goals nor supported the farmers.

There were many causes leading to the poor performance of the agriculture insurance companies in Vietnam. The analyses of business results of Bao Viet and Groupama as well as interviews with staff of insurance companies and experts in the field of insurance has provided some of the main reasons as discussed below.

One of the foremost important reasons was inappropriate design of agriculture insurance services by most companies. Most were multi-risk insurance services but not specific services for particular peril or subject which could be deployed in a large scale. As noted by experts in Bao Viet, paddy fields and farms were located in large areas but the number of insurance staff was few without proper knowledge of crops, animals and insurance. The cost for insurance operation was high while value of insurance was small and scattered in large area. There was no effective risk management practice for insured crops and animals. The fear of farmers exploiting agriculture insurance has been another reason. In addition, the settlement of compensation was slow and procedures were laborious making it more difficult for the insured thus affecting the enthusiasm of farmers after enrolling in insurance services. High losses and low profitability made insurance services least attractive for the insurers. In all these cases, the cost of selling insurance was high and damage assessment, inspection and compensation were problematic while commissions were low. Farmers could not afford to participate in insurance programmes with high premium rates and low financial viability made the insurance programmes unviable. In addition, businesses were targeting revenue and profit as their top priority and salaries of insurance operators were based on the profits earned. Financial capacity of the insurance companies was a limitation. Disaster and epidemic risks in agriculture insurance are sometimes catastrophic with mass destruction causing huge financial losses exceeding the financial capacity of the insurance companies. Hence, the insurer tends to select specific types of risks and deployed in limited areas. Since the risks are high in operating insurance business, the insurance companies need to be

backed by the reinsurance. However, the reinsurance market was undeveloped and there was no reinsurance programmes sharing the risks of the primary insurers.

Keeping the above lessons in view, the Government of Vietnam issued Decision on Crop Insurance – Decision 315/QD-TTg – which introduced a pilot insurance programme for agriculture in 2011 (Vietnam 2012). This pilot programme will be implemented in 20 provinces for three years from February 2012. The programme guarantees 100 per cent premium subsidy for poor farmers, 80 per cent for the near-poor, 60 per cent for other categories of farmers and 20 per cent for the organizations of agricultural production. The funding for subsidies come from the central government for most of the provinces receiving central budget allocation and others have to bear from their own provincial budget. This programme has been introduced in some provinces for paddy, livestock and aquaculture on a pilot basis. The provinces are given the opportunity to implement the programme in the whole province or in selected areas of the province keeping in view the vulnerability factors. The pilot programme covers a range of natural hazards, diseases and epidemics.

The Decision 315/QD-TTg also provides detailed guidelines and eligibility criteria for operating as insurance provider and lays down the roles and responsibilities of ministries involved in implementing insurance programmes (Ministry of Finance, Ministry of Agriculture and Rural Development, Provincial Peoples' Committees and insurance companies). Bao Viet and Bao Minh, two largest state-owned insurance companies, to implement the insurance programme, Vina Re in association with Swiss Re provides reinsurance support for the programme. In addition, Swiss Re provides strategic and technical support to the government in implementing the programme. The government has established elaborate institutional mechanism for implementation of the programme through steering committees at the national, provincial and district levels. Through the Decision 315/QD-TTg, the Government of Vietnam arranged a system of five main actors and their agencies involving in the pilot programme. The national level steering committee constitutes Vice Minister of Finance and line ministries and the provincial level committees constitute Vice Chairman of People's Committee and provincial departments.

Insurance experiences on the ground

Opinions of the insurance beneficiaries and those who did not join insurance provide an important insight into various issues and advantages of implementing insurance programmes. Though insurance providers conduct feasibility studies before implementing insurance products, these studies are often controlled and results are not made available widely and hence it is often difficult to judge what went into these pilot experiences. Keeping this in view, the study has conducted structured questionnaire surveys with farmers (insured and uninsured) to elicit responses on various aspects of insurance. The results are presented as per cent of responses. In Malaysia, 99 farmers (all uninsured) were surveyed as there is no crop insurance programme being implemented. In the Philippines, a total of 39 farmers (29 insured and 10 uninsured) and 19 institutional level respondents were surveyed. In Vietnam, 15 insured and 19 uninsured farmers have participated in the survey.

Malaysia

Keeping in mind the newly proposed crop insurance policy by the government, the study team has conducted a reconnaissance survey with agriculture communities to obtain their opinions and preferences on the proposed policy. These responses provided a useful insight into important characteristics of insurance as opined by the interviewees. The study relied on primary data collected through self-administered questionnaires which was distributed among paddy producing farmers in the Muda Agricultural Development Authority areas of the northern Peninsular Malaysia.[18]

The majority of respondents were males and more than half were 50 years old. More than one third leased or owned 1–2 ha of paddy fields and half of them were in the low income group. The survey has revealed that 77 per cent of the respondents received financial aid from the government after the disaster (in the form of disaster compensation). However, payments were not immediate. Most of them (43 per cent) received payments one or two months after incurring losses. Only 15 per cent received immediate payment and the rest of them waited longer for the payment, which could be more than four months after the disaster.

With regards to the timeliness of payment, more than half of respondents stated that it was timely for them to recover. In fact, 42 per cent of the respondents claim that the period taken by government in delivering the financial aids met their expectation. However, there are some weaknesses raised with regard to the payment system. Half of the respondents are dissatisfied with the loss assessment since the payment received did not represent the loss. A further 8 per cent of respondents claimed that there are leakages of fund along the distribution channels, thus hampering the effectiveness of the payment system. Nonetheless, it turns out that more than half of the respondents relied upon the financial aid in recovering their losses while only 22.7 per cent recovered independently.

The respondents were asked on their opinion regarding the financial aid given by government to the affected farmers. 80 per cent of the respondents were satisfied with the amount of the financial aid and less than 10 per cent are dissatisfied with the amount granted by government. In term of the basis of loss assessment, only 24 per cent of the respondents said that it was at least good. More than one third (36.4 per cent) of the respondents admit to forwarding their complaints to the authoritative bodies while half of them never made any complaint. In their opinion, the government has provided a good (51.3 per cent) mechanism for grievance redress and only 17 per cent said otherwise. Overall, more than half of the respondents had good perception on the overall government policy in the financial aid programme for crop losses and a quarter of the respondents had negative view on the financial aid policy by government.

Although, a high number of respondents provided good feedback on the government policy on compensating farmers for the crop losses, 70.5 per cent of the respondents suggest that crop insurance should be an alternative to the government financial aid programme. In fact, more than half of the respondents are aware of the recently announced government crop

[18] The north of Peninsular Malaysia is the main producer of paddy in Malaysia, accounting 40 per cent of the Malaysia's total production of paddy (MADA 2009). Most of the paddy areas in the northern Peninsular Malaysia are managed by Muda Agricultural Development Authority under the Ministry of Agriculture, and cover an area of 96,558 ha.

insurance programme but only one third claimed having good understanding on crop insurance. 40 per cent of the respondents said that they didn't know whether anyone in the community was called to participate in the development of the crop insurance programme.

The survey found that the average willingness to pay for a crop insurance policy is $9 per ha per season for insurance premium with conditions set as below:

- Maximum compensation should be $4,280 per ha
- Coverage should include floods, fire and disease outbreak
- Amount of compensation should to be paid based on valuation made by related authority

The Survey found 26 per cent of the respondents are unwilling to pay for the bid amount given to them. The most common reason why they are not willing to pay is because they believe the premium should be subsidized by the government (71.4 per cent). Only 14.3 per cent gave the reason that they do not believe in insurance. The respondents were also asked about their expectation if the crop insurance programme is not offered: 37 per cent indicated that they will not be able to recover from losses while 18 per cent said they will be able to recover with the helps from various parties such as friends, relatives, NGOs and government.

Philippines

Insights on how farmers, with or without insurance cover, look at insurance for agriculture were obtained from structured questionnaire surveys conducted in various locations with the help of MicroEnsure and Cocolife. A total of 29 insurance beneficiaries and 10 non-beneficiaries from various municipalities have participated in the surveys. The beneficiary group respondents included 35 per cent male and 65 per cent female, with 72 per cent above 50 years old. Most were farmers with one rural entrepreneur. 58 per cent considered themselves belonging to the low-income group and the rest to the middle-income group. 69 per cent owned 2 ha or less of land and 100 per cent of the lands owned by all respondents were arable.

All the respondents have experienced crop losses due to natural calamities (floods, droughts, landslides, forest fires, insect outbreak, uncongenial weather conditions such as temperature, humidity, etc.), mostly in 2012. 90 per cent had crop losses in the range of 75–100 per cent. 50 per cent of them have not recovered from their losses yet, 67 per cent of them are still at a loss, 3 per cent took a bank loan to cope with their loss, and 28 per cent resorted to various types of coping measures that included borrowing from microfinance institutions (all respondents), insurance pay out (50 per cent), personal money (38 per cent), and crop loan, compensation from other crops and assistance from the department of agriculture (12 per cent).

Among the participants of insurance programme, 55 per cent said they have been in an insurance programme for less than a year, 38 per cent for 2–3 years, 1 per cent for 4–5 years, and 1 per cent for more than 6 years. More than half of them (59 per cent) expressed having average level of understanding of their insurance programme and 41 per cent expressed having good level of understanding. They attributed their understanding to the efforts of the insurance providers, with 48 per cent of them rating such effort as good, and 41 per cent rating such effort as average. 10 per cent of them rated the efforts as bad.

Majority of the respondents paid more than $49 premiums for insurance per year, with 41 per cent paying $49–$73 and 31 per cent paying more than $73. Those who paid less were 17 per cent for $25–$49 and 10 per cent for $25 and less. Among those who responded to the question on affordability of the premiums, 17 per cent said it is affordable and the same percentage also said it was not. One third said it was costly but was made affordable by innovative approaches and one third of them were not sure.

Of those who responded to the question on the amount received as insurance claim pay out, all said it partially compensated their loss but was insufficient for recovery from disaster. On the level of satisfaction with the claim received, majority (66 per cent) was uncertain, 21 per cent thought it was bad, 4 per cent, very bad, and 10 per cent had high level of satisfaction. On the insurance claim procedure, 62 per cent was uncertain, 24 per cent thought it was bad, and 14 per cent had high satisfaction. 44 per cent said they received their pay out within three months after their submission of the required documents to the insurance agency. Over 30 per cent (31 per cent) received it within two months after and 25 per cent received it four months after. Of those who commented on the timeliness of the pay out, only 33 per cent said that it was timely for them to get back to their normal life. Most of the respondents (83 per cent) said that their claims were assessed fairly, 14 per cent were uncertain, and 3 per cent said they were unfairly assessed. Of those who responded to the question on grievances, 67 per cent indicated that their grievances on insurance settlement were not addressed well by the insurer.

Their recovery after the disaster was slow according to 59 per cent of the respondents and very slow according to 28 per cent. Some (7 per cent) had not progressed since the disaster. A few (3 per cent) said they are better than before the disaster or had recovered fully. Before enrolling in the insurance programme, 79 per cent were not able to recover from disaster, 14 per cent were able to recover with the help of relatives and friends, and 3 per cent were able to recover with the help of the government; but 3 per cent said that they were able to recover better than with insurance. All of the respondents said that the government should provide subsidy for the crop insurance premium, with 52 per cent of them saying 100 per cent subsidy, 17 per cent with 75 per cent subsidy, 17 per cent with 50 per cent subsidy, 7 per cent with 25 per cent subsidy, and 7 per cent with subsidy that is based on the economic level of the farmer. Most (86 per cent) of them wanted that 100 per cent of the crop loss would be covered by the insurer, 7 per cent said partially covered but could be insufficient for full recovery, and another 7 per cent said partially covered but sufficient for full recovery.

Among the non-beneficiary group covered by the survey, 10 farmers were randomly chosen, with 60 per cent male and 40 per cent female, with 70 per cent of them with an age more than 40 years. 40 per cent of them considered themselves belonging to the low-income group and 60 per cent to the middle-income group. 50 per cent of them owned 2 ha of land and 50 per cent owned at most one hectare of land. All of their lands are arable. All had experienced crop losses, mostly in 2012, with 50 per cent experiencing 50 per cent crop loss, 40 per cent with 75 per cent crop loss, and 10 per cent with 25 per cent crop loss. 70 per cent said they had not recovered from the disasters although 40 per cent of them borrowed money from microfinance institutions. All of them said they did not receive any government support to cover their crop loss. All of the respondents had no experience with any type of crop insurance. All wanted government subsidy for the premium, with 30 per cent

of them opting for 100 per cent subsidy, 20 per cent for 75 per cent subsidy, and 50 per cent for 50 per cent subsidy. All wanted insurers to cover their crop losses fully.

Vietnam

The questionnaire survey was undertaken in two communes - Lung Hoa (Vinh Tuong district) and Kim Long (Tam Duong district) of Vinh Phuc province- to understand farmer opinions on the agriculture insurance programmes which have been implemented in their locality. Among nine communes chosen for the pilot programme of agriculture insurance in Vinh Phuc province, Lung Hoa has lowest number of insured households. As the number of insurance beneficiary in Vinh Phuc province was only 7 households, it was decided to change the target respondents. 34 households were interviewed, 15 beneficiaries and 19 non-beneficiaries in the pilot insurance programme.

Of the respondents, 26 per cent suffered livestock losses due to typhoon Number 5 in August 2012. In this disaster, Vinh Phuc province was not considered among the most-affected provinces to receive post-disaster relief programme of the government. To offset the loss, 11.1 per cent of respondents had to take bank loans, 22.2 per cent borrowed money from their relatives and 33.3 per cent had to use personal effort to recover from the disaster. This delayed the recovery process and most of the damaged respondents (88.8 per cent) said the government should compensate loss of farmers in all affected provinces based on loss assessment.

Respondents expressed their opinions about a post-disaster relief programme implemented seven years ago. The programme had no loss assessment based on the extent of damage but compensation was equally provided to all the affected households. When asked to rate the programme, a high proportion of respondents expressed low levels of satisfaction on the basis for making compensation, the time taken for compensation and particularly the quantum of sum compensated as it was insufficient for recovering from disaster. Although complained about the programme, 61.8 per cent of respondents said that the relief programme was necessary for helping farmers sought improvement in the programme implementation at the local level.

A large number of the households participated in the pilot agriculture insurance programme expressed high levels of satisfaction on quantum of sum assured, period of risk covered, basis for making insurance payments and time taken for claim settlement but wished that the number of risks covered could be increased. The opinion on number of risks covered by insurance programme was same for households who did not participate in the insurance programme. Although expressed different opinion on the agriculture insurance programme, most of the respondents thought that the government should subsidize the premium of the agriculture insurance.

Of all the respondents, 44.1 per cent (15 households) have participated in the pilot agriculture insurance programme for the last one year. 80 per cent of the participating respondents were poor households below poverty line and had the government subsidized entire premium. 52.9 per cent of respondents said that the current premium was not affordable compared to their income and 41.2 per cent believed that the premium was made affordable by government subsidy.

In addition, many respondents stated that the compensation disbursement was complex and not reasonable. Those who did not participate in the pilot programme disagreed with insurance company insuring only for four diseases (two for pig, one for chicken and cattle) and they wanted damages to be paid for all natural disasters and epidemics. These respondents believed that insurance payment based on damage of more than 20 per cent of the commune's average yield was unfair. Although diseases in agriculture crops occur frequently, sometimes severely, farmers still do not buy insurance. Among farmers that did not participate in agriculture insurance programme, more than 30 per cent thought that the loss compensation was not sufficient.

One of the difficulties in expanding the pilot agriculture insurance programme has been the lack of information on the programme. Some farmers adopt industrial agricultural practices with large farms and these farmers wanted to be covered in order to avoid risks. However, these farmers are not convinced by the way the insurance companies sell their products and the information they get from the insurance agents. Although there are a number of promotional activities on agriculture insurance, most (94.1 per cent) of the respondents interviewed said that they had average or above average levels of understanding the agriculture insurance programme. However, after assessing their knowledge by asking some open ended questions, it can be said that they lacked knowledge on procedures for buying premium, compensation and grievance redress mechanism. This finding calls for improvements in the way the insurance products are communicated to the prospective insurance buyers and those who have already enrolled in the insurance.

In addition, interviews showed that the insurance companies were not closely associated with the rural credit institutions and did not coordinate with social organizations such as farmers' associations, women's associations, unions and cooperatives to implement and develop an appropriate agriculture insurance service. 95 per cent of the insured in Vinh Phuc province were poor households (the national rate is 88 per cent) and the insurance is 100 per cent subsidized by the government. Continuing subsidies may make these households dependent on government subsidies or disaster relief. Moreover, this may causes the middle and high income households to interpret the emphasis of pilot agriculture insurance programme as a poverty reduction mechanism and may refrain from participating in such programmes. This explains why only 4 per cent of non-poor households had participated in agricultural insurance in the province. This calls for agriculture insurance programme with proper loss assessment to encourage medium and large size agricultural producers. High voluntary participation of farmers in agriculture insurance is essential for a successful insurance programme.

Conclusions and recommendations

Tables 1 and 2 provide a comparative evaluation of insurance experiences in the three case study countries.

Table 1. Major issues and policy solutions identified for promoting agriculture insurance in the study countries

Item	Policy and institutional solutions/issues
A. Issues for which solutions have already been identified and or implemented	
1. High cost of insurance	• Subsidizing the premium (all study countries with varying degrees) • Mitigating non-crop losses (Philippines) • Implementing non-financial risk mitigation strategies (all study countries though not coordinated and not linked)
2. Instilling trust among farmers and insurance agencies	• Creating regulatory bodies, regulations and arbitration guidelines (all study countries with varying degrees)
3. Access to re-insurance	• Public-private partnerships (Vietnam and Malaysia) • Mostly government (Philippines)
4. Reaching economies of scale	• Introducing comprehensive insurance products that suits a wide range of target farmers (Philippines and Vietnam) • Provide monetary incentives in paddy farming to encourage landowners to outsource the management of their land (Malaysia)
5. Lack of weather and crop loss data	• Remote sensing approaches (Philippines and Malaysia)
6. Lack of capacity	• Public-private partnerships (all study countries though they vary in the strength of these relationships. In all cases, the introduction of national programmes have invariably happened with the help of an external private agency such as Swiss Re, Munich Re, GTZ etc.)
B. Issues for which solutions have not been identified and or not implemented	
7. Rapid land development	• A more comprehensive risk assessment of impact to surrounding arable land area before undertaking any development projects (Malaysia)
8. Unproductive arable land with high pest infestation	• Enhance cooperative efforts to ensure full land utilization and thus reducing risk of losses (Malaysia)
9. Relief dependency of farmers	• Efforts to increase awareness on the concept of crop insurance and to change the perception of dependency on subsidy programme (Malaysia)
10. Main insurance beneficiaries are not clearly defined in the policy	• Crop insurance policy should not start with/focus on poverty household/beneficiary but big beneficiaries whose products contribute high proportion to GDP (e.g. paddy, coffee, pepper, cashew nut). This direction may attract more players – both in insurance industry and agriculture – to participate in crop insurance (Vietnam)

Table 2. Major strengths and weaknesses of insurance for arable crops identified through surveys conducted in Malaysia, the Philippines and Vietnam

Country	Strengths	Weaknesses	Opportunities	Threats
Malaysia	• Strong presence of private insurance industry (both national and international) • Long experience with insurance for industrial crops • Educated young next generation of farmers with favourable attitude towards crop insurance • Strong political will in risk mitigation • Matured paddy sector • Well-structured government agencies in paddy production • Availability of good database on paddy farmers • Availability of remote sensing technology to allow for a more accurate loss assessment	• Lack of experience with arable (mostly food) crop insurance • High subsidy costs to be borne by the government • Average paddy field size is 2 ha • Highly dependence on government subsidy lead to relief dependency	• Government efforts to promote large-scaled farming will contribute towards a more cost-effective and viable crop insurance • High demand for insurance among paddy farmers • High confidence on the government ability to implement the crop insurance	• Farmers are reluctant to move into large-scaled farming • Variety of insect outbreak may increase the potential losses • Lack of understanding of insurance concept among paddy farmers • Difficulty in managing claim eligibility due to restrictive social system • Lack of emphasis on risk management strategies such as weak maintenance of irrigation systems
Vietnam	• High political will • Introduced law and guidelines on crop insurance • Strong and authoritative national and local governments	• Lack of willingness among farmers for enrolment • Limited private sector presence in the farm financing sector • High subsidy costs to be borne by the government • Limited expertise and market penetration	• Agricultural economy is one of the ways forward for the country's economic orientation • High farming population	• Relief dependant farmers unwilling to pay insurance • Risk in agriculture is high in its frequency and severity • Agricultural production is still in very small scale (household) and insurance buyers are dispersed • Lack of technical infrastructure for preventing and coping with epidemics in agriculture • High cost of loss assessment

Country	Strengths	Weaknesses	Opportunities	Threats
Philippines	• Creation of institutions that address risk transfer-Climate Change Commission, PCIC • Involvement of some private companies that actively promote WII and some local government units in crop insurance • Rich presence of community based organizations, including those in microfinance • Several years of experience with crop insurance, as well as pilot implementation of WII • Agricultural asset insurance covering non-crop losses	• Lack of policy and regulatory framework for micro-insurance • High subsidy of insurance premiums by the government • Absence of a level-playing field for more private insurance companies to be involved in crop insurance since their premiums are taxed and not subsidized • Limited new product development • Limited market development and penetration • Lack of reliable risk data and technical experts especially at the local level	• Growing interest on weather index based insurance products among private and public insurance agencies • Growing realization on the importance of crop insurance among farmers and agriculture supply chain • Newer projected threats from climate change studies especially related to typhoon • Greater emphasis has been given to insurance in the national policy framework for combating climate change	• Lack of willingness to design cost effective insurance products by private companies in absence of government subsidies • Lack of appropriate tools and regulations to take into consideration the future climate change impacts into design of insurance products could diminish the effectiveness of these instruments in the long-run. • Heavy dependence on foreign insurers leading to under development of domestic strengths

From tables 1 and 2 and the discussion above, it can be concluded that the crop insurance programmes in the case study countries are at different stages of development with the Philippines at the forefront followed by Vietnam and Malaysia. Several lessons and best practices emerge in terms of what should be the essential design elements for promoting agriculture insurance which are discussed here.

1) Keep the price of the insurance premium affordable

The price of the insurance premiums is one of the major determinants for enrolling maximum number of insured and hence keeping its price affordable is an important aspect of the overall design of insurance. In the case of Vietnam and the Philippines, the premiums were heavily subsidized to make the premiums affordable. In the Philippines, the prices of premiums were kept at an affordable level by linking micro-insurance with the cooperatives. The proposed insurance policy by the government of Malaysia talks about subsidizing insurance. However, there is a limit to which the insurance agencies can reduce the insurance premium prices since the premium prices would have to cover capital costs, reinsurance costs and administrative costs and profit margins. As seen in the case of Vietnam, the insurance companies went out of business trying to reduce the insurance costs. It proves that any substantial reduction in insurance costs can only be possible by a combination of approaches such as efficient management by the insurance firms, reducing basis risks through risk mitigation measure such as best management practices in agriculture including expansion of area under irrigation, providing timely weather and climate information for decision making and capacity building of farmers through farmer field schools etc. There is a great potential for promoting such combined approaches in the study countries.

2) Generate public awareness

The community surveys conducted in this study reiterates the importance of public awareness on various aspects of risk communication and management. Though insurance agencies tend to educate potential insurance buyers on the insurance products they offer, it was seen that this area still needs greater attention by all agencies involved in the insurance sector. The lack of awareness among various stakeholders is a major issue especially on the subject of damage assessment and payment mechanisms. This hurdle was mostly overcome by incorporating the grassroots level awareness generation activities. Though governments and insurance agencies are implementing several farmer advocacy programmes in almost all countries, the process still requires substantive efforts to make a real difference. The trust deficit between farmers, insurance companies and governments goes beyond implementing stringent rules and regulations. Most often, farmers were either consulted at the end of designing insurance products or were never consulted. Developing insurance products that incorporates the preferences of farming communities could be the first step in achieving a greater public awareness and acceptance of insurance products.

Overcoming beliefs, perceptions and other cultural and sociological barriers to the management of risks and use of insurance is a continuing challenge. However, the recent disaster experiences of farmers from climate-related events have convinced

more of them to become involved in protecting themselves and their farms from climate risks. Their lack of knowledge on and awareness of the risks, the variables that they can and cannot control and the measures that they may take must be addressed with joint efforts from the public and private sectors. Risk communication must also convey the message that climate change is related to deforestation, pollution and other environmental problems so that farmers will avoid contributing to them.

3) Avoid the moral hazard and adverse selection

One of the major problems with the traditional indemnity based crop insurance programmes has been the moral hazard, i.e. unfair practices by the insured that leads to higher insurance costs and adverse selection, i.e., propensity of high risk individuals to buy insurance and with more coverage. Our study neither found nor confirmed the absence of moral hazard and adverse selection. However, the study found issues with the way the crop damages are estimated by insurance companies and disparities between expected (by farmer) and actual insurance pay outs. The issue of moral hazard has largely been overcome by the advent of weather index based insurance systems where payment is triggered by factors that are extraneous to the human control, i.e. the actual incidence of the particular intensity level of the hazard (e.g. 60 per cent reduction in rainfall). One factor that needs to be taken into consideration, however, is the weather data required for developing such indexes. Index insurance is still in nascent stages in all the case study countries with the Philippines at advanced stages with pilot programmes being implemented than other countries.

4) Link with reinsurers and investment in financial markets

The study did find issues related to reinsurance. For example, insurance companies in Vietnam have often had difficulties to be reinsured and heavy dominance of foreign reinsurance companies often limited the development of domestic reinsurance companies. Support by reinsurers is one of the important considerations for putting in place robust insurance systems as reinsurers provide needed financial backup to the insurers. In addition, insurance facilities created may also consider investing, in part or total, in international financial markets by the support of the international reinsurance facilities. Such an example is epitomized by the current agricultural weather index programme in Thailand and the Caribbean catastrophe insurance facility. Efforts should be made so as to ensure that the financial markets provide greater risk reduction benefits to individuals by giving right price signals encouraging greater participation in insurance. The growing natural disasters and related losses necessitate the establishment of a regional catastrophic pool on the lines of Caribbean Catastrophic Risk Insurance Facility (CCRIF). Such a facility will enable sharing risks among countries in the region and be able to diversify the risk portfolio. In the wake of a catastrophic event, such a facility could reduce the burden on insurance companies and reinsurers.

5) Enhance the availability and accessibility of risk information and assessment tools

Availability of reliable rainfall data and associated crop losses is a prerequisite for designing a robust index based insurance facility. Similarly, comprehensive information on physical characteristics of the infrastructure such as agriculture practices, irrigation systems, risk taking behaviour of farmers etc., to be studied and quantified for estimating the risk from hazards such as floods, droughts and earthquakes. Such robust information infrastructure is still not readily available in the large-scale in most of the countries hindering expansion of insurance. Due to lack of or access to such data, the predominant form of insurance in case study countries is still indemnity based insurance that heavily depended on direct loss estimation with implication for human costs and overheads for implementing the insurance programme.

Risk assessment methods and models are highly specialized subjects and often are out of reach of most stakeholders involved in risk reduction. Methods and models used in risk assessment by insurance agencies and other groups should be widely shared and discussed with others who may help apply them in other areas so that the most appropriate ones can be applied on each location and more importantly more stakeholders are exposed to and become familiar with these tools. It is expected that there may be various methods and models as different disciplines and modellers may be involved. Hence, a modelling forum where the technical experts may periodically share their work and findings will help.

6) Pool risks at local level

While there has been much emphasis on risk pooling at the regional and international levels, there has been very limited discussion on the possibility of risk pooling at the local level and the role of local agencies in acting as risk aggregators. During the consultations in the Philippines, many insurance agencies expressed that the local government units could act as risk aggregators reducing the overall burden on the macro mechanisms leading to reduced costs and efficient management of insurance. Such a process could empower communities and local agencies leading to better acceptance of insurance products.

7) Climate change and insurance

In this study, no evidence could be obtained on how different insurance agencies approach the problem of climate change and how the insurance products could be designed for a changing climate. This indicates that the insurance industry is still to come to the grips with this subject before they could design products and introduce to the potential insurance buyers. With the uncertainty of climate change impacts in the future, both insurers and potential insurance beneficiaries face the challenge of securing an optimal level of protection from climate change risks. More rigorous risk assessment, with consideration of future uncertainties, not only past experience, should help in facing this challenge.

8) Public-private partnerships

Though often treated as a buzzword, the success of insurance is very much dependent on how well the public-private partnerships are created and nurtured. All the insurance products, whether currently been implemented or in the pipeline, are products of public-private partnerships wherein the governments engage with insurance industry (often an international entity) to design insurance products. However, it also shows the lack of expertise to design innovative insurance products among the domestic insurance players, including government and private sector. The increasing number and magnitude of climate-related disasters now require a more efficient and effective public-private partnership in implementing a risk management strategy in the agriculture sector. Closer relationships between and among the government and private insurance industry and with other business groups, e.g., agribusiness companies and institutions in civil society, especially the academe and farmers, must be developed and nurtured. More dialogues and interactions could address such comments as "lack of willingness at the policy level to hear recommendations."

9) Policy and regulatory framework and enabling environment

Just like any other developmental issue, a successful expansion in insurance can only happen in an enabling policy environment set by the governments. Though countries are waking up to this fact, the current policy environment is only congenial for implementing a traditional insurance programme such as indemnity based one. A major issue identified is the lack of policy and regulatory framework and enabling environment for micro and parametric insurance. Scaling up of insurance in the agriculture sector needs such regulatory framework and environment, with safeguards for protecting farmers. Such a framework must cover what parametric insurance is and its features and what standards, protocols and others shall govern its implementation, "who" can offer and buy the insurance, "who" the other parties are (regulator, data collector, funding source, data source, etc.), "who" should be involved in the insurance transactions and their roles and responsibilities and "how" the insurance system will be implemented and regulated.

10) Develop market for insurance

Only a few insurance companies are now involved in climate related risks, agricultural crops and micro insurance. There is a need to encourage more companies to become active in this challenging business. Although national agencies are increasingly playing a significant role in agriculture insurance, in the long run, it is important to have a well-functioning market for insurance. Continuing government subsidy to all types of farmers could become eventually unhealthy and unsustainable. One recommendation is to focus government subsidy to marginalized farmers and to industry that is in a bad economic shape for a limited period.

The private insurance industry must also assume the responsibility of offering affordable and effective insurance products to farmers. Private insurers believe that having a level-playing field is the key to encourage private companies to be involved and do so. One recommendation from the private sector is for government to simplify the tax system and to use collected taxes for the strengthening of the micro

insurance industry. Another is to extend the tax exemption granted to insurance premiums for agricultural insurance to premiums of private micro insurance companies and of the reinsurance covering them (especially in case of the Philippines).

This study has identified existing limitations in promoting insurance by drawing lessons from the three case study countries. Numerous insurance experiences show that risk spreading is a way forward for dealing with a variety of climate and non-climate related risks. However, feasibility and sustainability of implementing insurance programmes at global, regional, national and local level could face several barriers, as identified in this study, which include limited knowledge among stakeholders about the benefits of insurance systems, limited expertise to design and implement insurance products, challenges in keeping the premium prices low, lack of good quality data on risks and historical losses and limited presence of reinsurers. Addressing these limitations, with collaboration of the public and private sectors, is essential in enhancing readiness to acceptance of insurance. In this regard, further assessment is needed to identify the best mix or combination of risk mitigation and risk spreading tools for each country concerned with a careful consideration for implementing risk pooling concepts at all levels. A combination of approaches such as targeted subsidies or implementing risk mitigation measures as a package with risk insurance in agriculture sector is of paramount importance. An integrated risk communication, risk assessment and risk management strategy is needed within the sustainable development plans and programmes of the countries. The ultimate metric for the real impact of insurance proposals should be in terms of scaling up of insurance leading to substantial risk reduction on the ground so that sustainability and prosperity can be achieved, despite climate change.

V. Climate Resilience and Water Security in South Asia

PRIYANKA DISSANAYAKE[19]

Background

South Asia comprises Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The region is home to more than 21 per cent of the world's population, yet has access to just over 8 per cent of global water resources. Almost one in five people in South Asia lack improved water sources, despite significant progress made in recent years and the availability of many technically feasible and low-cost solutions. The *Water Security Index for South Asia 1.6* confirms the region as a hotspot where populations and economies are being adversely impacted by poor water security (ADB 2013). South Asia has the highest regional Global Hunger Index score. Some 299 million people in South Asia are undernourished, about 40 per cent of the world's hungry (IFPRI 2013). Most of the 1.5 million children that die each year as a result of unsafe water live in South Asia.

South Asia is among the areas expected to be hardest hit by climate change and this will have profound effects on food and water security. Climate change impacts also interact with the pre-existing social, economic and political stresses, leaving communities to deal with exacerbated risks. Building resilience is, therefore, about addressing international cooperation, water governance, ensuring security provisions, safeguarding livelihoods along with adapting to the ever-increasing uncertainties in climate. South Asia will need to face the full implications of the increasingly strong interconnections between water and food insecurity; where climate change resiliency and regional integration are crucial. Climate change adaptation (CCA) in the water and agriculture sectors along with coping with disaster preparedness through systematic planning and implementation is the most difficult challenge in the region. The outcomes of global and regional dialogues have clearly indicated that in the emerging scenario of increased frequency and intensity of disasters, CCA and improving resilience towards climate uncertainties are crucial to the success of strategic adaptation initiatives in the water sector.

The report *Trends in Climate Change Adaptation in the Water Sector in South Asia* concluded it is essential to design policies so that they take into account the uncertainties associated with climate change (IGES, GWP and SAS 2012). Disaster planning and risk reduction strategies must incorporate measures to deal with the new challenges of increasing frequency of climate induced disasters. It is well accepted that as the adaptive capacity of the country low, its vulnerability to climate change is high, leading to a greater cost of associated impacts. So there is a need to assess the national level adaptive capacity, strengthen institutional and human capacities to implement existing policy measures, document what worked and what did not, and develop and implement climate resilient strategies. Special attention should be given to strengthen institutional arrangements and institutionalizing

[19] Ms. Priyanka Dissanayake, Global Water Partnership South Asia (GWP–SAS).

knowledge generation and information sharing on securing water, which is at the heart of adaptation towards resilience.

GWP along with African Ministers Council on Water developed the "Framework for Water Security and Climate Resilient Development", 2012. The strategic framework prioritized portfolios of no/low regrets investments for enhancing water security and climate resilient development and its application to build institutional capacity, strengthening understanding and enhancing partnerships for action. However, such framework for the Asia-Pacific region or even for the South Asian sub-region is yet to be developed. Within this context, this chapter takes a stride to provide a regional overview, lay down success stories from the region on water security, underline the importance of integrating indigenous knowledge with modern technology and finally deal with the gaps and challenges in this direction to develop coherent policies and frameworks. Promoting water security and climate-resilient development reinforces actions that reflect the overarching messages from Rio+20 which emphasized the green economy, sustainable development, meeting the Millennium Development Goals and strengthening international climate action.

Adaptation and resilience to a changing climate: A regional overview

Hydro-meteorological disasters will occur more frequently, which has a higher intensity would create a high level of uncertainty in the coming years. The likelihood of more trans-boundary disasters will increase. Disaster size could de-capacitate systems and governance laid down for disaster management at both national and regional level. Therefore, to cope and adapt with new scenarios of extreme weather events may require regional and sub-regional support, programmes, systems, projects and laws. As also highlighted in the Post-2015 Framework for Disaster Risk Reduction (Hyogo Framework, Action 2) in the SAARC region, one of the key focus areas is to collaborate and work together as a region to address the various risks through early warning mechanism, regional response mechanism, knowledge management. The role of regional Institutions, intergovernmental bodies, treaties, associations, United Nations bodies will all be required to redefine mandates to address present and future scenarios. Implementation of Thimphu statement on climate change in the region is of paramount importance (SAARC 2010). The integration of CCA, DRR, loss and damage and development will improve climate resilience significantly.

Climate science and the projections of its various impacts are at an early stage of development in the region. Yet South Asia is among the most data-rich regions of the developing world and is well endowed with considerable analytical capacity for providing policy inputs, a capacity that has yet to be fully mobilized for effective policy and institutional responses (GWP 2011). Adaptation is a dynamic social process: the ability of societies to adapt is determined, in part, by the ability to act collectively. Community based adaptation approaches, emerging and social capital and the ability to act collectively is high in the region in disaster responses.

Adaptation efforts in South Asia have so far been fragmented, lacking a strong link between national climate change strategies, plans and existing disaster risk reduction, agricultural and other relevant policies (Oxfam 2011). Using the collective capacity of SAARC itself is important in addressing the gaps in adaptation and climate resilience.

To be effective, Adaptation measures should be promoted at the appropriate level:

- Transboundary level (treaties and agreements);
- National enabling environment (water laws and institutions);
- National planning (integrated water resources management (IWRM) plans policies and strategies); and
- Basin water management (functions of water management).

Hydrological data sharing in South Asia

South Asian countries are linked by trans-boundary rivers, many of which are bound by treaties. India and Pakistan share the Indus, India and Bangladesh share the Ganges and Brahmaputra rivers, Nepal and India share Kosi, Mahakali and several others. Pakistan and Afghanistan share nine important rivers, including the Kabul River. Hydrological and Meteorological Data Sharing among countries that shares trans-boundary rivers in South Asia has not been very successful and there is a considerable reluctance to share hydrological data. For reducing uncertainties it is important to have flood, tsunami, cyclone forecasting, therefore, it is important to initiate data sharing for forecasting and early warning for floods and other climate induced disasters. It is also important to identify which agencies are involved in sharing data, the public or private nature of such data, what type of data are shared and to have a protocol for data sharing. In South Asia available data has not been used in developing policy and advocacy tools that are mandatory for CCA. Sometimes data sharing at the country level has been difficult when multiple agencies are involved, and is even more difficult between two hydrologically connected countries. Long term data from Nepal is readily available from digital format to hardcopy for analysis with some charges associated with it. Similar approaches from other countries in the region are required. However, all member countries have agreed in principal to share data for early warning and it has to be ratified by the parliament of the respective member States. Sometimes governments are reluctant to share government-generated data considering it a threat to national security. Maintaining the sovereignty of each country should be a top priority when data are shared. Moving away from bilateral data sharing and initiating sub-regional and regional data sharing for meaningful water cooperation is the key for addressing trans-boundary hydro meteorological disasters.

Across the region there is currently no river basin management system or any long-term strategy for water management. This is compounded by insufficient coordination between agencies, a low investment, lack of clear regulation for rational land use and inefficient use of water, especially for agricultural purposes. An example of this is the lack of coordination between national and international institutions for river basins that transcend national boundaries.

Those responsible for managing river basins, including local governments, need to cooperate with a range of stakeholders in order to do the following:

- Advance monitoring and statistical analysis of their particular basin;
- Disseminate information to communities and other institutions;
- Operationalize flood and river overflows forecasting and alert systems;
- Improve understanding of the different types of interventions needed to regulate river flow during wet and dry seasons;
- Manage natural resources more effectively, including through efficient water use and land-use planning.

Regional Flood Information System: Hindu Kush Himalayan Hydrological Cycle Observation System (HKH-HYCOS)

Meaningful regional cooperation is required among the countries sharing the HKH region river basins, namely Bangladesh, Bhutan, China, Nepal, India and Pakistan. The bilateral river treaties and data sharing arrangements that are currently in force among these countries, although necessary, are not sufficient to avert flood catastrophes of trans-boundary scale. The International Centre for Integrated Mountain Development (ICIMOD), World Meteorological Organization and partner countries developed the HKHHYCOS project to enhance regional cooperation in hydro meteorological data collection and sharing for flood forecasting to support disaster prevention and flood management at the regional level. The project is establishing a regional flood information system to facilitate trans-boundary exchange of real- and near-real-time data, best practices and know-how in support of flood management. It also seeks to build the technical capacity of the national hydrological and meteorological services of partner countries. The overall objective is to minimize loss of human lives and property damage through timely exchange of flood data and information between and among partner countries.

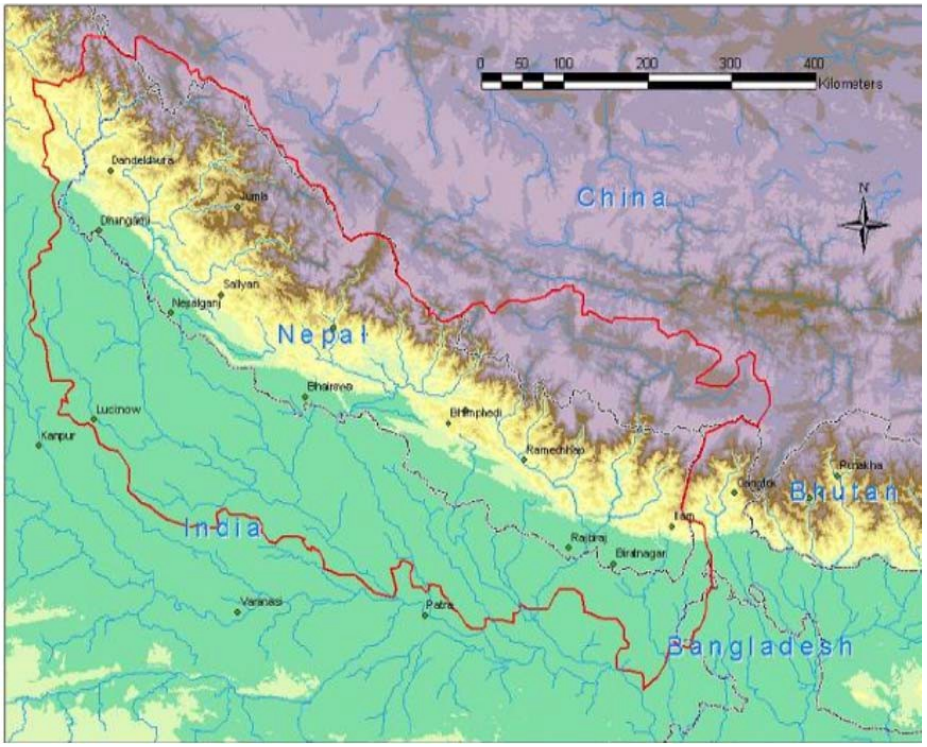
Nepal-India Joint Flood Forecasting Scheme

Nepal-India Joint Flood Forecasting Scheme (figure 1) initiated in 1998 is one of the successful flood forecasting systems in the region. In 1996 both Governments entered into a treaty concerning integrated development of the Mahakali river. The treaty has been ratified by both parties and is in operation.

At the review held in 2000 the importance of a flood forecasting system was recognized and a committee was created to forecast floods. New collection stations were developed and master plans for forecasting were created by including 150,000 km^2 and 120,000 km^2 from Nepal and India respectively (JVS/GWP 2013). Tibet was also included in the plan. Currently real time data is available on the Internet for around 60 metrological stations with the development of the flood forecasting and early-warning system. Further data are available regionally and globally and are being shared with other organizations which are using it to develop information systems. All these developments have facilitated Nepal to perform well in data sharing among the countries in the region.

However, there was lack of preparedness, sharing of information and resources and coordination on both sides of the Mahakali river (which forms boundary between Nepal and India at major stretches) that caused devastating floods in June 2013. Surprisingly, there was no river-level hydrological monitoring station on the Mahakali river for flood forecasting and early warning (JVS/GWP 2013). Had there been a river monitoring station for early warning, people could have had some lead-time to prepare and improve management in the Mahakali basin before the devastating floods.

Figure 1. Major rivers and locations in the area under the Nepal-India Joint Flood Forecasting Scheme



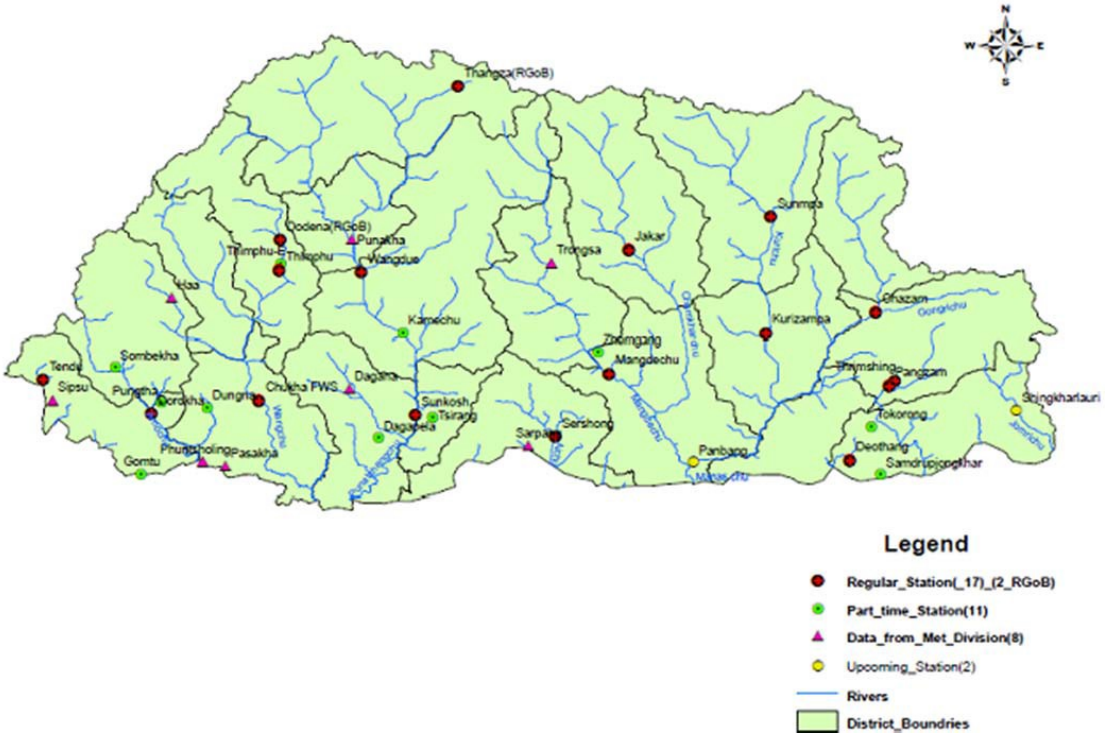
Bhutan-India Flood Warning System

There are flood warning stations set up on all the major rivers of Bhutan which share water level data with downstream Indian counterparts. Flood warning activity is undertaken by the Royal Government of Bhutan in collaboration between the Central Water Commission of India mainly to provide early warning for people downstream from floods. Flood warning network stations are established on the north-south rivers that are common to India and Bhutan (Bhutan 2014).

There are more than 28 flood monitoring stations (Figure 2) under operation in Bhutan. River water level and rainfall data from these stations are continuously transmitted to designated stations in Cooch Bihar, Jalpaiguri, Nalbari and Berbeta in the Indian states of West Bengal and Assam. The flood warning stations are monitored for 24 hrs during the monsoon season and data are transmitted using wireless sets on an hourly basis to stations in India.

The South Asian Climate Outlook Forum was established in 2009 and is hosted by the India Meteorological Department, Pune. The Forum has the World Meteorological Organization Regional Climate Center (demonstration phase) and makes regional forecasts before every monsoon season.

Figure 2. Map of 28 flood monitoring stations under operation in Bhutan



Source: Bhutan Department of Hydro-met Services (DHMS) 2014.

A step towards water security: Progress and success stories from the region

A key challenge for the South Asian region is achieving food and water security. Water security has been defined as "the reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks (Grey and Sadoff 2007). South Asia has the worst household, urban and environmental water security and the least resilience to water-related disasters (ADB 2013). Water security is the ability to ensure the availability of adequate and reliable water resources of acceptable quality, to underpin water service provision for all social and economic activity. This water service is provided in a manner that is environmentally sustainable; mitigating water-related risks, such as flood, drought and pollution. It also addresses the conflicts that may arise from disputes over shared waters, especially in situations of growing stress and turning them into win-win solutions. The following is a summary of the core elements necessary to achieve and maintain water security, as found in a broad range of published definitions:

- Access to safe and sufficient drinking water at an affordable cost in order to meet basic needs, which includes sanitation and hygiene and the safeguarding of health and well-being.
- Protection of livelihoods, human rights and cultural and recreational values.
- Preservation and protection of ecosystems in water allocation and management systems in order to maintain their ability to deliver and sustain the functioning of essential ecosystem services.
- Water supplies for socio-economic development and activities (such as energy, transport, industry, tourism).
- Collection and treatment of used water to protect human life and the environment from pollution.
- Collaborative approaches to trans-boundary water resources management within and between countries to promote freshwater sustainability and cooperation.
- The ability to cope with uncertainties and risks of water-related hazards, such as floods, droughts and pollution, among others.
- Good governance and accountability and the due consideration of the interests of all stakeholders through: appropriate and effective legal regimes; transparent, participatory and accountable institutions; properly planned, operated and maintained infrastructure; and capacity development.

Afghanistan

Less than half of Afghanistan's population has access to safe drinking water and only about a third benefit from adequate sanitation (Reich and Pearson 2012). Afghanistan's water resource challenges are reflected in its recent food security problems. In one assessment of 163 nations, Afghanistan ranked last in food security, lower than 11 African nations (Morales and Angelini 2010). Afghanistan's extremely weak infrastructure and one of the lowest water-storage capacities in the world means that large parts of the country cannot make use of their own water resources. Frequent droughts, localized and national, further affect the population, causing food shortages and migration. Afghanistan faced continuous drought during 1997–2002 and 2007–2008, which reduced agricultural production by about thirty per cent (SAARC 2010). In 2008, wheat production declined by 40 to 55 per cent because of lack of precipitation. According to the World Bank, agriculture accounts for 50 per cent of Afghanistan's licit gross domestic product (GDP), with only 40 per cent of agricultural land currently being irrigated. Increased irrigation and per hectare crop yields are a major priority for the Afghan government and the international community, a fact which will likely require increased water demands and usage in the future.

Afghanistan shares four river basins with its neighbours: the Kabul River Basin (part of the greater Indus River Basin), the Helmand River Basin, the Amu Darya Basin and the Harirud-Murghab River Basin. Afghanistan is experimenting with a River Basin Organization to introduce new water resources management strategies and set up institutions in the Amu Darya River Basin (Afghanistan 2008). Out of 57 billion m^3 of average annual rivers flow, less than 30 per cent is consumed in Afghanistan; the remaining water flows into neighbouring countries. Afghanistan is withdrawing less water from trans-boundary rivers than it would have legally been allocated by

international agreements. Although Afghanistan and Iran have a water treaty, Iran is now taking up to 70 per cent more water than agreed to according to officials and has built infrastructure on the incoming water without Afghanistan's consent. Even though Afghanistan is not making full use of trans-boundary water resources, the ecosystems of the lower riparian states are already experiencing significant pressures. However, the new hydropower plants and irrigation schemes built across the country are having a significant impact on the amount of water flowing towards its neighbouring countries.

Academy of Sciences of Afghanistan estimates that Afghanistan has the potential to generate up to 23,000 MW of electricity per year, which is much greater than the country's current energy production (Gonzalez Palau 2013). In order to deal with this future energy crisis and take advantages of the hydropower potential in the country to match the energy demand, Afghanistan is developing several hydropower schemes. As several sources, including the *Regional Water Intelligence Report Central Asia*, highlight, glaciers in Afghanistan decreased by fifty to seventy per cent during the twentieth century (Gonzalez Palau 2013). While shrinking glaciers increase water supply in the short term, the depletion of freshwater from glaciers reduces the water supply in the long term. The concept of Water Users' Associations is being introduced, and it is anticipated that such associations will supplant the traditional governance mechanisms which have long since become dysfunctional in many regions of the country (Afghanistan 2008).

Bhutan

Bhutan is endowed with abundant water resources having four major river basins. Agriculture and hydro-power are the two main industries in Bhutan. Electricity is mainly generated by hydro-power and the plan is to reach 10,000 megawatts by 2020. However, the impacts of climate change are becoming evident in the form of fast-retreating glaciers and erratic precipitation patterns that will prove to be costly for the hydropower sector as the country continues to bank on these renewable natural resource. In Bhutan, shifting rainfall patterns will have direct consequences for the majority of the population, as most Bhutanese are subsistence-oriented farmers depending almost entirely on the South Asian monsoon rains for the cultivation of rice (NEC 2011). The country has 2,674 glacial lakes, high up in the North similar to Nepal, out of which 25 are potentially extremely dangerous due to glacial lake outburst floods. Therefore these would adversely affect the country's agriculture owing to land losses and inundated fields. NAPA and LAPA are available in Bhutan to address these challenges. Bhutan does not have long term monitoring data and the analytical skills are limited to assess the Climate Change impacts. There is a lack of studies on snow, glaciers and groundwater and technology and finance are constraints. Urbanization and development (especially hydropower) is also taking place in Bhutan therefore that will affect the water security. Ground water use should be given a priority because even though the country is rich in water resources, access to water is still a major problem. However, information on groundwater is insufficient and ground water development is at a very infantile stage.

Bangladesh

Bangladesh has the highest rates of water related fatalities in Asia and potentially the most vulnerable country in the region that will experience grave consequences with an increase in cyclones, extreme flooding and higher than average sea level rise. According to IPCC, due to adverse impacts of climate change, the level of poverty in the country might increase by another 15 per cent by the year 2030 (Transparency International 2014). Due to salinity ingress because of sea level rise, the yield of rice would decrease by 8 per cent and that of wheat by 32 per cent. With the possible sea level rise by 28cm, the entire Sundarbans of Bangladesh, the largest mangrove forest in the world and also a world heritage site, might be engulfed by the sea in the coming future (Bangladesh 2012).

Bangladesh has developed an extensive flood management and irrigation infrastructure over a period of five decades. The coverage under flood management systems is 41 per cent of the country and that of irrigation is 55 per cent of the total arable land, mostly done by ground water (GWP 2013a). Water resources development has helped the country in achieving food sufficiency nearly, but nutrition security and absorbing shock is yet to be achieved. Pressures remain on agriculture to intensify production and maintain self-sufficiency in food grains, because of the population increase. The solution is the better and optimum utilization of available water resources.

Climate change is going to create major problems in Bangladesh's agriculture and food security. This calls for large scale investments in technological innovation or adaptation in water management, infrastructure development, cropping system and varietal improvement and development, modelling of climate change and its impact. Bangladesh remains highly proactive in facing the adversities of Climate Change. The government has already invested $10 billion over the last three decades to make the country climate resilient and less vulnerable to disasters. Recently the Government has created a taka 29 billion Bangladesh Climate Change Trust Fund with its own resources and is going ahead with adaptation activities carried out by government organizations and NGOs. Another fund, the Bangladesh Climate Change Resilience Fund, has been established by the Government with contribution from development partners. It has provided funding for projects implemented by different Ministries.

Beginning in 1998, Bangladesh developed a National Comprehensive Disaster Management Programme for disaster planning, coordination preparedness and response, The programme has brought in a paradigm shift in Bangladesh's disaster management culture by moving away from the earlier response mechanism of primarily relief and rehabilitation to disaster planning, preparedness, early warning dissemination, emergency response and rehabilitation by building capacities at all levels-national, sub-national and grassroots. The Government has so far improved 456 cyclone shelters, built 230 new ones and is going to build another 2,700 new multipurpose cyclone shelters in 10 years in the coastal belt (Bangladesh 2012, 66). The newly built cyclone shelters are also used as government/non-government primary schools as well as community centres for training and recreation. These

shelters are being provided with solar lighting, rainwater harvesting, separate rooms for pregnant women, bathrooms, doors and windows, first aid boxes and two to four tube wells, which were absent in the earlier cyclone shelters. All cyclone shelters are three-storied with one floor for keeping animals when a cyclone strikes and have provisions for vertical extension in their foundation. More new cyclone shelters are now in the offing.

Bangladesh is making all out efforts to improve its Flood Forecasting and Warning system. In terms of giving advance warning on floods, the Bangladesh Water Development Board with the application of more modern techniques is frantically trying to increase the lead time of flood warning to 72 hours from 24 hours for the major river floods and at least six hours for the flash flood prone areas. Bangladesh has no mechanism of drought forecasting in place. Relevant research organizations are trying to evolve appropriate drought forecasting systems in the country but in this case too, the active assistance of the upper riparian countries will be an essential prerequisite as in flood forecasting.

The recently enacted National Water Act 2013, based on the National Water Policy, is designed for integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. The Act provides for the formation of the National Water Resources Council with the Prime Minister as the head and an Executive Committee under the Ministry of Water Resources to implement the decisions taken by the Council. The Act has the provision to take initiatives for a basin-scale, integrated water resources management of trans-boundary rivers and exchange of data on flooding, drought and pollution with co-riparian countries.

Bangladesh is in the process of formulating the Bangladesh Delta Plan 2100 to achieve long term (50 to 100 years) sustainable development through adaptive governance, based on long term analysis and scenarios as well as the integration of relevant policy sectors and creation of adequate institutional arrangement and capacity. The plan will be ready by 2016. The plan will seek to improve the living conditions through the better water management and governance. The Delta Plan has created an opportunity for integration with the post-2015 United Nations water development agenda.

India

India's water security outlook for 2013 has been labelled "hazardous" by the Asian Development Bank (ADB) publication *Asian Water Development Outlook 2013*. Ministry of Water Resources, Government of India has estimated the country's water requirements to be around 1093 BCM for the year 2025 and 1447 BCM for the year 2050. With projected population growth of 1.4 billion by 2050, the total available water resources would barely match the total water requirement of the country. India is facing a serious water resource problem. The facts indicate that India is expected to become 'water stressed' by 2025 and 'water scarce' by 2050. With the present population of more than 1,000 million, the per capita water availability is around, 1,170 m^3/person/year (IWP 2014; NIH 2010). As the country is heading for acute

shortage, annual per capita availability of water will further reduce to 1,140 m^3 by the year 2050 (IWP 2014). Extreme climate variability, changes in precipitation conditions and evapotranspiration rates will further intensify this situation. Poor water quality resulting from insufficient and delayed investment in urban water-treatment facilities has made water in most rivers in India not fit for drinking and in many stretches water is not even fit for bathing.

Groundwater is an important water resource for India which needs to be effectively utilized for maximizing water potential of the country. However, over extraction of groundwater resources coupled with highly subsidized irrigation electricity tariffs and favourable investment terms offered for irrigation well construction, have contributed to indiscriminate level of ground water extraction in some states like Punjab, Haryana, Uttar Pradesh (IWP 2014). Some of the other factors which increase the climate change threat to water sector include water use inefficiency, poor water management, water pollution, inter-state river disputes, scarcity for safe drinking water, poor distribution and demand outweighing supply.

India already has separate treaties, agreements and memoranda on sharing river water with Nepal (Ganges), Bhutan (Brahmaputra) and Pakistan (Indus). There are tensions between Pakistan and India over Indus water, between Bangladesh and India over the Farakka barrage and between Nepal and India on the Mahakali Treaty and Panchewar project (Asia Foundation 2013). Bhutan is the only country with a good working relationship with India. They have a power sharing agreement, with half of Bhutan's GDP coming from the sale of hydro-power to India. A long-standing effort to negotiate a similar agreement with Nepal has failed. Nepalese policymakers see their hydro hydro-power as being similar to oil and yet they have eschewed dependence on India.

India’s 12th Five Year Plan (2012–2017) has focused attention on all of these issues discussed. The plan puts great emphasis on aquifer mapping, watershed development, involvement of NGOs and efficiency in developing irrigation capacity. Because water is a state subject in the federal constitution, state governments are expected to play a large role in these efforts. At the same time, many active NGOs are now able to enforce compliance with environmental obligations through the right to information act, active and competitive media and growing awareness on water issues.

The following recommendations by Dr. Kirit S. Parikh, Chair of the Integrated Research and Action for Development (IRADe) institute, address the most important issues in India’s water crisis. The central and state governments should empower local groups with knowledge, understanding and real-time information on the status of groundwater so as to manage extraction in a cooperative way. Since groundwater is an open resource, farmers extract as much as they can. But when everyone does this, it leads to extraction above a sustainable level. This problem can only be managed by a cooperative agreement among the users of the aquifer, who should know how much can be extracted without depleting the resource. The state can monitor and provide this information.

India needs to promote watershed development. The example of the state of Gujarat, as well as the efforts of Rajendra Singh and Anna Hazare, have shown that this approach is effective and profitable (NBR 2013). Moreover, it can be undertaken at the local level all over the country and can be done in a relatively short time.

India must educate people about the need for dams to store water. The environmentalists and other groups who oppose dams should be engaged in a dialogue to work out alternatives and build a consensus.

The government should strengthen state pollution control boards to enforce effluent standards. The technical and human resources currently available to the boards are inadequate to effectively monitor activities, enforce regulations and convict violators. In addition, adequate sewage treatment facilities must be constructed. Many cities treat only a part and some no more than half of the effluent. Cities need to charge a proper price for water so that local sewage work operators have the income and resources to sufficiently maintain treatment plants. If necessary, India should work with private firms to modernize urban water-distribution systems.

Maldives

Maldives is one of the most water scarce countries in the region and the annual average rainfall is more than 1,900 mm (Maldives 2006). Groundwater is a scarce resource because of hydrology and Surface freshwater is lacking expect few wetland and swampy areas. Traditionally people depended on shallow wells for potable and other purposes. Rainwater is widely used in the islands and accounts for more than 94 per cent use (Maldives 2006). In Male' and few islands desalinated water is supplied to households. Island Water Situations are Complex and Diverse and in the outer islands, households obtain water from a range of sources: local and imported bottled water, desalinated seawater using reverse osmosis plants and rainwater harvested from roofs and stored in household and community rainwater tanks and groundwater. The choice depends on the season, the use and household finances. A survey of 70 islands in 2010 reported that household groundwater is contaminated in most of the islands and not suitable for drinking. Piped water coverage in the outer islands remains low, with no more than 23 per cent of the population serviced via piped connections in any atoll outside the greater Male region (Maldives 2011).

The Maldivian Constitution (Article 23) recognizes the right of every citizen to safe water and adequate sanitation and the country is in the process of enacting a draft Water Act. Improved sewerage systems are in 30 islands, desalinated piped water is provided on five islands (across the outer atolls), Emergency desalination plants (without piped network) in 25 islands and Rainwater harvesting system 2500 litres water tank (HDPE) in each household. Regrettably the rainwater storage capacity is inadequate at household and community levels to supply water throughout the dry seasons. In 2012, emergency water was supplied to more than 55 islands. For the last seven years the country spent more than $2 million to provide emergency water during the dry spell (Ministry of Water and Environment, Maldives). The damaged wastewater disposal systems, mainly the septic tanks and soaking pits contaminate

the ground water. Also the water gets contaminated due to sewage and saltwater intrusion as the land contains a thin layer of porous sandy soil which is highly susceptible to pollution. Lacking good governance in water management and inadequate capacity to respond to emergencies are some of the challenges. Currently eight water and sewerage projects under implementation in different islands and 52 new water and sewerage projects are planned to be implemented this year. Public and multilateral investment into water and sewerage development planned for 2013 alone totals $64.2 million.

Maldives received a large number of desalination plants soon after the tsunami and the supply chain for the spare parts were not established. Once the Donor Agencies withdrew the operators found that the income they got from it was not enough and they moved on to the resorts. Therefore, desalination plants in many islands were abandoned. Therefore high tech equipment alone cannot ensure water security. Capacity building at the local level and well established supply chain for spare parts are essential for long term sustainability.

Nepal

Nepal is a country exposed to several types of natural and human-induced hazards. A wide variety of physical, geological, ecological and meteorological factors contribute to the high level of hazard faced. Nepal is found to be the least resilient to natural disasters due to widespread poverty and very low coping capacities, including typically poor disaster preparedness, although it is not as exposed to such events as many other countries. In the Himalayan region of Nepal glacier lakes are common. These lakes contain huge volume of water and remain in unstable condition, as a result, they can burst any time and a natural catastrophe may cause loss of life and physical property.

Nepal's rivers flow southward into India and contribute an average 45 per cent of the total flow to the Ganges river, with the contribution rising to over 70 per cent during the monsoon season (Rai 2014). 90 per cent of the water flow is during monsoons due to which there is an uneven distribution of water and the country suffers from water scarcity for eight months of the year (Price et al. 2014). Some parts of the country face the problem of drought. Uneven and irregular monsoon rainfall is the main factor of drought in rainy season and low precipitation in winter is the factor of drought in the winter.

The biggest challenge for Nepal is therefore the temporal difference; and bringing about inter-seasonal transfer of water from the wet seasons to the dry ones. Nepal follows a largely reactive, rather than proactive, approach to water management. Lack of coordination between government departments, poor physical infrastructure and insufficient water storage capacity were cited as the key reasons behind the water issues facing the country (Price et al. 2014). Recent analysis shows that Poor governance and political instability are preventing the Himalayan country of Nepal from taking advantage of its abundant water resources and ensuring water security for its people. It has been widely recognized that Nepal’s domestic financial and technical resources are inadequate to harness its hydropower potential and that

foreign lenders and investors are required (Media for Energy Nepal and JVS 2014). Given the various problems facing the water sector, it is therefore essential to introduce an integrated approach which takes account of the country's needs. There is a need for integrated management of available water resources and inter sectoral water allocation and management in Nepal. There is no national-level plan to tackle issues of water management within Nepal; and for there to be an integrated approach to water management, priorities must be set and long term plans must be developed and implemented (Price et al. 2014). Therefore, proper research in these areas is required before any action can be undertaken.

The treaties and agreements signed between Nepal and India have been the source of much mistrust and Nepalese feel that India maintains a largely dismissive attitude towards their concern about water issues. In relation to trans-boundary water, in order to ensure mutual benefits for Nepal and India a high level of reciprocal commitment is necessary whereby all issues agreed on are implemented, leading to a greater degree of cooperation. An insufficient share of water for Nepal was cited as the principal concern in these agreements. Nepal is smaller and financially poorer and does not have the same understanding regarding its needs to obtain maximum benefit in negotiation when compared to India. They are therefore unable to negotiate properly. There is a need for increased cooperation at government level on both sides. Cooperation models such as that between India and Bhutan, whereby India pays Bhutan for resources and services also need to be developed between India and Nepal.

Pakistan

Pakistan can be classified as one of the most arid countries of the world with average rainfall of 240 mm a year. Seventy seven per cent (77 per cent) of Pakistan's population is located in the Indus basin: 40 million people in Pakistan depend on irrigation water for their domestic use especially in areas where groundwater is brackish. Trans-boundary aquifer mining and trans-boundary surface water pollution are factors which adversely affect water resources of Pakistan. Presently Pakistan is using 94 per cent of its water resources in agriculture sector, industries use 3 per cent and the remaining 3 per cent is used by the domestic sector (PWP 2014). Pakistan's irrigation system is the largest contiguous irrigation system in the world. Managing the system is a challenge.

Pakistan faces all types of extreme event challenges induced by climate change. The direst threat to the country is the increasing intensity of flood events, which cause about $6 billion of damage annually, four times greater than a century ago. Pakistan faces flooding induced in areas: riverine, hill torrents, flash, urban, glacial lake outburst, cloud burst, and so on. Likewise droughts occur seasonally and are increasingly prolonged. Pakistan's coastal belt is prone to cyclones and tsunamis with large scale impacts on human populations leading to temporary migration and huge loss of life and property. Ground Water Depletion and water logging and salinity add to the miseries of a large share of the population, harming livelihoods and exacerbating marginalization with severe consequences for those living in extreme and abject poverty.

Pakistan's biggest opportunity lies in improving surface water management. Policymakers' stress that Pakistan needs to build more surface storage. Current storage capacity is only 15 per cent of average river flows. About 30 per cent of this storage is expected to be lost to siltation by 2025. As snowmelt becomes less reliable, Pakistan will become increasingly dependent on rainfall at higher altitudes. Rainfall provides 59 per cent of the Indus flows and 85 per cent of this falls during the monsoon, making storage a critical priority. According to ADB, Pakistan's emergency water storage capacity is limited to a 30-day supply, far below the recommended 1,000 days for countries with similar climates. Without meaningful action a water crisis could push the country into further chaos.

There is a National Disaster Management framework in place but requires much investment to be effective at the grass roots level. With recent enhancement in capacity-building of District Disaster Management Authorities, improvements are taking place. However, the role of early warning and improved coordination among all relevant public, private and civil society organizations will have high pay-offs and receive priority attention. Pakistan's super floods of 2010 and earlier 2005 earthquake provide plenty of experience to address vagaries of natural and human induced disasters. Creating resilience will require communities to be engaged in community based adaptation (CBA) at all levels especially in the eight hotspots prone to climate induced and natural hazard zones. Pakistan requires technology to predict and forecast flash floods while its flood forecasting capacity for river flow induced and trans-boundary impacted floods also needs to be improved. Disaster risk reduction (DRR) activities must be sustained during peace time and stock building made a regular feature to deal with upcoming challenges of drought. Post disaster rehabilitation be given equal emphasis and not taken as a onetime activity through compensation mechanisms. Better training and education of public with Mapping of disaster prone areas will go a long way in preparing the public to cater to such vagaries. A long term sustainable master plan needs to be prepared to meet natural disaster of all sorts.

The question over the flow of the Indus is a classic case of the conflicting claims of up- and down-stream riparian. The Indus Water Treaty addressed both the technical and financial concerns of each side and included a timeline for transition. In so far as the Treaty has survived stresses and strains between India and Pakistan and has continued to operate despite several wars, it must be regarded as a success story. Mr. Ramaswamy R. Iyer, former Water Resources Secretary in the Indian Government has concluded in an analysis: the Indus Water Treaty had its origin in a special set of historical circumstances and is, therefore, not a replicable model; it has been a modest success; its operation will continue to be characterized by recurring differences requiring occasional arbitration; it is not a treaty of cooperation, but could be treated as one if relations between the two countries improve; in respect of matters specifically dealt with in the treaty, the two sides must scrupulously adhere to the provisions; issues and concerns that could not be foreseen at the time when the Treaty was signed will need to be taken into account (Ramaswamy 2014).

Sri Lanka

According to United Nations standards, per capita water availability in Sri Lanka is at an adequate level. However, Sri Lanka experiences water scarcity due to spatial and temporal variations in rainfall pattern. Per capita water availability in Sri Lanka is 2,260 m^3 and is experiencing water scarcity due to spatial and temporal variations in rainfall patterns. The country has a history of water storage. The government is committed to invest in water resources, as water scarcity is a major development constraint in the dry zone. Improved water management and strategically planned water resources development is necessary to address the emerging issues such as increasing demand for drinking water. It is planned to increase water diversion to the dry zone by 1,000 million m^3 by 2025 (SLWP 2014).

One of the success stories are the trans-basin diversions which carries nearly 2,250 million m^3. Nearly 70 per cent of crop water requirement of Anuradhapura and Polonnaruwa Districts are being provided through such diversions (SLWP 2014). Some trans-basin diversions start in the wet-zone and end in the wet-zone but in most cases transfer of water is from the wet zone to the dry zone. Mahaweli River is diverted to the dry zone in three places, Polgolla, Minipe left bank and Minipe right. Menik Ganga and Kirindi Oya rivers in the dry zone are diverted to other areas in the dry zone. Menik Ganga water is diverted to the Kirindu Oya reservoir. Sri Lanka has made considerable progress in participatory management in irrigation through farmer organizations, and in water supply through community based organizations. However, there is a need to revive some of the institutional arrangements at the policy making level, considering the need for water to be managed in an integrated manner.

How indigenous knowledge and modern technology can work towards resiliency in the water sector

Adaptation is multidimensional process and phenomenon and it could be focused / based on single or multiple issues. The adaptation resilience strategies are multi disciplinary, complex and changing. Adaptation options should address both the physical and social vulnerability in order to be sustainable. Adaptive capacity is made up of a range of livelihood assets and strategies including the formal policies. Adaptation Technologies could be hardware and software tools, methodologies and approaches. Indigenous knowledge includes local actors, needs, experiences, available opportunities, means, technology and collective actions in a given context and the knowledge and the technologies are in the same system. Communities have already been adapting to climate change and climate variability for centuries. It is important to know what those local existing adaptation strategies are and how robust they are in the changing context in order to use them. Climate predictions should not be the central tool to guide adaptation to climate change. There should be enough emphasis to focus on existing vulnerabilities and the real causes of vulnerability in a context of change where climate change is one driver among others. Therefore CBA as a bottom-up and 'place-based' approach to adaptation should be given due consideration. CBA begins by identifying areas and communities that are most vulnerable to climate risk and then uses the best available science on climate-

induced impacts to engage with vulnerable groups (Huq and Reid 2007). Appropriate integration, mix, build on of indigenous and modern knowledge and technologies are needed for sustainable climate resiliency. Weather and climatic systems, awareness development, early warning systems and real-time forecasting, monitoring for impacts and adaptation planning needs integration. Enhanced research, development and access to area specific adaptive technologies rooted on indigenous knowledge and capacity but with modern improvements is the way forward to climate resiliency.

The modern technologies are generally expensive and the capital investment is not affordable to most vulnerable communities (table 1). Therefore, there should be an institutional set up to assist the vulnerable communities to meet the cost through accessing funding sources or credit facilities. It is important to facilitate the institutional set up within the government system, to enable the vulnerable communities to invest in technologies. Mobilising financial resources from various innovative sources to ensure the long term sustainability of the adaptation measures to ensure climate resiliency is vital. For example, drip irrigation, as a technology, one acre of land will cost $10,000 to invest. If a farmer has 0.1 acre and wants to invest in drip irrigation system to grow some high-value crop and sell it, the farmer will be willing to invest in that if there is some mechanism by the government to accommodate any losses and insurance against such losses. That type of support might be missing. Therefore, it is important to have some mechanism to motivate the farmers and communities to make use of new technologies to adapt to climate change. Bangladesh is in the forefront in the region in mobilising the funds for CCA.

Table 1. Comparison of indigenous knowledge and modern technology

Indigenous technology	Modern technology
Low capital intensity	High cost
Sustainable (environment and ecology-friendly)	Low labour
Location and site specific	Adaptable to wide areas
Low mobility	High mobility
Low productivity (limited to only few practices not whole system package)	Dramatic impact

Benefits from local knowledge can only be achieved with modern scientific and technical knowledge Science and technology validates and upgrades indigenous knowledge and drives modernization. Sustainable approach to modern technology innovation thus springs from a realization that sustainable adoption will be based from a mechanism where the ‘professionals’ first learn from the ‘practitioners’ before suggesting improvements. Research achieves greatest pay-offs when the approaches are based on indigenous technology.

Dams, ponds, tanks, rain water harvesting, improved irrigation systems, water conveyance systems, energy sources development, inter-basin water transfers, desalination, drainage, levees, terraces and contour farming, shallow and deep tube wells, surface system linings, treadle pumps, bucket drip systems, ceramic pot technology, fog harvesting are Infrastructure, machinery and equipment are few

among many adaptation technologies being currently used in South Asia for climate change resiliency in water management. Adaptation options should be considered in the interface where physical and social vulnerabilities are addressed through top down and bottom up approaches. Even though there are different types of technologies that are suitable to the local needs of the affected communities, many of these are beyond the reach of local communities. Before adaptation technologies are selected and introduced to the affected areas or communities, careful consideration should be given to the following questions: for whom/what is adaptation undertaken; and what are the trade-offs? The selected options need to be suitable to local conditions, socially acceptable and economically viable and feasible. Comparative assessments of ecosystem based adaptations and engineering options is required to ensure long term sustainability to avoid the selection of technologies that will shift the vulnerability in time and space.

When it comes to prioritizing technologies for CCA, the following criteria should be discussed and evaluated by the range of actors within the CBA framework.

- Environment: the extent to which the technology conserves and strengthens biological diversity and promotes environmental sustainability. The technology should also promote sustainable local resource use, for example, the hardware technology can be manufactured and serviced locally where possible.
- Awareness and Information: the extent to which the technology enables and facilitates (i) access to information about climate change and the uncertainty of future conditions, (ii) integration of information from seasonal and weather forecasting and early warning systems into decision-making processes, and (iii) strengthening information systems in general (and with local knowledge more specifically).
- Productivity: the extent to which the technology (i) supports natural life cycles (nutrients of soil and water) and thus, conserves adequate biological conditions for future production; (ii) enables farmers to produce enough for self-consumption (to achieve food security), (iii) improves crop quality and productivity; (iv) improves crops quality and (v) is of easy dissemination and replication.
- Economy: the extent to which the technology :(i) Strengthens existing productive systems. For example, growing maize starch in rural household plots provides a product for human consumption and food for cattle. Livestock activities can generate manure for organic fertilizer. (ii) Increases the amount of information about variations of prices of inputs and final products in the different months of the year. This protects and enables farmers to produce a surplus that can be sold on local markets to generate additional income. (iii) Reduces transaction costs of productive and commercial activities, for example, transportation costs, credit and rural insurance costs, costs incurred due to theft, among others.(iv) Does not generate influence, power and natural resource management inequities, which could be the source of social conflicts that obstruct the development of productive activities.
- Culture: the extent to which the technology (i) respects cultural diversity, (ii) allows for an intercultural dialogue and the incorporation of ancient and local knowledge, and (iii) is understandable and easily applied by farmers in their

current context. Cultural norms affect people's adaptive behavior: despite being deeply rooted, they can shift over time in response to the needs.

- Politics: the extent to which the technology is integrated coherently into regional and national policies and can be scaled-up for wider implementation.
- Institutions: strong institutions can sustain development and are vital for implementing adaptation measures. Adaptation technologies should therefore be evaluated and prioritized based on the extent to which they strengthen formal and informal institutions, such as government ministries, civil society organizations and community-based organizations by building capacity for planning and execution of adaptation strategies.
- Technologies should also support civil society to form social networks and participate in decision-making processes.

Knowledge, skills and practices

As climatic conditions change, people are testing new approaches and some contribute to increased adaptive capacities. Therefore, the indigenous knowledge has to be given due consideration and sufficiently captured to be replicate. Gaps in capacity, knowledge and experience are common across South Asia, especially as far as it concerns the dissemination of concepts and experiences on effective adaptation strategies (Oxfam 2011). Moreover, while knowledge varies across the region, a common challenge is the way in which knowledge and learning are structured. This might predicate the need for new approaches to share experience and expertise. These approaches should value diversity rather than uniformity in local and regional response strategies aimed at fostering resilience. Most importantly, new approaches must build practical local strategies for experimentation, local and scientific risk assessment and systematic sharing of research results (Oxfam 2011).

Creation of information sharing platform

From the experiences of traditional community practices, NGO interventions, scientifically sound water conservation technologies and government initiatives, India has a vast pool of knowledge on management of water resources for CCA. But this information is not tailor-made as per the requirement of the different stakeholders (policymakers, water managers, farmers or the common man). To manage the huge information pool, the Governments of South Asia countries now needs to create systems for information exchange between climate change and water management community. There is a need to assess climate change vulnerabilities of water sector and relate it to potential impacts on water availability and distribution, water usage and requirements and increase in water demand. This will help the water management community to manage and budget water resources accordingly. Scientific knowledge about vulnerability, climate change impacts and adaptation options needs to be translated in such a format and language that decision-makers understand and convert to timescales appropriate for the decision-making process.

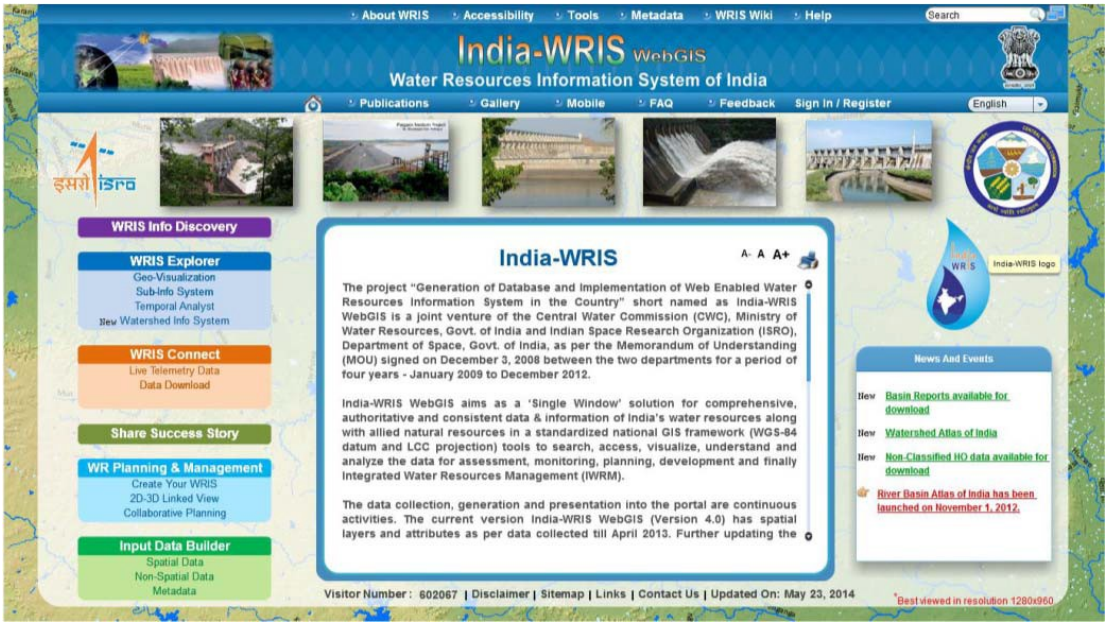
Translating data into meaningful early warning messages and communicating to the vulnerable populations also do not happen to a satisfactory level. Dissemination of information on climate change impacts, knowledge, skills and practices to farmers

and grass root level stakeholders needs improvement. The format that the early warning message is communicated is also important. For example, in Sri Lanka, the Metrology Department once reported wind speed as 70 km/hr but there was no early warning message in a format which is understood by the fishermen was given to the fishermen which resulted in deaths as the fishermen did not understand the level of destruction caused by wind speed of 70 km/hr. Fortunately with the available media options, dissemination of information and early warning etc. have become much easier even to the most remote areas. Sending early warning messages flood level data etc. via SMS can reach a high percentage of the vulnerable communities. For example nearly 75 per cent of people in Nepal have access to mobile phones and they can be easily reached. There is therefore a need to take advantage of, technological advances. Another example is India where SMS is used in the agriculture sector which has been proven to be a very effective way to validate scientific approaches and to uptake science into policy actions.

Information technology/ remotely-sensed data and Geographic Information Systems (GIS)

Modern information and communication technologies (ICTs) are helping to accelerate the efficiency and precision of research, particularly on issues related to climate change. New mapping techniques using remotely-sensed data and GIS have helped to assess vulnerability to climate change, devise more efficient water capturing methods, locate areas with water-harvesting potential and develop suitability maps for newly developed crop varieties. Integrating climate change into development programming would benefit from climate modelling under different scenarios, but this requires regularly updated data, dynamic GIS computing capabilities and linkage with required national data sources (and global and regional models from other regions) that appear to require further development.

Figure 3. Snapshot of India-WRIS website



In this regard, Central Water Commission, Government of India in collaboration with Indian Space Research Organization has developed Water Resources Information System (WRIS) for the entire country. The System will provide a comprehensive, credible and contextual view of India's water resources data along with allied natural resources data and information. It will allow users to search, access, visualize, understand, analyse and look into context and study the spatial patterns of data related to water management of the country (figure 3).

Some of the good initiatives of National Initiative on Climate Resilient Agriculture are as follows: (i) development of GIS and remote-sensing methodologies for detailed soil resource mapping and land use planning at the level of a watershed or at river basin level; (ii) development of drought-and pest-resistant crop varieties; (iii) development of regional databases of soil, weather, genotypes, land-use patterns and water resources; and (iv) development of crops with better water and nitrogen use efficiency which may result in reduced emissions of greenhouse gases or greater tolerance to drought or submergence or salinity.

Traditional and innovative adaptation practices

There are already proven adaptation options practiced by people who may ultimately enhance their resilience at local level in the countries in the region. Examples of such traditional and innovative adaptation practices include: rainwater harvesting, supplementary irrigation and traditional farming techniques to protect watersheds, crop and livelihood diversification, use of short duration new varieties seeds, seasonal climate forecasting, improved technologies on water quality testing. *Helmalu* (cascade) system is depicted in figure 4.

Figure 4. *Helmalu* (cascade) system in Sri Lanka Central Province

Source: Floating Gardens of Bangladesh, Farming on Water to Prevent the Effects of Climate Change http://www.nytimes.com/2014/11/19/business/energy-environment/bangladesh-farming-on-water-to-prevent-effect-of-rising-waters.html?_r=1 [accessed 24 November 2014].

Two types of *chang-ghar* (house on stilts) are shown in figure 5, and the floating gardens of Bangladesh are shown in figure 6. Traditional knowledge complements existing measures of coping with climate change and improves the adaptive capacity of the communities.

Figure 5. *Chang-ghar* (Mishing community, Nepal): left, original design of bamboo and wood; right, wealthier households invest higher stilts made of concrete

Figure 6. Villagers in northwest Bangladesh tending a floating farm.

Photo credit: Amy Yee, www.nytimes.com.

However, helping local communities to understand, access and use climate change-related information is a huge challenge. This is further hindered because efforts creating climate change awareness are met with low interest levels among the communities. This is partly due to the inappropriate nature of the awareness efforts and partly due to the cynicism that has developed among the communities towards any sustainable solution without immediate benefits. New means and interesting ideas of outreach to the communities are thus required to propel them towards adopting sustainable adaptation measures.

Examples of good practices of climate resiliency (adaptation capacities)

The Fourth IPCC Assessment Report (2007*)* gives the following definition for adaptation: "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". *Adaptive capacity* is a necessary condition for planning and implementing effective adaptation strategies in order to decrease the negative impacts of climate change (IPCC 2007). The report gives the following definition for adaptive capacity: "the ability or potential of a system to respond successfully to climate variability and change." Since the concept of adaptation came to the international policy agenda two decades ago, CBA has been among the most popular approaches (Oxfam 2011).

Social Capital

Over the recent twenty five years, the concept of "social capital" has gained a large momentum among scientists and practitioners of social science disciplines (Brunie 2009). There is a large potential for social capital in the communities to shape their adaptive capacity particularly in times of crisis and generate bottom-up adaptation measures. Self-organizing communities that effectively use their social capital become more sustainable, effective and resilient than those with adaptation mechanisms designed and imposed by external entities (Berberyan 2012). Trust and reciprocity are extremely important for the networking social capital to build adaptive capacity. The potential of social capital to disaster response was demonstrated during the Asia Tsunami 2004 in Sri Lanka. In summary, civil society in Sri Lanka proved remarkably resilient and helped to hold the country together especially during the first few weeks – apparently, the social capital embedded within traditional communities in affected areas and throughout the nation, played a crucial role (Munasinghe 2007).

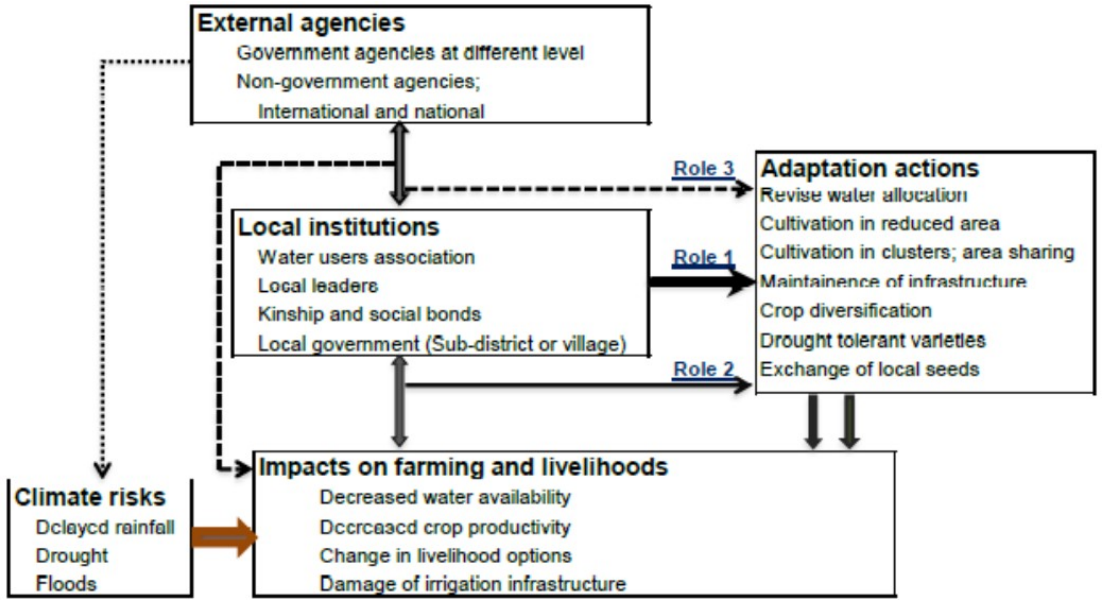
Institutional responses: Local institutions

Local level institutions and institutional arrangements serve important functions in information gathering and dissemination, capacity building and skills development, resource mobilization and allocation, providing leadership and creating linkages between decision makers and other institutions (Meinzen-Dick et al. 2013). Adaptation also depends on the institutional capacity of the community. Institutional capacity refers to the degree of social capital in the community, the ability of community members to work collectively and their ability to access resources and information from higher-level institutions such as government agencies and nongovernmental organizations (NGOs). Local institutions facilitate adaptation in

different ways (figure 9). Institutional arrangements that recognize and value local autonomous adaptations and innovations are necessary for enabling future innovations. While much attention has focused on the technologies adopted from the outside, less attention has been paid to the local innovations, including socio-economic and institutional innovations for gaining access to resources and organizing marketing activities.

All irrigation systems in Chitwan, Nepal have Water Users' Associations that are responsible for management and deal with external disturbances. However, some may not be formally registered and may also not have written constitutions. Association memberships are mostly based on ownership of land in the service area. Executive officers headed by a chairperson are selected from among the members. Officials are tasked with mobilizing resources for maintenance, organizing and supervising system work, maintaining records and accounts and resolving conflicts. Although officials of Water Users' Associations are permitted to take routine decisions, major decisions require consensus from a general assembly. All members make compulsory contributions towards the upkeep of systems either through labour or cash contributions. Rules are used extensively to structure irrigation activities.

Figure 7. Different ways local institutions facilitate adaptation



All systems have explicit and commonly understood rules and regulations relating to the allocation and distribution of water, contribution of resources for repair and maintenance and sanctions for violating rules. Sanctions can take any of the following forms: a) verbal warning without monetary fines; b) monetary fines; c) cessation of water turn; and d) removal from the association. Sanctions are imposed by water user functionaries, guards, or fellow appropriators depending on the nature of the sanction imposed. About 60 per cent of the systems in Chitwan have written rules and regulations. Many of the systems managed by the indigenous people (Tharu) do not have formally written rules, yet rule following is reported to be higher in these systems than in others. Local leaders facilitate water allocation in case of

shortage. Water Users' Associations can mobilize users for quick response, e.g., repair flood-damaged infrastructure.

External organizations, so-called bridging organizations, can play a key role in ensuring that local institutions have access to the resources necessary to build local adaptive capacity. These bridging organizations can also assist in "creating civic arenas or forums as well as social and political spaces for deliberation," leading to policy changes and enhanced representation. More immediately, though, these organizations can facilitate linkages with local agencies and government offices. One example from Sri Lanka illustrates this potential. A participatory rice selection project connected farmers with a local research NGO to carry out field experiments to determine which variety of rice would tolerate the increasing salinity of the water. The benefits were twofold. First, the community gained access to the research NGO and was able to use the NGO's resources and technical expertise to increase its adaptive capacity. Second, the process of experimentation introduced a new approach to problem solving, increasing local knowledge and capacity to make informed development decisions. Local administration play crucial role in establishing link with external agencies.

Coherent policies or strategies and institutional framework

Although water stress is a global issue, solutions in improved distribution, storage and treatment and source protection must be implemented locally. A clear, explicit water policy is important to provide guidance and to demonstrate commitment to local efforts by subnational administrations and the private sector. Governments must be made aware of the need and benefits of having an explicit water policy that addresses water scarcity. Local responses are influenced by wider trends, processes and pressures, in particular larger policy and market contexts. Therefore, it is important to understand the role of policies in influencing how people are supported (or not) in their efforts to deal with climate change.

In the South Asian region, there is a need to shift emphasis from disaster response to risk management; to focus on preparedness and mitigation measures; improve flood and drought forecasting; to establish early warning systems and to improve the communication flow. It is advised that comprehensive response plans include technical protocols and guidelines, disaster preparedness policies with allocated resources, decentralized coordination mechanisms, gender policies for implementation and access of women and children to all interventions in order to achieve an integrated management of floods and droughts.

Most of the international river water agreements in South Asia are not comprehensive in nature. Despite huge water resources available in the region, the inability among and between countries of the region to reach mutually beneficial comprehensive agreements could invite more conflicts in the days ahead. Policy advocacy at the head of the state level is an important driver for any regional level adaptation initiatives. SAARC could be a leader in galvanizing sincerity of various

stakeholders. System of taking stocks on the agreed actions is required for successful implementation.

The experiences of India and China continue to demonstrate the need for an integrated approach to water management (GWP 2013b). This requires using the instruments of an enabling environment, institutions and fiscal instruments, which together can help to improve the governance of water and food. The water management challenges that India and China face today and tomorrow are very different from those in recent decades. There is a general consensus that today's water-use patterns and environmental trends, if continued, will lead to major crises in many parts of the world. To meet the acute fresh water challenges facing humankind over the coming 50 years a new approach is needed. An approach that sets agricultural water management within an integrated water management process and which integrates the productivity of agricultural water within the broader context of ecosystem sustainability is required. This approach will need a framework for integrating policies: macroeconomic policies, water management policies, agricultural policies, trade policies, rural development policies, environmental policies etc. It will also need to integrate institutional changes and investments to achieve efficient outcomes in all aspects of agricultural water management, from modernization of large-scale irrigation systems to enhancing water management in rain-fed agriculture and better linking livestock and fishery practices to water management. Fragmented approaches are no longer an option. Progress may be slow and the questions complex, but there is no real alternative to integration.

The risk of floods and their impact on people's income and livelihood options have made public and private agencies cautious of bringing services. Vulnerability to climate change reduces access to systems, services and institutions that could decrease adaptive capacity, creating a potential downward spiral of increasing vulnerability. Remittances are known to be a relatively stable source of household income during natural disasters, financial crises and armed conflicts. In this way, labour migration and remittances 'moderate the harm' caused by water. Remittances from labour migration have a significant impact on the quality of life of recipient households and on their ability to respond.

Gaps and challenges: Recommendations

National and local capacities on CCA technologies need improvement. Although local institutions are critical to provide the solutions to the problems of climate changes, they are not sufficient to address CCA entirely. Therefore, governmental policies and international mandates needs to be operationalize to support and fund the interventions by the local institutions. Regional resources (funds, expertise, capacity) needs to be mobilized to build the national, sub-national and community level expertise and capacity for effective adaptation.

Dissemination of information on climate change impacts, knowledge, skills and practices to farmers and grass root level stakeholders needs improvement. Information in the context of climate change includes a variety of climate and weather

related information, from historical trends, to forecasts (of varying scales and time periods), real time monitoring and climate changes scenarios, as well as advice on specific technological interventions (including costs and benefits) and advisory services. As climatic conditions change, people are testing new approaches; some contribute to increased adaptive capacities, which are not sufficiently captured to be communicated to other beneficiaries. Mechanism and platforms which can help in bringing climate change knowledge for all levels should be built and focus should also be given on using traditional knowledge. Therefore, exchange of knowledge between climate change scientists, professionals and water management community should be promoted.

Integrated water resources management (IWRM) recognizes that stakeholders should be part of decision making process and water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels. A key component of integrated water resources management is an enabling environment facilitated by the active role of institutions. Considering water as a social good, equity within IWRM ensures access to water and related resources among poor people and consequently extracts maximum benefits from available water through proper allocation of resources (Gain et al 2013). Although a gradual transformation to IWRM is taking place in the region (including Afghanistan) the vast majority of current development undertakings are still being implemented on a project to project basis. Though the countries in the region adopted IWRM as the approach to its water resources development in its policy, strategy and plan documents, its implementation has remained miserably poor. The main reason for this deficiency is the lack of institutional setup and mechanisms to implement the policy principles. There is no mechanism nor institution framework for water allocation or re-allocation in any of the countries in the region. Institution building is especially required at the community level. As a large number of community organizations could reduce the participation of members, the community based institutions are recommended to be for multiple water uses, where ever possible. In the case of policy level institutions, the institutional framework would constitute a sustainable coordinating mechanism. The regulatory frameworks need revision in the light of integrated water resources management at basin and sub-basin levels. The need is also the ecosystem approach to water allocation and utilization in order for quality and quantity-wise conservation and wise use of water resources at basin and sub-basin levels. Appreciation of economic value of water has to be built-in in the decisions of allocating of water resources and pricing of water services.

Sustainability of the existing water infrastructures and the affordable, equitable, accountable and financially sustainable water services are the other fronts where institutional and regulatory reforms are needed. This should go hand in hand with the human resource development and capacity building of the institutions as the reforms demand. Reinstatement of Ministry of Water Resources, legal recognition to basin/sub-basin level stakeholders' organizations and implementation capacity building along with targeted programme execution are therefore the pre-requisites for competent water governance.

Bangladesh formulated the National Water Policy in 1999. To operationalize the policy directive, the National Water Management Plan was formulated in 2004. It seeks to rationalize as well as decentralize the management of water sector. Being a framework plan, the line agencies and other organizations are expected to plan and implement their own activities in a coordinated manner. The implementation of the plan is to be monitored regularly and the plan is to be updated every five years. Bangladesh Water Development Board, being the major implementing agency, is following the plan. Although 10 years have passed, the plan has not been updated. As per the legislative framework, the water governance should be participatory. There is a Guideline for Participatory Water Management to ensure effective participation of the community in water management. However, the practice of effective governance and community participation is a subject of criticism by media, practitioners and experts.

Many other countries in the region do have National Water Policy in draft which needs to be operationalized and implemented without any delay. The Water Act of Bhutan 2011 prioritizes management of water for drinking and sanitation, followed by the use of water for agriculture and hydro energy, yet many of the functions and activities outlined under the Act have yet to be implemented in practice and the water regulations remain in a draft form. The Ministry of Water Resources of India published its Draft National Water Policy on 7 June 2012. The Draft Policy seeks to address issues such as the scarcity of water, inequities in its distribution and the lack of a unified perspective in planning, management and use of water resources. In Nepal, the Water and Energy Commission Secretariat started formulating National Water Plan in 2002, which was approved by the government in September 2005. Sri Lanka is introducing a new national water policy based on conservation of water resources and has sought public views for its preparation.

In India, the National Initiative on Climate Resilient Agriculture and Central Research Institute for Dryland Agriculture under the Indian Council of Agricultural Research within the Ministry of Agriculture, have enhanced the resilience of Indian agriculture to climate change and climate variability through strategic research and technology demonstration. Such initiatives should be developed for other sectors also.

Conclusions

Climate science and the projection of the various impacts of climate change are at an early stage of development in the region. Yet South Asia is among the most data-rich regions of the developing world and is well endowed with considerable analytical capacity for providing policy inputs, a capacity that has yet to be fully mobilized for effective policy and institutional responses. Climate change provides the best opportunity to foster regional cooperation to cope with common water woes and boost water productivity. The ability of countries in South Asia to deal with the possible effects of climate change will be in part determined by their ability to manage water in the trans-boundary rivers.

CCA becomes attractive to the poor people if it is tailored into their livelihoods and if they can make some profit out of it. This approach is useful in introducing technologies and making them sustainable in poor communities. However, even with the new technologies, it is important to consider how CBA and ancient practices have enhanced resiliency. High tech equipment (for example desalination in Maldives) alone cannot ensure water security. Capacity building at the local level and well established supply chain for spare parts are essential for long term sustainability.

In Nepal CBA practices have developed to commercial level where private institutions earn profit by giving services to the needy farmers. Backyard gardening has been in practice for centuries in almost every south Asian country which can be an attractive option to promote which can, in the long term, ensure food security. Therefore, there should be a regional focus in collecting indigenous knowledge and practices that might be cost effective and encourage the poor people to adapt to climate change. Making use of existing farmer organizations etc. will also make the adaptation more sustainable.

Though the countries in the region adopted IWRM as the approach to water resources development policies, strategies and plan documents, its implementation has not been successful. The main reason for this deficiency is the lack of institutional setup and mechanisms to implement policy principles. There is no mechanism nor institutional framework for water allocation or re-allocation in any of the countries in the region. Institution building is especially required at the community level.

Water security in South Asia can has a strong regional dimension and the upstream actions in river basins very often have impacts downstream. Therefore, it is important to strengthen the coordination mechanism among upstream and downstream countries to minimize trade-offs in water use and maximize synergies and take a river basin approach.

VI. Lessons Learned on Implementing Climate Change Adaptation in the Pacific

NETATUA PELESIKOTI,[20] PENIAMINA LEVAI[21] AND ESPEN RONNEBERG[22]

Introduction

Pacific Island countries have reported serious socioeconomic, environmental, physical and cultural consequences of climate change. Numerous studies suggest that climate variability and change is likely to accentuate spatial and temporal variations, including variability, which result from El Niño Southern Oscillation (ENSO) events. The risks and impacts of climate change and variability for small island developing states (SIDS) are summarized in this chapter (IPCC 2015).

Consequences of sea level rise

The IPCC has recognized that Pacific Island countries are at extreme risk from sea-level rise. More than 70 per cent of the population in the region lives within 1.5 km of the shore and many of these countries are less than a few metres above sea level. An increase of as little as half a metre along with increased incidents of storm surges would inundate many critical areas and threaten their populations. While the impact of sea-level rise will vary from country to country and even within countries, the uncertainties are generally too large for responses to be based on any value other than the regional projections given above. The one exception is where tectonic movement results in locally rising or sinking coasts. In general, the impacts of sea-level rise differs between low (e.g. atoll) and high (e.g. volcanic) islands. This is especially the case for saltwater intrusion into groundwater and soils, generally making low islands more vulnerable. Nevertheless, many vulnerabilities to sea-level rise affect both low and high islands due to the concentration of human activity in coastal areas and the difficulty of relocating populations to the interior of high islands. Nevertheless, perceptible changes in sea level will have a number of impacts, including the exponential relationship of sea level to wave heights. A sea-level rise of 0.19–0.58 m by 2100 will result in accelerated coastal erosion and saline intrusion into freshwater sources.

Extreme weather events

Several well-documented recent events show an increase of extreme weather, such as tropical storms, cyclones, droughts, floods and heat waves. In 2004, Cyclone Heta caused storm waves to rise over the 30 m cliffs in Niue, leaving one person dead and many others homeless and causing $150 million (2004 figures) in damage. In another example, the Cook Islands experienced five cyclones within one month in early 2005, three of which were classified as Category 5. In prior decades, the Cook Islands could expect one storm of this magnitude approximately every 20 years.

[20] Dr. Netatua Pelesikoti, Director of Climate Change Division, Secretariat of the Pacific Regional Environment Programme (SPREP).
[21] Mr. Peniamina Levai, Pacific Adaptation to Climate Change Programme Manager, SPREP.
[22] Mr. Espen Ronneberg, Climate Change Adviser, SPREP.

Storm surges and extreme high tides (king tides) have also been documented as causing widespread damage in Kiribati, Marshall Islands and Tuvalu and parts of Micronesia. Cyclones occur less often, although these may be of a higher intensity, with increased peak wind speeds and higher mean and peak rainfall.

Changes in mean rainfall

Changes in rainfall can have wide-ranging and significant impacts, including effects on water supply, agriculture production (which is almost entirely rain-fed in the Pacific), food security and erosion. Rainfall is expected to become significantly more variable in the Pacific region, along with increased frequency, duration and intensity of droughts and floods. During summer more rainfall is projected as are more frequent heavy rainfall events. An increase in drought conditions will significantly reduce the soil's ability to cope with a sudden intense rainfall, exacerbating flooding and erosion. These effects will also impact on communities, particularly those most dependent on rainwater harvesting for drinking water. Increases in annual mean rainfall are projected to be most prominent near the South Pacific Convergence Zone and Intertropical Convergence Zone, with less change expected for the remainder of the region. The annual number of rainy days is expected to change little, except for increases near the equator. A widespread increase in the number of heavy and extreme rain days is projected.

Impacts on coral reefs

Coral reef ecosystems are vital, providing at least one-quarter of the fish catch in most developing countries in the Pacific. They also provide one of the biggest tourist attractions in the Pacific. Increasing sea surface temperatures, the rising sea level, damage from tropical cyclones and decreased growth rates due to the effects of higher CO_2 concentrations are very likely to affect the health of coral reefs and other marine ecosystems that sustain island fisheries. Research conducted by the Secretariat of the Pacific Community and the Forum Fisheries Agency indicates that the possible destruction or degradation poses a threat to every Pacific country.

Fisheries

Climate change will affect the productivity and economic viability of both inshore and deep water fisheries. Alterations in ocean temperatures and currents due to increased ENSO-like conditions will impact coral reef areas, which serve as fish nurseries and change the distribution and abundance of tuna, a significant fish harvest in the Pacific region. Surface air temperature increases of 1.00°C–4.17°C in the northern Pacific and 0.99°C–3.11°C in the southern Pacific by 2070, leading to increases in sea surface temperature of 1.0°C–3.0°C. From 1997 to 1998, the ENSO event saw a significant westward shift of major tuna stocks. Increased incidence of bad weather is likely to increase costs of ocean fishing due to safety considerations and lost days at sea. Acidification of the oceans through increased absorption of CO_2 will have considerable impact on all marine ecosystems. The pH is forecasted to drop by an estimated 0.3–0.4 units by 2100, which will adversely impact coral growth rates. Aquaculture, a developing industry in the Pacific region, will also face difficulties due to the effects of changing rainfall patterns (e.g. increased sediment and rainwater flooding of some ponds and drought affecting others), as indicated by

research carried out by the Secretariat of the Pacific Community and the Forum Fisheries Agency.

Agriculture and food security/water supply

Extreme weather events, irregular rainfall (with resulting floods and droughts), changing weather patterns and saltwater intrusion will all have significant impacts on agriculture production and food security. These will, in turn, affect diet (with more reliance on imported and often less healthy foods), income and the overall livelihood of families relying on agricultural livelihoods. Some farmers have already begun to grow crops (e.g., taro) in raised tin containers and some of the smaller islands have lost coconut palms to saline intrusion. These changes also affect the secure supply of potable water. The combination of changes in rainfall patterns and saline intrusion has a large impact on freshwater supplies. Climate change models indicate that these effects will be more significant in the future. For example, a possible 10 per cent reduction in average rainfall by 2050 for Kiribati would lead to a 20 per cent reduction in the size of the freshwater lens on Tarawa Atoll.

Threats to human settlements and infrastructure

The majority of human settlements and critical infrastructure in developing countries in the Pacific are located in coastal areas, including hospitals, schools, churches, power plants and distribution systems, fuel depots, telecommunication systems, disaster coordination centres, hotels and other tourist infrastructure, airports, wharves and business structures. It is estimated that coastal flooding will potentially affect between 60,000 and 90,000 Pacific Islanders by 2050. Any factors that impact coastal areas – such as extreme weather events, coastal erosion and sea-level rise – would have a very high human and economic toll. Climate change threatens some of the most fundamental needs of society: a safe place to live, access to water, health care (e.g. disease and nutrition), food supplies and the ability to earn a living. When these needs are threatened, whole economies and societies are at risk. Building codes and other design standards for commercial and residential structures and many other infrastructure investments do not address climate change impacts (including return periods for extreme events, wind and rainfall loadings to address more intense storm events). The assumed weather and climate conditions in many project designs will need to be adjusted to take better account of projected changes. Increased costs for infrastructure maintenance and rebuilding place a large burden on the limited resources and budgets of Pacific Island countries. Due to rising insurance costs for vulnerable coastal infrastructure, many critical infrastructure assets (airports, ports, jetties, roads, hospitals) are not insured and their loss presents a setback to social development, economic growth and business competitiveness.

Consequences on human health

Diseases that are sensitive to climate change are among the largest global killers. These include waterborne and vector-borne diseases, such as cholera, typhoid, malaria and dengue. Occurrences and mortality rates of these diseases are likely to increase as the climate changes. Rising temperatures and increased humidity create perfect conditions for pathogens to grow and spread, resulting in increased incidence

and prevalence of infectious diseases. Urban areas can expect more heat waves, the risks from waterborne diseases will rise due to increased flooding and areas susceptible to malaria, dengue fever and other communicable diseases are expected to widen, as are injuries and other health impacts from extreme weather events.

Natural disasters

Pacific Island countries rank among the most vulnerable in the world to natural disasters. Since 1950, natural disasters have directly affected more than 3.4 million people and led to more than 1,700 reported deaths in the region (excluding Papua New Guinea). In the 1990s alone, reported natural disasters cost the Pacific Islands region $2.8 billion (2004 figures). Between 1950 and 2004, extreme natural disasters (such as cyclones, droughts and tsunamis) accounted for 65 per cent of the total economic impact from disasters on the region‘s economies. Ten of the 15 most extreme events reported over the past half a century occurred in the last 15 years.

The number of reported natural disasters in the region has increased significantly since the 1950s, with a growing human impact per event. While this may be due to improved reporting, higher populations and increasing environmental degradation, there is no doubt that disasters in the region are becoming more intense and probably more frequent. Certainly, the number of hurricane-strength cyclones has increased in the southwest Pacific in the past 50 years, with an average of four events now occurring each year. Significant wave heights of recent cyclones have exceeded even climate change model projections. With the climate trend for the Pacific pointing to more extreme conditions and increased climate variability in future, Pacific Island countries have little choice but to develop comprehensive risk management plans for the natural hazards they face.

Climate change, climate variability and sea level rise are not just environmental, but also economic, social and political issues for Pacific Island countries. The impacts, particularly economic and social, pose serious political and national financial management issues. Climate extreme events can adversely affect gross domestic product (GDP), balance of payments, budget deficits, foreign debt, unemployment and living standards. The potential economic impact of climate change on the Pacific countries is estimated at $1 billion. With a population of only 3.4 million people (World Bank 2014), the Pacific cannot afford this extra burden on their already small and insignificant economies. Many communities and the resources they depend on for their daily livelihood and income tend to be adversely affected by the changing climate. In some situations the very survival of communities is already seriously threatened. These concerns have reached the highest Government levels, including the Pacific Islands Forum Leaders meetings. With the Pacific’s unique combination of geographical, biological, sociological and economic characteristics that can be found nowhere else in the world, the effects of climate change and extreme events are threatening the very existence of these vulnerable ecosystems and people. Since the Sixth Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), Pacific Island Governments have urged the international community to consider the need for urgent and immediate funding climate change for adaptation. They have also raised the issue of climate change as

a security threat at the United Nations Security Council and have received assurances from the Secretary-General that the issue will be kept at the forefront of the work of the United Nations.

Adaptation objectives of Pacific Island countries

From the mid to late 1990s, efforts in Pacific Island countries to adapt to climate change focused primarily on enabling and capacity-building activities, carrying out baseline vulnerability and adaptation assessments, simple climate modelling and establishing ad hoc institutions. This changed quickly to implementing immediate and urgent adaptation activities from as early as 2002 when national communication reports to the UNFCCC secretariat recommended immediate actions for adaptation, especially for LDCs in the Pacific. These individual country efforts encountered financial and resource problems affecting the sustainability and impact of adaptation efforts. With ample capacity-building activities from the late 1990s into the early 2000s, the objective also included immediate implementation on the ground in isolated island communities. This meant that the government climate change focal points, primarily ministries of natural resources and environment and central government agencies such as finance, had to assist other line ministries (health, water, agriculture, fisheries, tourism including island and village communities) to develop their capacities in addressing climate change risks and impacts in those sectors.

The adaptation objectives of some of the Pacific Island countries included a dual approach of implementing adaptation and mitigation activities that contributed to adaptation. For example, Fiji, Kiribati, Samoa, Tokelau, Tonga and Tuvalu are promoting the use of renewable energy technology to reduce the reliance on imported diesel, save electricity and cushion the impact of the cost of imported fossil fuel on the economy. The Pacific Island Greenhouse Gas Abatement through Renewable Energy Project and Pacific Adaptation to Climate Change (PACC) are two major regional projects that exemplify a dual approach to adaptation to climate change.

There has been an increased focus of the objectives to adapt to climate change through mainstreaming of climate change risks into national and sector development plans and programmes. Most recently, it has included climate financing objectives such as linking public finance and climate change policies, requiring a logical response to climate change that involve both the public and private sectors. As such, the Pacific Island countries adaptation objectives continue to evolve with the complex changes in addressing adaptation by the international and regional communities.

Climate change responses in the Pacific Island countries have taken into account their vulnerabilities and the climate change impacts in key sectors. For example:

Implementing adaptation measures

Adaptation has been recognized in the region as a key priority by Leaders and by communities around the Pacific since the 1992 Rio Summit. Some adaptation-related

activities were carried out within the context of the Pacific Island Climate Change Assistance project, which provided some training on vulnerability and adaptation (V&A) assessments. This followed a model prepared by Waikato University, New Zealand and the University of the South Pacific, Fiji. Using simple simulations, the model allowed participants to make predictions on climate change impacts on vulnerable areas. Vulnerability assessments highlighted the following key sectors which have been affected by climate change and sea-level rise: coastal zone and coral reefs; agriculture and food security; marine resources; water resources; and biodiversity. Some examples of the effects included a decline in fruit crop production and low export sales due to drought and low rainfall in previous years and loss of agricultural land due to intrusion of seawater through flooding, inundation and coastal erosion especially in the atoll islands.

The model has been recognized as a valuable if limited tool and further efforts in the region sought to use other approaches.

Climate adaptation in the Pacific Islands

The Asian Development Bank project entitled Climate Adaptation in the Pacific Islands project was designed to assist participating countries to adapt to current and future climate risks through the use of a framework and methodology for Climate Change Adaptation through Integrated Risk Reduction, to demonstrate a risk-based approach to adaptation and to mainstreaming adaptation. A number of case studies were carried out to demonstrate why reducing climate-related risks should be an integral part of sustainable development and practical means of how to do this. Climate-related risks are already high for island communities, as well as for basic infrastructure. Risks are likely to increase considerably under current climate change scenarios, as well as under observed climate variability and extreme events. The project's studies have shown that for infrastructure development, there are cost-effective ways to avoid most of the costs attributable to damage from climate change. Climate proofing undertaken at the design stage of the project is one approach to achieve this. Some participating countries found this model useful while others deemed it overly complicated and not really suited to their conditions.

Capacity Building for the Development of Adaptation Measures in Pacific Island Countries (CBDAMPIC)

The Canadian-funded project took a somewhat different and commendable approach to adaptation in the region. It integrated substantive consideration of longer-term climate change risks into development and resource management planning, and improves adaptive capacities and enhance livelihoods through integration. It also gave the following:

- Recognition of a wide range of risks associated with climate change, not only those derived from climate change models/scenarios;
- Focus to community-based (and hence community-relevant) vulnerability assessment and community-based ("bottom-up") adaptation options;
- Focus on government, non-government and community nexus partnerships, utilizing in-kind government services of sector authorities and non-government organization and civil society expertise (civil engineers, coral reef gardeners,

disaster management authorities - Red Cross, forestry, fisheries, coastal planners);

- Real community engagement in the processes of improving capacities to deal with climate-related risks; and
- Incorporated adaptation to climate-change risks and related vulnerabilities into existing institutional and decision-making processes ("mainstreaming"), at both the community level and the national planning level.

CBDAMPIC was the first climate change project in the Pacific region to pilot adaptation implementation. Decision 11 from the first Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) laid out three stages of adaptation as follows: Stage I: Planning, which includes studies of possible impacts of climate change, to identify particularly vulnerable countries or regions and policy options for adaptation and appropriate capacity-building; Stage II: Measures, including further capacity-building, which may be taken to prepare for adaptation, as envisaged by Article 4.1(e); Stage III: Measures to facilitate adequate adaptation, including insurance, and other adaptation measures as envisaged by Article 4.1(b) and Article 4.4. Most climate change projects implemented in the Pacific region fitted into the Stages I and II category while the CBDAMPIC project is the first to proceed to Stage III.

The CBDAMPIC project had set-out to employ a two tiered “top-down” and “bottom-up” “learning-by-doing” approach to adaptation to climate change. The project promotes CCA that empowers the local populace to start addressing the adverse effects of climate change using the participatory approach. While the global and regional community may provide solutions to common issues, local solutions should be the basis for longer-term adaptation to climate change. The project was piloted in 16 communities in 4 countries (Cook Islands, Fiji, Samoa and Vanuatu) and provides valuable lessons for future work on adaptation in SIDS.

Pacific Adaptation to Climate Change (PACC)

PACC is a regional project for 14 Pacific Island countries. It was jointly requested by Pacific Leaders and Environment Ministers and could be better described as an umbrella of nationally driven and implemented adaptation pilots. Assistance provided by the Global Environment Facility (GEF) was targeted at improving adaptive capacity to address climate change concerns at the national level and, together with individual country co-financing, finance the implementation of pilots that reduce vulnerability to climate impacts which countries themselves have identified on the basis of nationally and scientifically endorsed assessments.

The objective of the PACC, based on national consultations with experts on climate change impacts in the fourteen participating countries, is to “enhance the capacity of the participating countries to adapt to climate change, including variability, in selected key development sectors”. Now that the project has successfully completed, the following outcomes have been secured:

(i) Enhanced adaptive capacity of key economic sectors such as the coastal sector (in the Cook Islands, Micronesia, Samoa and Vanuatu), agriculture and food

security sector (in Fiji, Palau, Papua New Guinea and Solomon Islands) and the water sector (in the Marshall Islands, Nauru, Niue, Tokelau, Tonga and Tuvalu);

(ii) National policies and programmes in above economic sectors integrate and mainstream climate change risks and consider CCA priorities; and

(iii) Regional cooperation promoted between participating countries to share lessons learned and promote innovation in mainstreaming CCA into national development goals, plans, strategies and programmes.

The Kiribati Government that is not a PACC member country, is itself implementing a national level project, the Kiribati Adaptation Project Phase II. Other adaptation projects are being considered for national implementation.

In view of the duality approach above mentioned, it is noteworthy to closely examine the adaptation and biodiversity related benefits of reducing emissions from deforestation. Depending on how the pilot phase will be structures, expected to be established at Bali, there could be important synergies to adaptation and biodiversity conservation. This could increase eligibility for financing or for other technical support. In this regard the recent conference on the Action Strategy for Nature Conservation 2008–2012 adopted a set of priorities on empowering local people, communities and Pacific institutions that clearly links the need to conserve and protect biodiversity with the threat from climate change.

For the purposes of discussion under the Nairobi Work Programme of the UNFCCC and other adaptation related discussions it should be noted that the staged approach works well for Pacific Island countries especially in combination with community-based work, but achieving a successful outcome is quite time consuming. In the light of the absorptive capacity of national administrations, the development of further proposals should include greater emphasis on capacity-building and ensure that there is a cadre of available personnel in the communities that will implement the adaptation measures. The understanding of the community of what is occurring through climate change, and hence what the intervention is intended to do, must precede implementation. While outside independent advice is valuable and necessary, ultimately adaptation must be country driven, if not community driven.

Some countries have in place small grants programmes supported by GEF and questions have been raised on whether adaptation projects could be funded through those resources. This is feasible, but there have been few attempts to do so. There appears to be an obstacle in that the climate change terminology has seldom been translated into “community” language. Support for activities under Article 6 will thus be complementary to adaptation funding proposals coming forward for small grants.

In terms of discussion of adaptation funding, it should be noted that the PACC project required a large amount of co-financing. Participating countries were successful in attaining the necessary cash and in-kind to reach 75 per cent of the project costs, but it has been noted that this is an onerous task.

Experience with PACC so far suggests that adaptation issues need to be "housed" in a high level ministry. Suggestions have also been made that the co-financing would be easier if integrated with development cooperation funds. On the other hand it is clear that adaptation funds should be "new and additional" and hence not part of existing official development assistance, but rather new funds.

It could also be noted that the Pacific GEF constituency meeting discussed the adaptation fund. Discussions on the Adaptation Fund of the Kyoto Protocol generally favoured the position taken by the GEF secretariat in its paper prepared for the Council; that it was willing and able to be the secretariat for the fund and that it would be flexible in terms of administering the fund consistent with the decisions by the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol. Delegates agreed to support the position that SIDS and LDCs should be given special consideration and that at an appropriate time when governance issues are considered that support be given to having a representative of the Alliance of Small Island States on the governing council. The meeting noted that no other international agency has indicated interest in hosting the fund.

PACC adaptation outcomes

Table 1. PACC outcomes per country

Adaptation measure	Countries implemented
1.1 Capturing and storage of rain and groundwater resources (individual household and community storage capacities)	Marshall Islands, Nauru, Niue, Papua New Guinea, Tokelau, Tonga, Tuvalu
1.2 Reducing leakage of reticulated systems and water storage facilities	Marshall Islands, Niue, Tokelau, Tonga, Tuvalu
1.3 Water saving (e.g. introducing compost toilets, demand management through awareness raising, trainings of plumbers)	Niue, Tonga, Tuvalu, Tokelau
1.4 Water quality enhancement and assurance	• Solar water purifiers in Marshall Islands, Nauru • Groundwater quality monitoring, Tonga
2.1 Development and use of climate-resilient crop species and varieties (resilient to drought, water logging, saltwater, pests), including techniques for their consistent supply (germ-plasm collections, nurseries)	Fiji, Palau, Papua New Guinea, Solomon Islands
2.2 Farming and land use techniques facilitating soil and water conservation (e.g. mulching, organic farming, mixed cropping, drainage)	Fiji, Palau, Solomon Islands
2.3 Food storage and processing techniques	Palau, Solomon Islands
2.4 Aquaculture techniques	Palau
3.1 Protective coastal structures	Samoa, Vanuatu, Fiji
3.2 Coastal vegetation	Samoa, Vanuatu
3.3 Reinforcing existing coastal infrastructure (climate proofing of roads and harbours)	Cook Islands, Micronesia, Vanuatu

Adaptation measure	Countries implemented
3.4 Relocating coastal infrastructure to less-exposed areas	Vanuatu
3.5 Coastal resource use changes (e.g. reducing sand-mining by local communities, conserving reefs and coastal wetlands and forests as natural protection barrier)	Samoa

Cook Islands

The PACC project in the Cook Islands focuses on coastal zone management on Mangaia Island. Mangaia is the southernmost and second largest of the Cook Islands and has a population of about 570 people. The project helped develop 'climate-proof' coastal infrastructure, in particular and to develop an integrated coastal management policy and plan for Mangaia.

Property and infrastructure located in the coastal areas of the Cook Islands are extremely vulnerable to coastal inundation, a problem that is currently and will continue to be exacerbated by climate change. Most coastal inundation in the Cook Islands occurs either during tropical cyclones or periods when a large swell, which has travelled across the ocean, reaches the Cook Islands. If one of these events coincides with high sea level due to tide or other sea fluctuations, coastal inundation usually occurs. Understanding extreme water levels and wave conditions, how likely they are to occur together during cyclone and swell events, and how these influence wave set-up, wave run-up, overtopping and over washing at the shoreline is fundamental in understanding and assessing inundation of land areas in the Cook Islands and how this may change with sea level rise and other climate change effects (such as changes in intensity and frequency of cyclone conditions).

Taking into consideration the above, the project identified measures to reduce cyclone risks (by improving strength and durability of harbour structures) and rough seas risks (by improving operational features of Mangaia harbour). A newly developed coastal calculator tool, geospatial assessment, cost benefit analysis and community consultations identified the following activities to improve the strength and durability of the harbour structure:

1. Extend the width of the concrete hardstand to reduce degradation of hardstand; and
2. Install precast concrete panels along the face of the quay walls to minimize corrosion of steel piling.

The project identified the following activities in improving operational features of the harbour:

1. Complete the channel widening and deepening works to minimize wave setups in the channel;
2. Relocate the boat ramp to the south of the quay platform to minimize ramp exposure to waves entering the channel; and
3. Construct a beach spending zone to the north of the existing boat ramp to dissipate any wave energy and hence minimize turbulence.

The results of the durable Mangaia harbour include:

- Thickness of the concrete slab of 250 mm; separate concrete slabs with contraction joints (average 6 m x 6 m pads) with individual joints constructed to include steel rods that can be embedded into each pad; A double reinforcing mesh on the upper and lower surfaces of the concrete pads; construction joints anchored into the underlying limestone rock;
- Features that help to reduce the effects of wave scour; a perimeter 'quay platform' concrete slab, comprising a concrete wall anchored into the underlying limestone rock; a concrete barrier wall on either side of the harbour to reduce cross current flows; and
- Features that help to minimise wave energy onto the quay platform and new ramp, i.e. a wave energy dissipation zone.

In addition to the durable design, monitoring and maintenance programmes, the Mangaia Coastal Policy Framework developed under the PACC project is an important instrument. When it becomes operational, it will contribute significantly to the sustainability of the project and other coastal infrastructure, as well as broader sustainability for the coastal zone sector on Mangaia.[23]

Micronesia

Kosrae is one of the four states of Micronesia. About 70 per cent of the 6,616 (2010 census) population and infrastructure are located in low-lying coastal areas hence, are very vulnerable to climate change and sea-level rise. To address this vulnerability, the State of Kosrae has embarked on a road construction programme that considers climate risks such as flash flooding and heavy runoff with debris, and improves on other development features such as joining isolated village communities to the country's road networks.

The project has enhanced adaptive capacity to the people of Kosrae by providing easy access for inland relocation, settlement and provide immediate disaster risks retreat options should the need arise. For example during tsunami emergencies and or tropical cyclones and king tidal surges. Part of the planned route will have to traverse or circumnavigate a large freshwater swamp, which is the largest remaining stand of *T. carolinensis* in the world. Kosrae made available $6.9 million co-financing for the development of the road, closing the current gap. The drainage works for the original road design were based on a maximum hourly rainfall of 178 millimetres, which supposedly had a return period of 25 years.

The project identified a 7 km section of the road in the Tafunsak municipality which was being progressively damaged by flooding from heavy rains and high tides. The original road had been designed to withstand a maximum hourly rainfall of 178 mm. Analysis of climate and sea level data and projections to 2050 concluded that the road should be redesigned to withstand maximum hourly rainfall of 254 mm.

[23] A documentary of the harbour project can be found online at www.sprep.org/pacc/ titled 'Vital Harbour'.

Following a socio-economic assessment, community consultations and input from expert coastal engineers, the road was redesigned and rebuilt to withstand the anticipated heavier rainfall and higher sea levels. Adaptations included raising parts of the road by up to 1.5 m, fitting larger culverts and improving drainage. The improved road was officially opened in May 2014. The PACC team is now developing guidelines to share their experiences with climate proofing the road, which will help others to replicate this success.

Activities specific to building the resilience of the road to withstand an hourly rainfall rate of 254 mm includes:

- Gravelling and raising the surface of the new road; construction of drainage works and installation of outflows engineered for a 25-year flood event;
- Mangrove protection and replanting; planting of trees on shoulder of road; and
- Construction of coastal protective structures with design specifications for a 25-year storm/flood event, with establishment of buffer/set back zones and construction of protective structures (i.e. culverts, breakwater).

The project has since been completed and the coastal road is now expected to withstand heavier rainfall and high sea levels. Also under the PACC project, a tide gauge and rainfall gauges were installed on Kosrae in 2011 to improve availability and quality of local climate and sea level data. These feed into climate-sensitive decision making and development for the state. The project team promoted the mainstreaming of climate risk into all development in the state and the country. The team supported development of the Kosrae State Climate Change Act, which was endorsed in 2011; and amendments to Kosrae's Regulations for Development, that now require all development projects to consider the climate risks in all planning and development. PACC Micronesia integrated climate risks into Kosrae's Environmental Impact Assessment Guidelines. The team also contributed to the recently revised Kosrae Shoreline Management Plan, which provides a comprehensive strategy for building resilience of Kosrae's coastal communities and infrastructure into the future.[24]

Samoa

Samoa is a high volcanic island with very low lying coastal areas where the majority of the population and infrastructure is located. The vulnerability of the people is a cumulative impact of exposure, to climate related risks reflecting both climatic conditions and location of human settlement, assets and infrastructure and the capacity of the people to cope with climate related risks. Climate related extreme events are increasing which have greatly impacted on people's adaptive capability, livelihoods as well as their socio-economic and physical environment. Samoa in recognition of this vulnerability, carried out its coastal infrastructure management assessments with the aid of the World Bank through Samoa Infrastructure and Asset Management programme. Coastal infrastructure management plans were developed for 15 districts of Samoa. These plans contain an assessment and identification of

[24] More technical information is available at www.sprep.org/pacc/publications.

measures necessary to increase the resilience of the socio-economic infrastructure to the impacts of climate change and sea level rise in the long term. The government had committed $2.5 million of national and donor support to the identification and implementation of adaptation support to vulnerable coastal areas and communities.

The Samoa PACC project developed a community-based integrated coastal protection model, to increase the resilience of the country's coastal communities and infrastructure to the impacts of climate change. Activities included:

- Reclamation of land, buffer zone protection, replanting and protecting the existing mangrove areas; and
- Construction of engineered coastal protective infrastructure including drainage and outflows for a 50-year storm event.

Results of the Samoa project included lessons that focus on planning, risk modelling, climate and sea level projections as well as awareness raising among decision makers and communities. The issues of the range of measures available to reduce vulnerability and understanding climate risks, options to reduce the risks have been practices and lessons to apply to make informed and better decisions. A 'Living with Rivers and Seas' manual is one example of a knowledge management product that Samoa will be looking to provide clear guidance on how to design, construct and monitor river and sea defence schemes in the future. These useful examples from the Pacific are informing policy level activities, guiding the development of strategic frameworks for an integrated approach to addressing the vulnerability of island coastlines.

Vanuatu

The island of Epi is in the Shefa Province of the Vanuatu archipelago. The island population is mostly distributed along the coast with the most populated area on the north eastern coast (Lamen Bay). Epi experiences on average 2.6 cyclones per year. A total of nine tropical cyclones have either directly or indirectly affected the infrastructure on Epi Island since 1941. Extreme events (tropical cyclones, ENSO-related events) can set the whole economy of Epi and Vanuatu back by 5 years, as much of the funding and assistance is diverted towards national recovery. In the case of Cyclone Ivy in 2004, damage was estimated at a total cost of $4.276 million (VT427.6 million).

Cyclone Ivy affected 50,000 people. 90 per cent of water resources; 70 per cent of roads; 60 per cent of health infrastructure; 112 schools and over 80 per cent of food crops were damaged. Epi was one of the rural areas worst hit by the cyclone and as a result, the main road network (main community lifeline) were eroded away. Reef debris deposited over the roads and flooding extending right into village grounds. The island's coastline has receded significantly, in most parts by over 20 m in the last 20 to 26 years. As a result several parts of the main road network in Epi are not functional at present (PACC 2006).

PACC demonstrated on-the-ground practices that promote the resilience of the road infrastructures in Epi. This is by enabling them to implement road designs that takes

into consideration current and future changes in climate and sea level rise. Through promotion and building community ownership, the Vanuatu project team engaged communities in a three-dimensional participatory mapping, which helps understanding as well as participation in decision making; and establishing the Epi Island Climate Change Committee, established in March 2013, which includes representatives from community and government. Activities included:

- Implementing road relocation designs soliciting views of the various community groups of the island;
- Construction of coastal/flood protection systems including through a Locally Managed (village-based) approach; including gravelling and upgrading of road using a mix of local and outside sourced raw resources. Construction of culverts, drainage and outlets using a nation-wide climate-resilient road Standard set by the Government of Vanuatu for all road infrastructures (inland, coastal); and
- Establishing set-back zones for infrastructure development in coastal areas that include planting and maintaining buffer zones along coastal infrastructure assets such as airport strips, roads, bridges and other public utilities.

A 39 km stretch of road has been constructed with parts relocated in land to avoid severe coastal erosion in the 20-30 year period. This is important adaptation as the road infrastructure plays a vital role in the socio-economic livelihood of Epi Island. It provides links to market access and essential services for the people. By way of in-kind contribution, the government had already rebuilt the main Lamen Bay wharf in Epi costing $2.9 million. These are providing storage houses that are able to hold produce from the communities to await shipment to Port Vila and also overseas markets.

Communities considered it essential to them that they are involved in the designing and management of the road works. The project therefore carried out training for men and women in road works construction and management through a locally-managed community approach. This capacity building is seen as key to building resilience at the community level. The Ministry of Works facilitating the project with the island communities plan to complete a 'locally managed road construction' guideline to be used by other outer and isolated islands of Vanuatu that are suffering from similar impacts of climate change on their island coasts. These include hard and soft engineering approaches that include ecosystem based activities that enhance and improve coastal protection.

A number of sections of the Epi roads urgently require relocation and redesigning to enhance resilience to climate related risks. Vanuatu committed $2.9 million to the rebuilding of the main Lamen Bay wharf Epi with storage houses that now hold produce from the communities to await shipment to Port Vila and other overseas markets.

Fiji

In Fiji, one of the most populous Pacific Island countries with nearly 900,000 people, sea level rise combined with flooding from heavy rain is affecting low-lying farms and coastal communities and current drainage networks cannot cope. This is having a

direct impact on food and cash crops, threatening food security and damaging the economy.

The agriculture sector was once a major stronghold of Fiji's economy but is now the third largest, contributing $451 million (9 per cent) annually to the nations GDP. Sugarcane which used to dominate the sector now contributes only 0.9 per cent and has been surpassed by other crops, horticulture and livestock production and subsistence sector, although it still directly employs about 13 per cent of the labour force. 17,000 people are directly or indirectly dependent on the export of taro for their livelihood.

In recent years, growth in Fiji has been largely driven by a strong tourism industry. Tourism has expanded since the early 1980s and is the leading economic activity in the islands. Fiji's gross earnings from tourism in 2011 totalled $1.051 billion, more than the combined revenues of the country's top five exports (fish, water, garments, timber and gold).

The PACC project has been working to improve agriculture at two pilot sites in low-lying coastal areas of Viti Levu. Activities have focused on upgrading the drainage systems and trialling and demonstrating tolerant crop varieties. Activities included:

- Protecting arable land and crops from flooding by re designing drainage schemes that are able to cope with extreme rainfall regimes (i.e. flooding) associated with climate change. That is, constructing drainage system and outflows and coastal protective structures designed for a 50 year storm event;
- Redesigning and constructing engineered outlet waterways, construction of culvert crossings, gravelling of feeder roads, upgrading/redesigning seawalls, installation of gabion baskets and upgrading of access roads and outfall structures- floodgate and flap gates in each drainage scheme for a 50-year flood event;
- Strengthening networking and information sharing/exchange among farmers/stakeholders to develop appropriate measures to address climate change, climate variability and sea-level rise in the immediate and long-term;
- Testing and trialling water-logged resistant and salt-tolerant varieties of crops (cassava, taro, sweet potatoes) in low-lying farming communities.

The results of the Fiji project shows 3 km of the drainage network have been improved (dredged). This allowed reclamation of farming land for crop trials, which involved varieties of taro, cassava and sweet potato. These were tested for characteristics such as saltwater and water-logging tolerance. Nine varieties have been tested and yielded positive results and are now being grown on 10 ha by 65 farmers. Farmers have also received training in good production practices of these varieties.

Solomon Islands

Any increase in frequency or intensity of extremes in the future could seriously affect the carrying capacity of atoll-type environments to sustain crop production for consumption and commercial purposes. In Solomon Islands the PACC project

focused on enhancing food production in low-lying areas, with a first pilot in Ontong Java Atoll trialling permaculture farming systems.

In the early stages, the project team carried out a V&A assessment to clarify the issues and adaptive capacity and to prioritize needs. The assessment highlighted poor soils, saltwater intrusion into soils and drought as some of the key challenges for agriculture. Recommended activities included:

- Introducing an 'atoll permaculture' system of mixed cropping and agroforestry;
- Using salt-tolerant, disease-resistant, quick-maturing crops;
- Using raised beds to protect against saltwater intrusion;
- Developing a good seed supply system; using organic manure instead of chemical fertilizers;
- Pest and disease control and quarantine; and
- Improving soil health.

The project went on to develop demonstrations of the recommended permaculture systems. The systems are designed to be low-maintenance and high-yield and incorporate good management practices to restore soil health while producing good yields of diverse food crops. The project has also set up a hybrid solar dryer in Honiara to demonstrate preservation of food by this method, which can then be shipped to atoll communities in times of need. Training in processing and preservation was carried out and targeted women's groups.

Nauru is a single island of about 22 km^2, with most of the population of about 10,000 living in the 150–300 m wide coastal strip. The island has very limited freshwater resources and relies heavily on rainwater and desalination of seawater. Drought is a major threat to water supply and exacerbates saltwater intrusion into groundwater. The aim of the Nauru PACC project is to improve resilience to drought by improving management of the island's water supply.

Nauru

Nauru's adaptation measure identified under the project was the development of a conjunctive water supply system for Nauru. This means using water from the various sources for different uses at different times. As desalination is expensive, using rainwater, seawater and groundwater appropriately and depending on availability is a sensible way to sustainably improve Nauru's water supply. An example of how this might work is shown below.

The project team carried out V&A assessment and these measures were then subjected to multi-criteria analysis to select the most feasible, relevant and sustainable option.

By this process, the option selected for the Nauru demonstration project in Aiwo district was the introduction of solar water purifiers. These units, have solar panels linked to a water distillation circuit, produce clean drinking water from non-potable sources such as seawater or contaminated groundwater. Nineteen (19) households

had solar purifier units fitted, providing 80 litres of additional potable water per day per household. During a drought, this can be used for drinking, cooking and if in sufficient quantity, personal bathing. Even when not under drought conditions this is a useful and safe potable water supply. During monitoring phases, the system was operated by the household and did not require any major maintenance. The lifespan of the solar purifier is 15 years and no replacement of material was reported during the project phase. Alongside the practical demonstration, the project supported effective planning for water management in promoting best use of potable and non-potable water from different sources.

The project carried out some major mainstreaming achievements through its contributions to the endorsement of three key documents: the National Water, Sanitation and Hygiene Policy, which incorporates climate change; the Water Sector Climate Change Action Plan; and the Drought Management Strategy. The project team helped to set up a Water Unit, a Water Technical Committee and other coordination mechanisms that are contributing to mainstreaming climate change into the water sector.

Niue

Niue is the world's largest and highest single coral atoll. It is a single island of raised limestone with an area of approximately 260 $km^{2.}$ The island has no surface water. The population of about 1,600 has relied mainly on the underground lens for freshwater. Studies on Niue's groundwater carried out in 2005 indicate that the lens yield is adequate to meet the demands of the current populace during the rainy season, however, the lens yield is not able to meet demands during dry season due partly to an increased demand for irrigation. As a result, water shortages are regular occurrences in Niue. The situation is expected to worsen in a climate change scenario where droughts are expected to fluctuate towards an increase. Niue has carried out assessments of its water resources and also continuously supports improvement of infrastructures. It earmarked $110,000 to continue to assist in the development of water retention capacity for the 14 villages in the island.

The PACC project therefore sought an alternative water source and identified rainwater harvesting as the most promising. A process of research, consultation and analysis led to the decision to build a tank moulding facility and begin manufacturing water tanks in Niue. Tanks could be made at half the price of importing them and this would further increase resilience by reducing dependence on imports.

The new moulding facility was opened in December 2013. The facility is now capable of producing up to eight 5,000 litre tanks each day. The tanks are made of a robust plastic called high-density polyethylene (HDPE), which is imported in powder form before it is processed and moulded into tanks. The tanks are lightweight, there are no joints that can split and the plastic material complies with New Zealand and Australian safety standards. Properly maintained, the tanks will last for many decades.

The project is now providing a tank to each household on the island. Householders are responsible for maintenance of their tanks and are required to cover the costs of guttering and fascia boards needed to complete the system. The project team worked within communities to raise awareness of the value of the tanks and carried out training on system maintenance to ensure the tanks are kept in good order. It also raised more awareness on water conservation and protection, related to climate change. Activities included:

- Construction of a tank moulding facility;
- Building additional village/community water tanks to allow storage of rainwater for use during drought for agriculture, health, education and business sectors;
- Produce climate information for water resources management and planning; and
- Media campaigns and advocacy of CCA targeting communities, schools and businesses.

Tonga

In Tonga, the mean annual rainfall for the island of Tongatapu is 1,753 mm with a mean annual recharge of 524 mm to the groundwater or 30 per cent of the total rainfall. During ENSO there is less rainfall as indicated by a monthly mean rainfall of less than 100 mm as opposed to monthly mean of 200 mm. With less rainfall, there is less recharge and with continued pumping of groundwater and a rise in sea-level leads to saltwater intrusion into the groundwater aquifer.

The PACC project focused on the Hihifo District of the main island of Tongatapu, situated 15 km west of the capital, and specifically on 6 village communities of the upper area of the district. These communities have water sources that are mainly groundwater and supplemented by rainwater, with heavy reliance on the former source. They had long struggled with an unreliable water supply and changing rainfall patterns and recurrent drought are exacerbating their already vulnerable resources.

The project carried out a socio-economic assessment of the district to understand the current situation and to collect essential baseline data. From a survey of all 354 households and a focus group discussion with key members of the communities, the socio-economic assessment found that the problems were due to a combination of natural, governance and technical factors: the fragile and thin water lens which is increasingly vulnerable; a lack of community participation in the management of the precious water resources; and technical issues, such as breakdown of pumps and leakages.

The solutions proposed included: putting a water meter in every household, installing solar water pumps in villages; more water tanks; strengthening governance capacities of water committees; and improving transparency and communication between water consumers and water committees.

The project was designed with the objectives to improve the water supply system to provide Hihifo residents with better access to water in terms of reliability and pressure and better water quality; and to enhance the capacity of the residents to

sustainably manage their water resources and to effectively operate and maintain the improved water supply system. Activities included:

- Construction of additional village/community water tanks, a water reservoir, piping water supply system from reservoir to household water tanks and storage; solar-hybrid water pumping system and station;
- Salinity monitoring using piezometers to establish drought storage and recharge mechanisms sustaining the freshwater lens; and
- Integrated water management plans that involved members of all six villages, land owners, village authorities, village water committees that were established and others that had a stake into water supply and demand management of the water supply for the district. These include the tourism businesses within the district. Catchment management initiatives would have wider environmental benefits, including reduced erosion and soil loss, maintenance of biodiversity and land productivity.

In the six villages in 2013, the project installed three 45,000 litre water tanks, an overhead tank holding 22,500 litres and 30 smaller tanks that hold 10,000 litres each. To complete the system, monitoring and production boreholes have been drilled, new pipelines and pipes laid, water meters have been installed for each household, and there are new solar and diesel powered pumps. Hihifo's new water supply system was officially opened in April 2014 and all Hihifo households are now benefiting.

Tuvalu

Tuvalu has nine low-lying islands scattered over 500,000 km^2 of ocean with a total land area of 27 km^2. Tuvalu's population was estimated at 11,206 in 2011, with approximately half living on the island of Funafuti. Due to the poor quality of groundwater in Funafuti Island, much of the population (4,800 people) depends entirely on rainwater for consumption and other uses. Heavy reliance on rain water makes Funafuti highly vulnerable to variations in rainfall regimes. A period of 2–3 weeks of drought (i.e. period of no rainfall) on Funafuti can cause serious shortage of water as the water levels in many of the holding tanks and reservoirs reduce in volume by up to 50 per cent. This situation is exemplified by the ENSO-forced drought of 1997/1998, which forced the government to declare a State of Emergency and also to purchase a costly desalination plant with support from the Government of Japan. Another emergency occurred in 2011, and this time, the government of Australia assisted with desalination plants. While the original purpose of desalination plant was to provide additional water supply in times of drought and other natural disaster emergencies, recent government reports indicate that a large population is now dependent on water supply from desalination plant which has an operational cost of AUS$30,000 per month.

The PACC project in Tuvalu was one of the first projects to have completed implementation of its activities relative to its other 13 Pacific Island countries. It focused on the village community of Lofeagai which has a population of 637 in 97 households. It was selected as the pilot site for the PACC demonstration project through a Funafuti atoll V&A assessment and a stakeholder consultation process. This process identified Lofeagai as the most vulnerable community on Funafuti,

followed by Tekavatoetoe. The only source of freshwater in Lofeagai is rainwater and desalinated water purchased from the government. Before the PACC project, there was no communal cistern, rainwater was stored privately and supplies quickly ran out during dry periods. Activities included:

- A socio-economic assessment in the Lofeagai community, community consultations;
- A cost-benefit analysis. These helped to clarify the decision to build a cistern with capacity of 700,000 litres. It was also decided this would be linked to and managed by the EKT church (Ekalesia Kelisiano Tuvalu, or Congregational Christian Church of Tuvalu), of which 75 per cent of the community are members;
- Construction of the 700,000 litre cistern including down-piping and fittings to the EKT church building guttering and rainwater catchment roof system; and
- Replication of the successful intervention to Tekavatoetoe community and church building, with a capacity of 288,000 litres.

As a result, at least 90 per cent of the Lofeagai and Tekavatoetoe population now have access to the minimum water supply of 40 litres per household per day during dry periods and droughts.

Tuvalu's demonstration project is a good example of how comprehensive planning and proactive management can successfully deliver outcomes. The project successfully identified one of the most vulnerable communities, selected a sustainable and efficient solution within the PACC budget and used informal community leadership to implement and manage the adaptation measure. The project also incorporated a gender perspective by actively involving the Tuvalu National Council of Women.

As well as carrying out the demonstration project, the Tuvalu PACC team has been central to the development of Te Kaniva, the Climate Change Policy Framework, and the National Strategic Action Plan for climate change and disaster management. PACC and the integrated water resources management (IWRM) projects have also coordinated the development of a national water and sanitation policy.

National level approaches to strengthening CCA

JNAP process in Tonga

The first country to formally combine work on CCA and DRR was the Kingdom of Tonga. In July 2009, Cabinet gave approval for the Ministry of Environment and Climate Change (MECC) to work with other ministries, NGOs, statutory boards and donors to develop the Joint National Action Plan (JNAP) on Climate Change Adaptation and Disaster Risk Management 2010–2015. The preparation of the plan was deliberately scheduled at the same time as a country-wide consultation to develop Tonga's second national communication to the UNFCCC, reducing 'workshop fatigue' among NGOs and communities who participated in both meetings.

The new plan was signed off by Cabinet in July 2010 with the aim of coordinating implementation and aligning local action with Tonga's commitments under national, regional and international agreements.[25]

To assist with implementing the plan, the Tongan government approved the creation of a JNAP Task Force with its own secretariat, based in the Environment Ministry. Primary funding came from donors, such as the Australian Agency for International Development, which contributed dedicated funding for salaries through the International Climate Change Adaptation Initiative.

The JNAP Task Force includes representatives from a range of government ministries (Health, Education, Lands, Survey and Natural Resources, Agriculture and Food, Forestry and Fisheries), agencies (Police, Defence, Tonga Meteorological Services, National Emergency and Management Office, Water Board) and key community organizations involved in adaptation and disaster programmes, such as the Tonga Community Development Trust, Civil Society Forum of Tonga and Tonga Red Cross.

The JNAP Secretariat, established in August 2011, is based at the Environment Ministry (from 1 July 2012 renamed the Ministry of Land, Environment, Climate Change and Natural Resources). The unit currently includes a Team Leader, Climate Change Finance Officer and Technical Implementation Support Officer. To support JNAP staff, the process also established Technical Working Groups, involving government and key community organizations such as the Red Cross.

Beyond coordination, a core function of the Secretariat is to improve the effective use of resources, in line with regional and international agreements like the 2009 Cairns Compact and the Paris Declaration on Aid Effectiveness. Broader policy on climate responses is governed by a range of structures, at parliamentary and senior officials' level. The Cabinet Committee on Climate Change includes the Ministers for Environment, Finance, Transport, Works, Justice and the Attorney General, while the Legislative Assembly of Tonga has created an Environment and Climate Change Standing Committee.

The National Environment and Climate Change Committee is mandated to coordinate all activities relating to the environment, climate change and impact assessments. The Committee includes representatives of key ministries and serves as advisor to Cabinet. The equivalent National Emergency Management Committee has the responsibility for disaster risk management capacity-building.

Papua New Guinea's Office of Climate Change and Development

Papua New Guinea's experience of establishing a coordinating body for climate responses has been far more problematic than in other Pacific States, reflecting a complex interplay of factors: the diversity and size of an island nation of 7 million

[25] PIFACC and the Millennium Development Goals, UNFCCC and the Yokohama and Hyogo Framework for Action on natural disasters.

people; the greater focus on reducing carbon emissions from deforestation and degradation of forests (REDD+) rather than adaptation; and broader problems in the management of public finances and lack of outreach to rural areas at a time of major political change.

In 2008, the Papua New Guinea government established an Office of Climate Change and Carbon Trading, which reported to the Office of the Prime Minister and was headed by the Prime Minister's then chief-of-staff. The agency was renamed the Office of Climate Change and Environmental Sustainability in early 2009, but its operations were crippled by allegations of fraud and mismanagement that led to the suspension of the Director in June 2009 and a review of the Office. Scandals have undermined the legitimacy of the Office and eroded trust in domestic and international climate change institutions. It also raised serious concerns about nepotism in appointments to key policy positions.

Papua New Guinea's National Executive Council decided to abolish the Office on 23 March 2010 and created new structures to coordinate policy and action on climate change:

- The National Climate Change Committee first met in June 2010. It comprises key representatives of planning, finance and line ministries and was established as the main policy- and decision-making body; and
- A new Office of Climate Change and Development (OCCD) was established in September 2010 as the main coordinating unit. The Secretary of the Department of Environment and Conservation serves as the acting director of OCCD. The Office recruited a range of young professional staff and established a series of technical working groups on adaptation; REDD+; low carbon growth; monitoring, reporting and verification; and national communication. The working groups include a range of government, private sector and non-government representatives.

Creating a culture of learning, OCCD also began a national series of consultation workshops to reach to all provinces. Compared to other small Pacific Island nations, discussion on adaptation responses in Papua New Guinea are at a very early stage. Much more attention has focused on REDD+ and the possible introduction of emissions trading schemes using forests as carbon sinks. Nonetheless, OCCD has begun an adaptation programme focused on: malaria and vector-borne disease; developing a coastal early warning system; mapping high risk areas for landslides or flooding; developing low-cost and cost-effective measures for adaptation responses by villages with limited resources (such as planting mangroves).

From the National Advisory Committee to the National Advisory Board in Vanuatu

As with other Pacific countries, Vanuatu has begun to investigate the integration of climate change and disaster risk management into one structure. According to an April 2012 government report:

> "The current separation between climate change and disaster risk management has led to stakeholder confusion, duplication of efforts,

excessive time and resource demands on a limited number of actors, weak governance arrangements and a less effective delivery of services to ni-Vanuatu people."

The process of integration involves a range of tasks:

- Combining a series of overlapping strategic policy documents, including Vanuatu's UNFCCC National Adaptation Plan of Action (NAPA), the National Climate Change Adaptation Strategy and National Action Plan on Disaster Risk Reduction and Disaster Management 2006–2016;
- Creating unified governance structures and processes. Until now disaster work has been managed through the Disaster Risk Reduction and Disaster Management National Action Plan Task Force, housed under the Ministry of Internal Affairs. In contrast, the body that oversees climate change implementation, the National Advisory Committee on Climate Change is located under the Ministry of Infrastructure and Public Utilities, chaired through the Vanuatu Meteorological and Geohazards Department;
- Passing new legislation beyond the existing National Disaster Act of 2000 to fully enable climate change and disaster risk integration (Unlike the advisory board, the Advisory Committee currently operates without formal legislation); and
- Establishing a system of monitoring, reporting and verification on adaptation initiatives.

The reform process is supported by locally based consultants funded by the World Bank and jointly by the Secretariat of the Pacific Community and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). Technical advice is provided by the Secretariat of the Pacific Regional Environment Programme (SPREP), the Secretariat of the Pacific Community and other regional networks.

In February 2012, the Vanuatu government held a workshop to discuss the shift to a new coordinating structure. The aim was to effectively merge the structures that currently manage work on disaster and climate responses into a single national advisory board. This board officially came into existence in May 2012, replacing the NACCC, and is made up of senior officials with clear tasks and mandates, detailed in legislation. A fully staffed Project Management Unit is being created as the national advisory board secretariat, based at the Vanuatu Meteorological and Geohazards Department. The government has explicitly requested public feedback on the proposed structures, as well as draft legislation to implement the changes.

Strengthening partnerships and coordination, Vanuatu civil society organizations have formed a Climate Change Network, and local and international NGOs are working together on disaster responses through the Vanuatu Humanitarian Team. This networking has allowed them to come together to present common responses to government, especially over proposals in the draft legislation that might restrict their work on the ground.

Current gaps and areas of adjustment

The adaptation actions identified above will be put under the assessment framework for an in-depth analysis. This analysis will reveal gaps in 'business as usual' or 'maintenance' pathways for CCA.

Gaps will be reflected systematically using eight indicators and the sub-indicators described in the framework paper. The analyses will be based primarily on qualitative judgment regarding adequacy, presence/absence of instruments and practices, quality of delivery and effectiveness of measures and instruments. Quality of compliance will also be treated for the maintenance gaps analysis.

Pacific Island countries readiness for enhance adaptation actions

Readiness will be highlighting approach and gaps between current level of adaptation practices and efforts at national levels (primarily realized by the lead agency, as assigned by respective countries) and the efforts that are projected to reach a hypothetical 'safe' level of adaptation in view of recent science (i.e., IPCC 2015) and assessed needs for adaptation. The hypothesis is that much enhanced efforts than current levels of adaptation practices must be committed to achieve the future adaptation vision for Pacific Island countries.

The analyses will be primarily based on eight indicators, as stated before. The same elements of judgments will be applied against a much enhanced (hypothetical adaptation vision/pathway, projecting from the current level of adaptation efforts.

Pacific capacity-building needs

In an era of rapid change in international economy, characterized by the redirection of investment flows away from primary producing activities and the quick outflow of capital from troubled markets (for example, the South-East Asia financial crisis of the late 1990s), adjusting to external shocks and the associated management of vulnerability is a foremost challenge to SIDS.

Responses to 'vulnerabilities' can be by building up resilience or by planning around hazards and risks. As SIDS have limited ability to absorb natural and human induced shocks, and limited resources, strategic assessment and forward planning of land use and development provides an effective and efficient means to address vulnerability. Planning systems provide the framework for pro-active measures as well as the vehicle for mainstreaming environment into economic development pursuits, the multi-use of data, provision of consistent guidance and early participation of the community. They provide the means for instituting confidence in decision-making, certainty in processes and security in 'investment' all essential for sustainable development (overall vulnerability reduction management).

Leadership

The responsibility for leadership to reverse the current trend of growing vulnerability falls squarely in the domain of government. A major challenge for the government will

be resolving the conflicting advice and requirements regarding the role of government and its corresponding size and structure. For example, on one side, governments of SIDS are being urged to: implement decentralization; reduce the size of the public sector; adopt the Agenda 21 principles of citizenry participation and consultation; and effectively participate in and fulfil reporting requirements under international agreements either linked to the rapid pace of globalization or environmental degradation.

Additionally, international agreements on trade call on SIDS to take certain policy decisions that are very likely to negatively impact revenues for the public sector and subsequent social investment, for example, World Trade Organization (WTO) requirement to reduce tariffs on imports in order to facilitate free flow of trade. In industrialized and industrializing countries, tariffs are a possible mechanism for protecting domestic industry and likely to negatively impact on free trade. In SIDS, there are a very limited number of domestic industries (which are increasingly foreign owned) and tariffs are the principal means of sheltering them form injuries of increased imports and for collecting revenue for the public sector.

Case evidence confirms that despite the growing recognition that the development challenge is different and more difficult because of the peculiarities of SIDS, this is seldom taken into account when donors or international organizations enter into agreements. For example SIDS are being advised to privatize their relatively small utilities (water, electricity and communications). As a number of Caribbean SIDS are finding out, this advice is resulting in escalating costs of utilities. In the case of electrical energy, increases in costs have resulted in significant loss of textile jobs to countries with cheaper energy.

Human resources development

High energy costs usually correlate with low wages. The question that arises is, given the unique nature of the electricity sector in SIDS, was a model developed for the United Kingdom appropriate? Was a serious analysis done before this model was recommended, as the means of mobilizing investments for electricity generation? Within SIDS, a lack of capacity in the area of water and energy limits their ability to do the in-depth analysis usually necessary to determine whether the prescribed solution is likely to have the desired outcome. Clearly SIDS needs additional professional will a wider or higher range of skills than is now available owing to factors such as the pay, career prospects and educational infrastructure.

Reducing the overall vulnerability of SIDS will require capacity within governments to analyse external advice and conditionality. Given the limited capability of the private sector in most SIDS, the minimal flow of foreign direct investment which is strongly linked to the perceived vulnerability small islands, the limited market infrastructure and ineffective and inefficient operation of market forces, SIDS governments will have to play a greater role to reduce their vulnerability. This opinion is not consistent with the prevailing ideas of some donors and international development

organizations as to the size, structure and function of government. Reducing economic vulnerability will require SIDS to reduce their dependence on imported fossil fuel, undertake economic diversification and protect the biological resources.

Institution strengthening

As development assistance becomes less available it increasingly comes with more conditionality that represents donor's perspectives on how beneficiary countries should pursue sustainable development. SIDS will need the capacity to do the necessary analysis in order to determine relevance as well as the best methodology for implementation and the international community should help SIDS more effectively and efficiently reduce their vulnerability and build resilience. Consider the case of food security. The vast majority of resources devoted to agriculture in SIDS are directed at the production of commodity crops (sugar, bananas, copra, coffee), a legacy of the colonial history. Over the past decades the unit value have continued to decline as once lucrative preferential agreements get dismantled by the coming into force of WTO agreements.

The dismantling of these historical agreements without implementing alternatives is resulting in increased vulnerability of farmers and their households. The current strategy for food security advocated by technical assistance agencies like the World Bank is for SIDS to depend on the international market, a strategy complimented by WTO, which encourages SIDS to lower tariffs on imported food. Does this advice reflect the vulnerable status of the SIDS economies or their farmers, and will the long-term impact lead to improve food security and sustainable natural resource use? Or, is it based on present trends that will result in further environmental degradation, ecosystems loss and increased overall vulnerability? The institutional capacity of SIDS need to be strengthened to address the interrelated nature of the use of resources, social outcomes and environmental impacts.

Reducing environmental vulnerability in SIDS will require the provision of necessary social, educational and economic support for the protection of natural resources on which all development is predicated in SIDS. In small societies, especially where the domestic sector is weak and undeveloped, the role of government must, of necessity, be more interventionist than it would be in large and more developed economies. A major challenge of government as it seeks to reduce national vulnerability, will be increasing the efficiency and effectiveness of government. Government will have to do a better job of differentiating causes and symptoms, identifying linkages and optimizing the potential returns on limited investment resources. The framework for achieving much of this is detailed in the Barbados Programme of Action. Unfortunately, as stated by the United Nations Secretary-General at the Special session on SIDS in 1999, limited capacity and resources have significantly hindered progress of SIDS in implementing the Barbados Programme of Action.

It is equally necessary to develop the competitiveness of private productive enterprises for it is they who conduct the nation's trade. Competitiveness in the modern world demands a greater use of knowledge to inform decision-making, to provide services at international standards and use modern technologies in

production processes. It is also enhanced through niche market export strategy, flexible specialization, enhanced entrepreneurship and, where appropriate, economic deregulation.

Local level

The engagement of many SIDS Governments, especially those in the Caribbean, in the range of functions that now exist, has its genesis in colonial history. The transition from colonial administration to self-government and finally to political independence heightened the consciousness of community leaders as to the social responsibility of Government to provide basic services to a highly dependent population. Furthermore, the collapse of the plantation-based agricultural economy left an extremely vulnerable and disorganized private sector dependent on protected markets, import trading and various forms of Government intervention. Unlike other countries, the SIDS did not have the advantage of significant industrial progress before entering into a fully democratic and liberal system of governance, who today are among the most open global trade markets. It is not surprising therefore, that in many SIDS, Governments have had to assume a role beyond that of regulator, to the point where their influence dominates every aspect of social and economic life derives its revenues from tariffs on trade.

Getting the policy right is proving to be very difficult. Policies being formulated seem to attract investment in one sector: tourism. Instead of economic diversification, the agreed-on approach for reducing vulnerability of SIDS, tourism is beginning to dominate most SIDS economies with very little to supplement or take the shocks in case of negative downturns or during periods of economic difficulty. As SIDS economic future becomes disproportionately more tourism-focused, vulnerability increases. The growing vulnerability of SIDS is manifesting itself at the local level in poor health and sanitation services. Limited prospects for employment are proving difficult issues for national government to cope with. New approaches call for diversification to the local level, however in the absence of capacity at this level the anticipated result will not be realized. It is therefore essential that the SIDS Capacity 2015 programme provide support for capacity-building at the local level. The private sector, NGOs and community based organizations will all have to play larger role at the local level.

Capacity-building in SIDS for vulnerability reduction

The importance of capacity-building for small economies has been emphasized in the Commonwealth Secretariat/World Bank Task Force report (2000). Limited capacity has also been cited as one of the principal reasons responsible for the slow progress with the implementation of the Barbados Programme of Action. In partnership with the United Nations Development Programme (UNDP), GEF has devoted special attention to the capacity needs at the individual, institutional and systemic levels needed in SIDS for implementation of the global environmental conventions Rio conference approved Capacity 21 to support capacity building for implementation Agenda 21. In addition to the implementation of Capacity 21 in some SIDS the major capacity building activity is the recently completed national Communications reports under UNDPs Climate Change enabling activities.

Notwithstanding the general current towards leaner administrative structures, economic liberalization and an increasing concern for the environment is bringing with it an increased requirement for regulatory activity. Equally, the strong pressure towards consumer-oriented services is leading to requirements for more, not less government, with an emphasis on transparency rather than size. SIDS governments will need to convince donors of the uniqueness of their situation and the need for greater partnerships to develop capacity at all level of civil society, the private sector and the government in order to meet the challenges of sustainable development. To do this, they must reduce economic, environmental and social vulnerability and become more effective in the areas of water, sanitation, health and energy services, food security and the protection of biodiversity.

The need to rationalize public expenditure in situation of chronic budgetary deficits, to improve the quality of public goods and services and to control increasing demand for such goods and services, has brought into question the level of Government capacity to continue to serve as the main and direct provider, in the long term local groups will have to assume many of the function that government by default has to play. However in order for successful functioning at the local level community capacity has to be significantly strengthened.

Lessons learned and conclusions

While Pacific Island countries have reported serious socioeconomic, environmental, physical and cultural consequences of climate change, the whole region has established an enabling environment at the national and regional levels and implemented direct and immediate adaptation programmes on the ground within the last two decades. Much of this expansion, while seemingly due to outside support, has largely been driven internally at the national or federal and state levels.

The lessons from temporary organizations such as the PACC project provide a significant learning curve for future regional and national adaptation programmes in the Pacific. PACC has supported and itself set new trends in adaptation within countries. It has developed on-the-ground tools tailored to the Pacific and ventured into real-time integration of policy and demonstration work on the ground and yielded successful results. It has shared successive failures as well, in a bid to promote a more effective and efficient way of implementing better adaptation projects that benefit village and island communities in the long run.

The following are some of the key PACC project lessons summarized with the view to share each of these country practices or procedures that are accepted or prescribed as being correct or most effective (i.e., best practices).[26]

[26] Lessons from each of the 14 Pacific Island countries are available at www.sprep.org/pacc/publications.

Cook Islands

Projects such as the climate proofing of coastal infrastructure should not be carried out as stand-alone efforts; they need to be part of comprehensive coastal management planning within an integrated coastal management policy, backed up by appropriate and effective legislation. Alongside the demonstration project, the PACC team has worked to develop a policy framework for coastal management on Mangaia Island. However, this also needs to be aligned with national coastal policy (which has not yet been formulated). Other requirements include appropriate governance structures that are well coordinated and that encourage wide participation of all stakeholder groups.

Micronesia

Good strategic planning and governance is essential to protect coasts and the project in Micronesia demonstrated these well. The State of Kosrae found it crucial to support the development of the Kosrae State Climate Change Act, which was endorsed in 2011. Lead the changes and amendments to Kosrae's Regulations for Development, which now require all development projects to consider the potential impacts of climate change. It looked at environmental safeguarding instruments such as the Environmental Impact Assessment Guidelines and incorporated climate risks into the procedures. Lastly, mainstreaming climate change risks into revised Kosrae Shoreline Management Plan that now provides a comprehensive strategy for building resilience of Kosrae's coastal communities and infrastructure into the future. These are examples of most effective practices of addressing climate change at the sector level plans and programmes in any country.

Fiji

For any food security project efforts farmers and farmer associations should be involved as much as possible. On-farm research, such as was carried out by the project, is the best approach for transferring any new methodology or practice. Further, the trial is relevant to that location, rather than the research station, which negates any genotype by environment effect. Working with the farmers, right from the start of such a project also provides the opportunity to address potential problems such as the non-marketability of any introduced crops and varieties.

Marshall Islands

Technical assessments are essential for complex infrastructure projects such as the reticulation network in Majuro. The V&A process helped to identify issues with the network and possible adaptation options. From there, MWSC conducted various evaluations to assess the leakages of each storage tank and the loss of water through evaporation. The assessment of the reservoir from Fabtech later confirmed these results and evaluated the costs involved in the adaptation options. Finally, the use of a CBA provided important insight on how to maximize benefits within the given budget. These technical assessments allowed designing a tailored, relevant and effective demonstration project.

Nauru

Identify operating and maintenance needs during project design. Maintenance of water infrastructure is a major issue in Nauru. The overall state of the water network

and storage is poor. At a household level, 50 per cent of rainwater harvesting infrastructure is not properly maintained. It is important to fully consider these issues during project design: running costs; funding and operator capacity; and interest in maintaining the related infrastructure.

Niue

The PACC demonstration project in Niue exemplifies good coordination between the Government of Niue and donor partners. The strong commitment of the Government to an all-of-island approach and the flexibility of donor partners through the PACC, PACC+ and GCCA projects have contributed to the success of the project.

Individually, none of the projects would have had sufficient funds to build the moulding factory and provide the entire island with rainwater harvesting systems. With the original PACC funding alone, the project would only have been able to cater for about 20 per cent of the island's households, without the development of a permanent facility on island.

Palau

Sustainable farming systems that maintain soil health, use water efficiently, respect and promote biodiversity and produce good yields under current climate variability are a vital base for building climate-resilient food production systems. As part of the drive to increase local food production, reduce reliance on imported foods and address the non-communicable disease crisis, Palau promoted growing and eating local foods. The food processing component trained many stakeholders in local food processing and cooking, mostly with young people and 80 per cent of participants are women. Sixty new recipes have also been developed, substituting locally grown ingredients instead of imported ingredients. 'No regrets' adaptation measures include sustainable farming methods, climate-resilient crops and training in food processing and preservation.

Papua New Guinea

In most isolated communities, low-tech, low-cost irrigation system which the farmers can easily set up and manage is a sustainable activity. This is because it utilizes local materials that are available locally and can be sourced with incurring costs to be bought from distant urban areas. The community of Kivori in Papua New Guinea is one of those isolated communities located about five hours' drive west of the capital. It has no electricity, no piped water and poor road infrastructures with no bridges. Thus establishing supporting institution at the local level such as the Kivori Cooperative Society assists in ensuring the low-tech low-cost irrigation systems are functioning. They also help to support farmers to address challenges, expand and reach new markets.

Samoa

Sea level rise, storms, high waves and high tides are already damaging fragile and often densely populated coastal zones. With the added threat of climate change, measures are urgently needed to protect and manage the coasts. These must take into account the natural systems, environmental change and people's needs. A key

lesson from the Samoa project is the importance of careful and thorough planning in the early stages of adaptation projects and the use of tools such as V&A assessment, socio-economic assessment and cost-benefit analysis to identify and evaluate all options in order to select the most appropriate one. Another lesson is that 'hard' adaptation measures need to be designed based on a detailed understanding of the surrounding coastal and watershed environment and flood conveyance routes. This should include coastal and flood risk modelling and climate and sea level projections. A third lesson is the need for awareness raising among decision makers, including communities, of climate change and its impacts, and especially the range of measures available to reduce vulnerability. When decision makers understand the climate risk and the options to reduce the risk, they will make informed and better decisions.

Solomon Islands

In terms of mainstreaming climate change into national development plans, the project sought country-wide consultations that saw public and province consultations all the way down to community meetings. In soliciting views of what goes into and form the national climate change policy. The PACC was instrumental in drafting and then endorsement (in June 2012) of the national Climate Change Policy, which is now being implemented. One of those implementations targeted the hard to reach, isolated atoll islands of Solomon Islands. Implementing food security to respond to impacts of climate change in these atolls, the PACC successfully developed demonstrations of the recommended permaculture systems. The systems are designed to be low-maintenance and high-yield, and incorporate good management practices to restore soil health while producing good yields of diverse food crops. And also set up a hybrid solar dryer in Honiara to demonstrate preservation of food by this method, which can then be shipped to atoll communities in times of need. Training in processing and preservation has been carried out, with a focus on women's groups. These practices have proven effective in Solomon Islands and are encouraged for similar isolated islands of the Pacific.

Tonga

The project team found that it is not easy to regulate common resources used by everyone, i.e. water in this case. People fear that their use will be restricted. The team addressed this by raising awareness of good water resources management, for fair use and sustainability, as provided by the national Water Policy.

The lessons learned workshop was an extremely useful exercise for the project team. Bringing together diverse project stakeholders, it provided the opportunity to have open and honest discussions on what had worked and what could have been done better or differently. The lessons learned workshop is recommended as a best practice for similar projects.

The use of renewable energy for pumping (solar pumps) to lower operating costs, decrease dependency on carbon-producing fossil fuel (diesel) and to minimise

pollution of groundwater has been a success in the new water system. Even though the capital cost of solar technology is expensive, the benefits outweighs the cost and the technology will pay for itself in approximately three years.

Tokelau

In the particular context of Tokelau, with three isolated atoll islands and the project coordinator based in Samoa, effective communication and coordination is vital. One of the main lessons learned from the project is that definition of roles and responsibilities at national and village level need to be very explicit from the start of the project. With three projects running in three islands and only one ship every fortnight to provide necessary supplies, coordination mechanisms also need to be explicit and well understood by all project stakeholders.

For example, various materials needed to be shipped to the islands and most of the delays were due to delays in delivery of the materials. Better coordination between villages and national departments such as the OCOG, Transport and Health would have improved the likelihood of the correct material arriving in the right amount and on time.

Tuvalu

Comprehensive planning can deliver great outcomes. It can be argued that the construction of a cistern is a relatively easy task compared to other PACC water projects, however the PACC project Tuvalu has been very successful in identifying gaps in knowledge and necessary steps to implement its demonstration project. The project successfully identified one of the most vulnerable communities, selected a sustainable and efficient solution within the PACC budget and used informal community leadership to implement and manage the adaptation measure. Tuvalu's demonstration project is a good example of how comprehensive planning and proactive management can successfully deliver outcomes.

Vanuatu

Climate analysis is a key step in the early planning stages of climate-sensitive projects, alongside other essential assessments such as socio-economic assessment and cost-benefit analysis. Vanuatu demonstrated how to do this for coastal zone management projects, within a V&A assessment framework. In particular, engaging communities in owning the project outcomes and results through the training, hands-on participation and use of the three-dimensional participatory mapping tool. The key objective is to help everyone with different levels of understanding to be on the same level of appreciation of their island or community environment. It therefore helps in decision making. As a result, a 39 km stretch of road was selected for improvements and work is underway. The road improvement strategies are based on the results of the community mapping exercise, a V&A assessment and an environmental impact assessment. The design work has been completed and the communities themselves have been trained to carry out roadwork using locally available materials and with guidance and training from the PACC project team.

VII. Emergencies, Risks and Responses within the Context of Climate Change Adaptation.

NAILYA MUSTAEVA AND RUSTAM ARSTANOV[27]

Background

This chapter describes how climate change affects the risks of natural disasters and emergencies and which efforts are being undertaken by countries to adapt to climate change in terms of disaster risk reduction (DRR) activities.

It is known that the key climate factors, which impact the Central Asian region is increase of air temperature, fluctuation in atmospheric precipitation and change in permafrost. According to IPCC (2007), the temperature would rise by 1.4°C by 2030 and by 2.5°C by 2050. These drivers will most likely exacerbate the aridity of the region and increase a risk of climate-induced disasters.

Intensification of aridity increases a risk of disasters in the form of droughts and dust storms, while fluctuations in precipitation and melting of glaciers increases a risk of water-borne disasters, like mudflows and floods. It is known that all countries of Central Asia will observe different climate risks in both the short and long term. For example, droughts will likely impact most downstream countries, while rapid snow and glacier melting will cause flash floods and mudflows in mountain countries like Tajikistan and Kyrgyzstan in the near future. The long-term perspective foresees a deficit of water resources and will have a critical impact on socio-economic development in the whole region. Climate change is already affecting the national sustainable development agenda of countries and inhibits economic growth. At the same time it is well known that prevention and preparedness are less costly than dealing with the response to climate induced disasters.

Lack of institutional and technical capacity and awareness about climate risks, adaptation measures and policies are the key challenges towards resilience in the most vulnerable economic sectors of Central Asia. There is a lack of awareness among governments and decision-makers in Central Asian countries on climate risks and vulnerabilities and how these may affect economically important sectors. There is also low level of understanding of CCA and is thus given little attention. Rarely are adaptation components included within strategic documents and plans of relevant government agencies. It is necessary to continue raising awareness with employees of the state agencies at the various levels (national, provincial, district, county) about the emerging and critical issue of CCA and integrating adaptation processes into state planning and budgeting.

[27] Ms. Nailya Mustaeva and Mr. Rustam Arstanov are affiliated with the Regional Environmental Centre for Central Asia (CAREC).

This chapter aims to reveal the major changes that have taken place in Central Asia during the recent past with regards to:

- Policy, strategic planning and institutional development in the light of CCA at the regional and national levels;
- Awareness raising among the public and decision-makers, trainings and involvement of target groups in the adaptation activities through disaster risk reduction; and
- Development and application of adaptation technologies in economic sectors that are vulnerable to climate risks.

Temperature

In Central Asia, the sectors that are most vulnerable to climate change and where adaptation measures are deemed urgent are agriculture, water and preparedness for natural disasters. Significant budgetary supports are now needed in order to build resilience for these economically important sectors. Weak awareness of decision makers and government employees at various levels as well as lack of relatively easy-to-use methodologies to calculate the loss and damage from the climate risks makes the inclusion of adaptation measures and strategies to the agenda of the relevant agencies necessary (RoKMoEP 2009; Centre of Hydrometeorological Service 2009; State Agency for Hydrometeorology 2008; Turkmenistan MoNP 2010; UNDP 2009).

Improved science observations in the field have led to a better understanding and increased awareness about the climate risks that are faced. According to instrumental observations, which have been collected in Central Asia starting from 19th century, the main consequence of the climate change in the region is a ground air temperature increase.

For example, average temperature has risen in Kazakhstan by 0.26°C every 10 years between 1936 and 2005. According to data from the hydro-meteorological agency that were published in the annual bulletin 2012 it is mentioned that in 2012 Kazakhstan was ninth out of 10 countries with the hottest years starting from 1850 (Kazakhstan 2012).

Twenty-six hydro-meteorological stations are also conducting systematic observations in Kyrgyzstan with two locations in Naryn and Bishkek, contributing to the Global Climate Observation System. Kyrgyzhydromet has observation data, collected for over 70 years targeting air temperature, precipitations and river flows. The average temperature increase trend in Kyrgyzstan is 0.78°C during the last 100 years (UNDP 2009).

Between 1961 and1990, there was an increase in the average air temperature (of up to 1.2°C) observed in the vast valleys of Tajikistan, where the most of the country's population is living (State Agency for Hydrometeorology 2008). This trajectory has also been noticed in Turkmenistan. Roughly every 10 years the temperature has risen in Turkmenistan by 0.18°C according to observations for the period from 1961 to 1995 (MoNP of Turkmenistan 2010). In Uzbekistan, the average statistically

significant increase in temperature is 0.29°C every 10 years according to the 1950 to 2005 observations (Centre of Hydrometeorological Service 2009).

Precipitation

In many parts of Central Asia the patterns of precipitations are also changing. The overall trend is an insignificant decrease in annual precipitation quantities. The region has experienced a redistribution of rainfall and uneven pattern of seasonal quantities of precipitation. In winter, the quantity of rainfall is increasing thus resulting in poor accumulation of moisture in soil. Heavy rains followed by periods of drought cause soil erosion. Also heavy rains in the summer periods do not contribute to accumulation of soil moisture, as the soil cannot quickly absorb moisture because of rapid evaporation of water from the surface due to high air temperature.

A visible and immediate climatic risk is associated with warming that leads to increased melting of glaciers. It is forecasted that due to degradation of mountain glaciers the water flow in dry and wet years shall decrease and increase, respectively (by 25.4–27.9 per cent and 31.4–42.4 per cent) (State Agency for Hydrometeorology 2008). The annual distribution of stream flow shall also significantly change. The runoff for July, August, September shall decrease by two times, yet for April, May and June it is expected to increase (almost by 2 times as well).

The Central Asian countries are at the same time suffering from the consequences of drought conditions. For example, in Kazakhstan, the average annual droughts duration periods have risen from 56 days during the period between 1925 and1954 to more than 90 days during recent years (UNDP 2008). The severe drought in 2000 in Tajikistan affected 3 million people (half of the country's population at that time), risking the food security and development (World Bank 2013).

According to the conclusions of the Intergovernmental Panel on Climate Change, the vulnerability of Central Asia to climate change will increase (IPCC 2007). For Asian developing countries, climate change will impede sustainable development due to the negative impact on natural resources, the environment and, in general, the economies of countries.

Adaptation to climate change in Central Asia: Regional review

In 2013 many countries in Central Asia prepared for their Third National Communication (TNC) to the UNFCCC secretariat. Information was collected in the field of climate change related to education, relevant agencies employees training and the technology. On 29 November 2013 the final draft of the TNC for Kazakhstan was presented at the final seminar in Astana. The draft included the potential consequences of climate change in relation to the natural resources, national economy and the public health, as well as the development of adaptation practices and awareness raising.

The TNC for Uzbekistan will become the basis of the National Program on Climate Change and the basis for the development of further policies and the activities.

Climate change is having dramatic impacts on various areas of the economies of Central Asian countries. The following synopsis outlines some of this impact in key economic sectors.

Agriculture

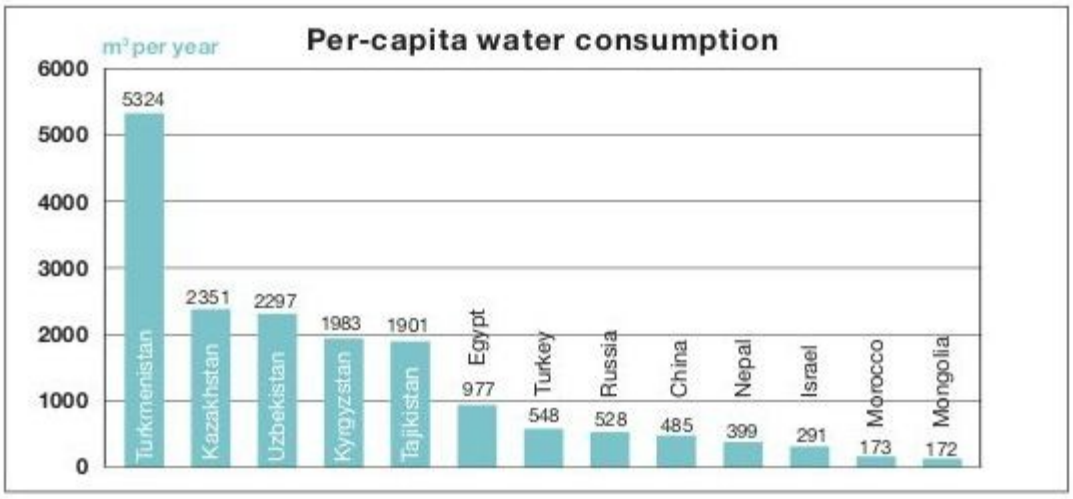
In all five countries of Central Asia, deforestation, mountains slopes erosion and the agriculture lands and pasture lands degradation is being observed. In Kazakhstan, the third of the countries' agricultural lands are degraded or are under serious threat. More than 10 million ha of potentially arable land is currently abandoned. Productivity of wheat is still very low in comparison to other countries. Currently the economic losses due to low land productivity are approximately $1.5 billion annually. This leads to negative social consequences particularly in agricultural regions where 30–45 per cent of the population are employed in the agricultural sector (Granit 2010). Continuous dry periods combined with the extremely high spring and summer air temperatures may increase the risk of desertification and significantly impact the economic stability. For example, the drought of 2001–2002 caused a critical drop in crop yields by 30–40 per cent in most dry farming areas of Tajikistan (Oxfam 2009). The drought of 2008, which was followed by a compound crisis, led to the decline of agricultural crops by 40 per cent (IWPR 2008).

In Kyrgyzstan it is forecasted that due to the reduction in humidity and the enlargement of the arid areas of deserts and semi-deserts – by 15 per cent in 2000 and between 23.3 per cent to 49.7 per cent in 2100 – the size and the productivity of the pastures of the Inner Tyan Shan will be dramatically reduced (UNDP 2009).

Water

Countries of Central Asia experience a marked water deficit, yet have very high per capita water consumption compared to Asia. Non-uniform distribution of water resources and unsustainable use (refer to Graph 1 below) leads to the lack of water in irrigated agriculture.

Graph 1. Per capita water consumption



Source: Data derived from http://waterunites-ca.org/book.html.

With a 1°C air temperature increase, the evaporation intensity increases by 16 per cent, even without taking into account a reduction in precipitation. This will be accompanied by the reduction in water resources. In Kazakhstan, it is forecasted that the water resources deficit will reach 12.9 billion m^3 by the year 2030. Capital expenditures to close this gap will reach $5 billion–$10 billion (Kazakhstan 2009). In Kyrgyzstan it is forecast that the surface water amount will increase from 2020 to 2025 due to water from melting glaciers (UNDP 2009). However by the year 2100 this amount will decrease by 43.6–88.4 per cent from the level of the year 2000. In Tajikistan, due to temperature increases it is forecast that irrigation requirements in agriculture will rise by 20–30 per cent and in Uzbekistan by 5–10 per cent in the year 2030 (Turkmenistan MoNP 2010; State Agency for Hydrometeorology 2008).

One of the major problems in Central Asia is a problem of water usage and water distribution. The water security under the conditions of limited accessibility and vulnerability of water resources related to climate change is already a component of national security in each country of Central Asia.

The majority of water volume resources in Central Asia are in Tajikistan and Kyrgyzstan. In Kazakhstan, water is a contentious issue as only 56 per cent of water resources are formed within the state and the rest is derived from trans-boundary waters formed in China, Kyrgyzstan, Russia and Uzbekistan. Kazakhstan already faces the deficit of water resources and by the year 2040 may face shortages. Currently two out of eight water basins (Aral-Syrdaria and Nura-Sarysu) indicate the lack of water and by the year 2030, six out of eight basins can face similar problems. In dealing with the problem of water deficit, a basin-based water management approach is very effective. Basin water management is being implemented in Kazakhstan and Kyrgyzstan whereas Tajikistan has developed the statutory legal documents for its implementation (UNDP 2011).

Natural disasters

Most natural disasters in Central Asia mainly relate to water bodies. These natural disasters include floods, landslides, damage to dams and other water facilities and mudflows. Annually, around two hundred ice lakes are being formed in the mountains adjacent to such major cities as Almaty and Bishkek, in the surroundings of the Issyk Kul lake and in the mountains of Pamir and Gissaro-Alai.

According to the *Kazselezaschita*,[28] mudflows pose a threat to 160 inhabited areas in Kazakhstan and up to 6000 pieces of economically valuable infrastructure. During less than a hundred years about 1000 mudflows were registered in Kazakhstan alone. Many of them were qualified as natural disasters accompanied by human fatalities. Considering a 2°C–3°C temperature increase scenario, the acreage of water collecting soil will significantly increase and thus the land surface in many areas could become a source of potential mudflows (UNDP 2011).

[28] Agency within the Ministry of Emergency Situations responsible for mudflow protection.

In comparison to the twentieth century during which rain-triggered mudflows happened once in hundred years, from now on the risk of such events may be faced annually. Currently in Kazakhstan there are 77 flood protection facilities priced at $40 million including 21 dams with the capacity of 63.5 million m^3, 25 embankments and shoreline protection structures with a length of 26 km and 31 stabilization channels with a length of 22.4 km. The available risk assessment files should be reviewed to understand whether such infrastructure is currently adequate in response to major threats. All DRR activities must be supported by effective forecasting and long-term forecasts should be included in regional development plans.

Natural disasters in Tajikistan, except earthquake, mainly relate to meteoclimatic conditions that trigger landslides, mudflows and rock fall events. The analysis implemented by the Committee for Emergencies of Tajikistan for the period from 1996 to 2010 showed that extreme weather events were the reason for 40 per cent of natural emergencies. At the same time mudflow events, are mainly triggered by heavy rains.

The World Bank indicated that four countries of the region are the most vulnerable to natural disasters among 28 States of Europe, Caucasus and Central Asia. The average annual economic loss to Kyrgyzstan from natural disasters that was calculated according to a climate risks evaluation is more than $27 million, which is currently the equivalent of 1.1 per cent of GDP (World Bank 2009). According to data from the Kyrgyzstan Ministry of Emergency Situations (MES), DRR and recovery is budgeted only for $6 million.

Health and health care

The effect of climate change on the health of the population in Central Asia was a subject of the WHO study. Major health related disasters triggered by the scarcity of water include epidemics, diseases related to bad water quality, transmissible diseases including malaria, yellow fever and encephalitis (WHO 2010).

The preparedness to the Natural Disasters in health care should be built around the following factors:

- Prevention of transmissible diseases, injuries and fatalities related to extreme weather, strengthening the system of early warning in Kazakhstan;
- Energy efficiency in hospitals and the installation of the alternative energy sources in Kyrgyzstan;
- Water related diseases prevention and injuries and fatalities related to extreme weather in Tajikistan;
- Dust storms warning systems, prevention of respiration system illnesses and provision of adequate nutrition in Uzbekistan

Emergencies and preparedness: Progress and success stories

In the countries of Central Asia there is still not enough appropriate attention paid to adaptation for natural events focusing mainly on response rather than mitigation. However positive trends in shifting from response efforts to investments in mitigation

are also observed. This section describes several institutional activities that were implemented on a regional scale.

Taking into consideration the interconnectedness of the ecosystems in Central Asia and also the specificities of the risks of natural emergencies that cannot be dealt with by only one single country but require cooperative action, Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan in 1997 concluded an “Agreement on cooperation in the field of preparedness to and mitigation of emergencies” that remains in force today.

In 2011 the governments of France, Belarus, Kazakhstan and Kyrgyzstan have ratified agreements on civil defense, preparedness and response to emergencies. These agreements stipulate the implementation of activities on development of infrastructure for dealing with seasonal natural events and their inclusion into regional development programmes and strategic plans. Such events include snowstorms, extreme frost, overbank flooding and large floods, mudflows, landslides and avalanches.

Positive examples of regional cooperation on DRR is on trans-boundary water courses, where expert groups under the special Kazakhstan-Kyrgyzstan Commission worked on the water management of the Chu and Talas rivers. It was agreed that for the integrated and sustainable use of water resources Kazakhstan will invest about $20 million annually to maintain water facilities in Kyrgyzstan. This model became an instrument for downstream countries to participate in the management of dams and other water facilities in the upstream countries (Kazakhstan 2013).

All five countries of Central Asia have developed National Strategies on disasters risk reduction. All countries of the region are also signatories to the Hyogo Framework for Action (HFA) [29] as well as the United Nations Programme on DRR for the period from 2005 to 2015. In Kyrgyzstan the project “Views from the frontline” is being conducted to control the implementation of the five HFA priorities:

- Making DRR a policy priority, institutional strengthening;
- Risk assessment and early warning systems;
- Education, information and public awareness;
- Reducing underlying risk factors; and
- Preparedness for effective response.

The regional initiative on disaster risk management in Central Asia and Caucasus was initiated together with the UN International Strategy on Poverty Reduction and Global Framework for Disaster Risk Reduction. The activities of this initiative in the countries of Central Asia mainly focus on the strengthening of the hydro-meteorological services, coordination of actions on emergency response, financing the loss compensation and reconstruction and recovery of the damaged facilities and infrastructure.

[29] Building the Resilience of Nations and Communities to Disasters was initiated at the World Conference for Disaster Risk Reduction and was designed allowing participation of multiple interested parties in the development of national strategies on DRR.

One of the factors that hamper adaptation is a lack of the methodologies on socio-economic valuation of the climate change consequences, including loss and damage, and the lack of data, such as maps, statistical data and calculations that would allow defining the most vulnerable geographical areas where the main investments should be directed. Lack of risk assessment and the assessment of the economic loss makes it hard to develop financial plans that would be included into the adaptation policies and practices. The inter-agency and regional integration is necessary in order to develop methodologies and approaches, and synchronize terminology and measuring units.

In 2013, MES prepared an analytical review on natural emergencies occurring in Kazakhstan in 2012 and during the first 10 months of 2013. According to the review, despite the risk reduction measures undertaken natural disasters in 2012 amounted to 3,115 cases (15.5 per cent of total amount of emergencies). Compared to the same period in 2011, the number of natural emergencies decreased by 156 cases or 4.8 per cent. During the reporting period there were 39 hydro meteorological emergencies compared to 43 events in 2011. During 10 months of 2013, there were 2,115 natural disasters (16 per cent of total number of disasters) and 31 hydro meteorological emergencies have occurred (Kazakhstan, MES 2013).

According to “Kazselezaschita” 60 per cent of water facilities have issues and it is recognized that this increases the risks of natural disasters related to climate change. During the implementation of the Kazakhstan Transition to Sustainable Development 2007–2024, high-risk areas and zones are being monitored. National and regional catalogues of natural and anthropogenic disaster threats and datasheets were developed and approved showing facilities located in the high risk areas in Kazakhstan that are vulnerable to mudslides, avalanches, landslides and floods. This allows for determining the risk of emergency situations and evaluating the consequences and responses to emergencies. Natural disasters datasheets were also developed for the major regions of Kazakhstan and, in particular, for the cities of Almaty and Astana.

Box 1. Reducing a flood risk for 400,000 people of Kazakhstan

The construction of the flood control compensating reservoir on the Syrdaria river reduced flood risk for 71 villages and towns in Yuzhno-Kazakhstanskaya and Kzyl-Ordinskaya, populated by 400,000 people. The reservoir technical capacity is 3 km3 and the output capacity is 1,800 cubic metres per second. The dam length is 44.7 km and its maximum height is around 12 m. The project was implemented as part of the Accelerated Industrial Innovative Development Program 2010–2014. The cost of construction was KZT48,331,899 or about $312,000. Construction began in June 2008 and finished in December 2011. The project is a positive example of DRR in Kazakhstan.

Source: Baimoldayev 2011.

In 2013 the legislation was amended in a way that from now on the heads of the administrative units (region, province, district, village etc.) bear the mandate of the natural disasters Commission head. The transfer of the responsibility to the local

level and the training of the heads of the relevant agencies in the MoE's training centres will result in the strengthening of preparedness and effective response to natural emergencies.

In August of 2013, the Kazakhstan Ministry of Emergencies made a "Shared Agreement on Natural and Anthropogenic disasters warning systems by means of SMS messages." This agreement was concluded with the major mobile operators, and applies to the entire country.

In Kazakhstan the development of the national platform in the format of multi-agency structures including the private sector, NGOs and civil society, will allow DRR to be integrated into various sectors for achieving the sustainable development in the frames of the Sustainable Development Goals, sustainable development strategies and poverty alleviation among other aims.

In Kyrgyzstan, the issues of climate change mitigation and adaptation are included into the mandate of the National Committee on Climate Change Consequences, which is also responsible for the Clean Development Mechanism. The committee (created by presidential Decree in 2005) is an inter-agency body that unites all key partners in the country. For the effective functioning of the committee relevant legal documents that describe the project selection criteria and approval procedures were developed. The National Platform for Disaster Risk Reduction was also created in Kyrgyzstan in 2011 providing coordination on priorities for DRR. The National Platform Secretariat was organized and technical working groups on education, awareness raising and capacity building were also created (e.g. Civil Defense working group).

In order to identify and reduce the disaster risk factors during 6 months of 2013 the specialists of the Monitoring Department in the MES analysed 1,030 natural processes that could lead to disasters in Kyrgyzstan. According to the results of the study 623 facilities were in need of urgent maintenance works as well as design and survey activities are required. For the construction of the new defense facilities and embankments the programme of emergency preparedness activities was developed and included 101 facilities. Government requested the MES to fortify 4 embankments on the river Chu in Chuyskaya oblast, with an estimated cost of $1 million.

In the course of implementation of the Program of Capacity Building and Development of the MES Agency on Hydrometeorology for 2011–2015 and the World Bank Project "The modernization of the hydro-meteorological service in Central Asia" the hydro-meteorological monitoring system in the country is being upgraded. 25 per cent of stations received improved hydrometry aerial ferries and conventional and digital gauging equipment was installed.

In the villages of Shabyn and Shankol in the Osh oblast, due to the joint project between MES and the United Nations Development Programme (UNDP), the shoreline of Shankolsai River and the associated channel were fortified. Two river dams with the length of 80 m and 60 m were constructed and associated waterworks

was repaired. This project resulted in the mudflow risk reduction for the inhabitants of the downstream villages.

There are too few examples of involving local population into the DRR activities on the permanent basis. However, in cooperation with the Swiss Development and Cooperation Agency together with Swiss Association “Pamir Bridges” the project “Reconstruction of mountain bridges” was implemented. Inhabitants of local villages received training and are still engaged with the regular maintenance of mountainous bridges and roads that connect people with vital resources in the mountains.

Other successful example is the project “Disaster Risk Reduction in the forests of the IssykKul oblast” implemented in 2010–2011. It was dedicated to the strengthening of the eroded slopes to reduce the risk of landslides. The chosen methodology was the planting of the local species of fast-growing trees and the enlargement of the forests area. Due to the grant from the World Food Programme and well-coordinated actions of the relevant stakeholders (local dwellers, local governments, forest service) 357,520 coniferous, leaf-bearing and horticulture trees were planted on the area of 128 ha. In addition, forest nurseries were found on area of 1.8 ha that would allow 360,000 of trees to grow annually.

In the training centre for civil defense specialists under the MoE of the Kyrgyz Republic the scientific conference “Providing integrated safety of people and land from natural disasters” was conducted. In November 2013, the local level policymakers and the civil defense officers in the city of Nookat, Osh region and the village of Suzak, Zhalal Abad region went through the training on practical testing of the “Guideline on the valuation of the loss and damage from natural disaster in Kyrgyzstan.

In Tajikistan, at the organizational level, the Committee on Emergency Situations and Civil Defense is the lead agency on DRR. Their mandate and activities are dictated by four main laws. Because none of these laws mentions climate change or CCA, the Committee cannot request funding to work directly on these issues (e.g., offering civil defense training related to climate threats or establishing an emergency response plan for extreme heat or cold) even though the agency has experience with climate risks and risk management and these areas directly relate to adaptive capacity. While the committee has educational facilities and officers in the field, low salaries and hazardous working conditions have resulted in high turnover.

One of the best examples of institutional coordination and collaboration to deal with disaster risks is the REACT platform, which has been established in Tajikistan (box 2).

The National Strategy of Turkmenistan on Climate Change, which ensures priority for development of high-tech industries and creation of conditions for the development of clean production, was adopted in June 2012. Among the identified priorities of the Strategy are the following projects: construction of new reservoirs on the rivers across the regions; construction of hydraulic structures designed to catch mud water;

improvement of carriage capacity of the Karakum Channel and the introduction of water-saving technologies. The policy pursued by Turkmenistan is based on the main priorities covering environmental protection; sustainable use of natural resources; introduction of "green" technologies; and the provision of environmental well-being, has prepared the country to review and analyses existing and potential future priority practices to adapt to climate change (UNDP ALM 2013).

Box 2: REACT as a good coordination platform to respond to disaster risks

The Rapid Emergency Assessment and Coordination Team (REACT) was established in 2001 jointly by UN Agencies, international organizations and national counterparts in order to strengthen the disaster management partnership in Tajikistan. The key objective of REACT is to promote the information exchange and assure coordination among different partners, dealing with disaster risk management issues in Tajikistan. Other tasks of REACT include:

i. Promoting effective risk reduction, disaster preparedness and disaster response;
ii. Support coordination and collaboration of humanitarian actors, international organizations and the Government of Tajikistan;
iii. Provide a platform for collaborative planning of risk reduction, response and recovery activities;
iv. Provide a platform for the transparent exchange of information and learning on DRR, preparedness, response and recovery operations;
v. Provide a forum for the open discussion of policy and practical issues related to the purpose of REACT.

The REACT team, chaired by the Committee of Emergency Situations under the Government of Tajikistan, involves over 50 governmental and international organizations to regularly coordinate the efforts on disaster risk management, including preparedness, response, mitigation and capacity-building. During emergency situations the partnership works closely together, coordinating response and assistance. REACT is very well positioned in the country and has its teams in seven sub-regions, including Dushanbe, Sugd, Zeravshan, Rasht, Kurgan-Tyube, Kulyab and GBAO.

Note: More details about REACT and its terms of references are available at http://www.untj.net/index.php?option=com_phocadownload&view=category&id=129:react-strategic-documents&Itemid=746&lang=en.

At the sixty-seventh session of the United Nations General Assembly, Turkmenistan proposed several initiatives on environmental issues, climate change, water management and combating desertification. As a practical step in the development of a dialogue, and following the provisions of the Final Document of Rio+20, Turkmenistan proposed to hold the Ashgabat International Conference "Green Economy for the twenty-first century: the national experience and international partnership".

Turkmenistan maintains active cooperation with the Interstate Commission for Water Coordination, the Interstate Commission for Sustainable Development and the International Fund for Saving the Aral Sea. Under such collaboration jointly with the countries of Central Asia, Turkmenistan conduct activity in many fields, including the issues related to climate change. The main chapters of the National strategy on

climate change, approved by the Presidential Decree dated 15 June 2012 are as follows: “The main directions and sectors to mitigate climate change”; “The main directions and sectors to adapt to climate change”. The National Forest Programme, the National Action Plan on Climate Change Adaptation and the National Action Plan on climate change mitigation shall be designed to implement the Strategy.

In practice, many DRR activities relate to agriculture and afforestation. The major threat to agriculture and people in Turkmenistan are dust storms. The increase in intensity of winds due to climate change leads to the formation of sand dunes, sometimes with a height of up to 15 m. This threatens many villages and agriculture fields. The Government of Turkmenistan has created the *GyokGushak* (Green Belt) joint stock company, which is implementing activities on sand fixation by means of tree planting. The technology consists of building the protective cells in the dunes and planting in them saksaul (Haloxylon Bge) and other indigenous desert plants. The artificial forests were also planted in the high slopes in order to reduce the risk of landslides.

A Bilateral Framework Agreement on “Technical and financial cooperation and humanitarian assistance” between Uzbekistan and Swiss Confederation consists of 2 bilateral and 10 regional projects in the field of water supply and sanitation, water resources management and management prevention natural disasters actions for the of. One of the current projects aimed at the creation of the Central Asian Regional Information Base for Water Resources.

The international workshop on strategies for adaptation agriculture and food security sectors to climate change in Central Asia and South Caucasus has held in Tashkent during 22–24 October 2012. The event has been arranged by the regional programme of the International Center for Agricultural Research in the Dry Areas for Central Asia and the Caucasus; the Association of Research Organizations in Central Asia; and the Caucasus and the World Meteorological Organization. The decision of the seminar stressed the need to draw out an integrated strategy for adaptation to climate change, which would bind public administration, education and health care. It also urges on the necessity to design national and international adaptation strategies for the sustainable development of agriculture under changing climate.

The Government of Uzbekistan has started the work on crops diversification: it reduced area under cotton and increased the area under wheat, thus ensuring to successfully solve the problem of food security.

Currently German scientists work together with Uzbekistan partners on implementing constant glaciers monitoring specifically in the high difficult to access areas. In several areas stations equipped with satellite transmitters are installed. This gives a possibility to measure the possible changes in water quantity in large trans-boundary rivers and predict possible disasters.

Thus, currently the Climate Risk Management and Disaster Risk Reduction are not particularly stressed and integrated into the national and regional strategies and long term development plans, especially in areas particularly vulnerable to climate change.

All mentioned above shows the necessity for representatives of the relevant state agencies, decision makers in the economic sectors particularly vulnerable to climate change, local communities, NGOs, business and academia, to search for and implement DRR activities and develop preparedness for natural disasters at different levels of society. It is important to contribute to more active coordination between all parties involved into DRR in Central Asia.

It is also necessary for countries to implement inter-agency and regional coordination in order to improve the system of climate change related disaster preparedness and response. It is necessary to plan and implement adaptation activities together by means of climate risks management, capacity building and awareness rising activities.

One of the ways to enhance adaptation to climate change is to reduce the vulnerability of economy and population by means of information sharing, awareness rising and improving the standards of education, as well as strengthening the civil society and supporting adaptation technologies at all levels.

Four countries: Kazakhstan, Kyrgyzstan, Uzbekistan and Tajikistan participated in the project “Adaptation to climate change through sustainable management of natural resources and trans-boundary cooperation for disaster risk reduction in Central Asia.” This project was implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) from 2011 to 2013. The project activity resulted in the creation of the inter-agency working group in Kazakhstan which included lead experts representing relevant state agencies, academia and scientists and working in the field of management, monitoring and DRR in water sector. The main target of the group is to develop recommendations to the policymakers on the watershed monitoring of the Syrdaria river basin and water resource management in view of climate change, natural disasters and geo-meteorological risks. During six meetings in 2013, the representatives of Kyrgyzstan, Tajikistan and Uzbekistan studied the experience of Kazakhstan. They will implement the inter-agency working group in their respective countries to help improve information exchange, simplify the negotiation process regarding international agreements and monitor implementation.

World Bank Office in Central Asia organized the First Central Asian climate knowledge Forum on 18–19 June 2013 in Almaty. More than 100 people participated in the forum including representatives of the state agencies from all 5 countries, universities, civil society groups, donor community and the World Bank experts. The Forum was another possibility for Central Asian states to exchange experience and try solving common issues for capacity building on the national level and regional cooperation.

CAREC has developed a report entitled “Technology Needs Assessment for Adaptation in the Water and Agricultural Sector in Central Asia”. The report stated that adaptation measures shall mainly emphasize using water efficient technologies and strengthening the sustainability of irrigated agriculture. The following measures that also relate to disaster preparedness are recommended:

- Afforestation and forest restoration that would contribute to the snow retention function of the ecosystems;
- Adoption of micro-irrigation technologies;
- Construction of necessary infrastructure to access ground water;
- Reconstruction of the irrigation and water supply and water storage systems;
- Support to breeding programmes for development of drought-tolerant crop varieties;
- Introduction of advanced farming technologies (soil protecting and moisture conservation technologies);
- Crop diversification and rotation;
- Adjustment of water releases from the region`s hydroelectric dams to the needs of the irrigation;
- Develop modern systems for early warning and prevention of natural and temperature anomalies, daily and seasonal weather forecasts; and
- Promote breeding programmes to diversify crop and cattle varieties and develop varieties and species resistant to the expected alterations in climatic conditions (CAREC 2012).

Coordination and cooperation between countries should allow the transfer of the lessons learned and the best practices from the national to the regional level. As regards the practical activities in Tajikistan it is worth mentioning the saksaul (Haloxylon Bge.) planting in the “Tigrovaya Balka” reserve. During the last three years in order to restore natural desert ecosystems and protect downstream areas from the landslides 150 ha of saksaul were planted.

In Turkmenistan, the inhabitants of local communities within three agro-ecological regions (Karakum, desert; Nokhur, mountains; and Sakar-chaga, Mary Velayat oasis), have received the new knowledge and experience in adaptation to climate change and discussed how climate change affects water resources. This was a topic of the series of seminars organized by UNDP from 21 June to 17 July 2013.

DRR in Central Asia may be evaluated in terms of social, economic and environmental effectiveness. In its previous report “Trends in climate change adaptation in Central Asia” CAREC evaluated the priority adaptation measures as shown in the table 1.

Table 1. Priority adaptation in disaster risk management

Priority adaptation practices	Effectiveness			Countries, Donors
	Social	Economic	Environment	
1. Raising awareness of disaster risk management at the local level March – November, 2007	The following facilities were protected against flooding due to the built dams planted trees: apricot orchard, land plot of 58 ha; 104 ha of agricultural land, 870 houses, district power supply plant, two secondary schools, canals.	Six dams of gabions were built. In addition to that plantation of trees was arranged on the area behind the dams to strengthen their protective capacity. Such practices have been published [19] and the proposed methodology can be used in the mountainous areas of Kazakhstan.	Annual mudslide threatens the village. Landslide which stretching several kilometres in length destroys irrigation canal, causes the erosion of the river banks, threatens rural buildings and facilities.	Kyrgyzstan, Batken rayon, Zhanybak village; Swiss Agency for Development and Cooperation (SDC); CAMP Alatoo
2. Flood management at the community level 18 May 2009 – 31 August 2012	Technological technical, infrastructural, educational and behavioural approaches.	Preparation of the Master Plan. Effective mechanisms for ecosystem restoration and tugai-floodplain vegetation of Khatlon region.	Flood protection by forests; restoration of natural ecosystems to strengthen the river banks and to protect residential areas against flooding.	Tajikistan, CAREC, Dushanbe, Asian Development Bank

Source: CAREC, 2013

Coherent policies, strategies and institutional frameworks

It is worth mentioning that there is a certain improvement in understanding by the governments and relevant authorities of the urgency of actions related to mitigation and reduction of vulnerability, i.e. adaptation to climate change. Unfortunately, how the adaptation is being integrated into the state policies and action plans needs a lot of improvement.

There are significant gaps in terms of inclusion of adaptation into the state planning and raising awareness of decision makers at the various levels of its importance.

Adaptation process implementation at the country level will require the support of international organizations in terms of raising awareness of the policymakers and general population about climate change and the threats to sustainable development.

All five countries of the region: Kazakhstan, Kyrgyzstan, Turkmenistan, Tajikistan and Uzbekistan have declared the willingness to develop the 'green economy' for sustainable development and minimizing climate risks. The conventional concept of the green economy implies the provision of the economic growth of countries in response to the growing deficit of resources. International experience shows that green economy stimulates the regional development and contributes to social stability. The transition of the countries to green economy can significantly strengthen the economic potential and the well-being of countries creating the new jobs in the sectors of green economy.

For example, in Kazakhstan, the Overall National Plan has been approved through a New Strategy "Kazakhstan-2050" adopted by the Presidential Decree No. 449. The Strategy identifies state policies to be pursued on further development of the nation through the prism of a "green", environmentally friendly economy. The decree stresses the need for a fundamental rethinking of the attitude to the national nature resources. The theme of "green" economy and new forms of energy was selected for "EXPO-2017" to be held in Astana, Kazakhstan.

The sector-wise programme "Zhasyldamu (Green Development) for 2010–2014" adopted by the governmental resolution dated 4 August 2011 focuses on the application of green economy principles and ensures the decoupling of natural resource use and environmental impacts from economic growth. The inter-sectoral programme encourages a comprehensive solution to many problems, including: greenhouse gas emissions, water resources and so on. The programme shall be implemented on the cost of funding allocated from the national budget.

Agriculture

The productivity of agriculture lands is expected to increase and the degradation of the soil is expected to stop owing to efficient implementation of the 2020 agriculture development strategy, better access to finance and the involvement of foreign investors, the implementation of the water saving methods in agriculture and the expansion of greenhouse farming.

Though the natural disaster preparedness is not directly stated in the programme, the nature of its goals and objectives include climate risk management. They are reflected in Strategic Plan of the Ministry of Environmental Protection (MEP), "Green Bridge" Partnership and other cross-sector development plans. Yet, despite of the achievements mentioned above climate adaptation is not integrated into the sector specific programmes in Kazakhstan. The primary document is a National Concept on Adaptation developed in 2010. However it is not yet approved by the presidential decree. In the National Adaptation Concept the priority is given to integrated water resources management.

The policies that relate to adaptation in Kyrgyzstan include Agricultural Strategy, Concept on Environmental Safety, Forest Policy and other. The major document on adaptation, the National Climate Change Adaptation Strategy, was developed by the National Agency on Environmental Protection and Forestry supported by UNDP in October 2013.

A pilot programme for climate resilience was launched in Tajikistan in 2010. For implementation of the first phase of the programme consisting of six projects, the inter-ministerial committee chaired by the Deputy Prime Minister has been set up to ensure effective communication with a broad range of stakeholders. The country adopted National Action Plan for climate change mitigation (2003) and now is in the process of developing the national strategy on CCA, which is expected to be adopted in 2015. Priorities for adaptation projects in Tajikistan are: ecosystems; forest and land resources; water and agriculture; and energy and health.

The National Development Council meeting chaired by the President of the Republic of Tajikistan has held on 11 December 2012 to discuss the implementation process of the National Development Strategy, the Poverty Reduction Strategy for 2010–2012 and the Strategy for improving the welfare of the population of Tajikistan for 2013–2015 approved by the Government of Tajikistan. For the period 2010–2012, the growth of national economy has been sustained at the level not lower than 7 per cent. It was also stated on the implemented activity on achieving the Millennium Development Goals. Combating with poverty Tajikistan could decrease its level from 83 to 39 per cent. Tajikistan played an active role in implementing global initiatives such as “Energy for All” and “Green Economy”.

The project “Capacity Building in the management and monitoring of remote geo-hazards” launched on 18 March 2009 with the support of SDC has been targeted at building national capacity for monitoring and preventing remote natural disasters, especially sudden spill of glacial lakes.

The Programme that directly aims at expansion of climate change adaptation activity in Central Asian countries is the Central Asian Multi-country Programme on Climate Risk Management (CA-CRM, 2010–2013) implementing by UNDP. The programme helps the five Central Asian countries to adapt their national development processes to the risks associated issues caused by current climate variability and seeks to strengthen climate-related natural disasters risks reduction and adaptive capacity as well as conducting preparatory measures at early stage. The Programme was undertaken in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Gaps and challenges yet to be addressed

The key gap for CCA, DRR, natural emergencies preparedness and response activities on the level of the state agencies and policymakers in Central Asia mainly relates to capacity building activities and awareness rising. These include trainings, seminars, conferences, working group meetings and exchange visits. There has been a noted increase in governmental decrees and national multi-agency and

international cooperation agreements in the field of DRR. It is hard to describe the effectiveness of such events, i.e. what is being done as a follow up and how these activities help relevant agencies. Systems that would help evaluate the feedback and the outcomes are not in place. Examples of practical activities given in the text are typically local projects lead by international organizations. Actions implemented by local governments are limited to the planned preventive maintenance of the existing facilities such as dams, waterworks, anti-landslide walls and other.

Constraint factor in the sustainable use and dissemination of adaptation technologies in the region is often referring to lack of technical skills. It should be noted that the many projects completed to date at the local level, have been focused on building the capacity of farmers, ordinary land and water users. This approach has shown that the efforts of local non-governmental organizations and international programmes, are better suited to new climate conditions and lead to the generation of knowledge, which can be applied in practice. It is essential to continue the capacity-building activities in rural communities, especially in terms of dissemination of technology and ensuring the sustainability of relevant efforts.

In addition to the above said it might be required first to adjust policy at the national level to promote certain technologies at the local level. For example, farmers in the upstream irrigation network will not be interested in the application of water-saving technologies due to unattractive existing incentives, as long as they are not offered adequate incentives means or mechanisms. Another example is that in some countries farmers are limited in the choice of crops for cultivation. This is an example of an institutional issue that prevents transition to drought-tolerant crops. In this regard it might be assumed that promotion of adaptation in the region requires a revision of the current policy and provision of adequate institutional framework in the sectors of water resources management and agriculture.

With regard to financing, it is believed that the higher capital costs, the more efficient technology. However, there are technologies that are introduced at the farm level and do not require large capital investments, but operation and maintenance may require more labour or other resources as for example the introduction of such technologies as pasture rotation schemes or estuary irrigation and etc.

The National Communications of the Central Asian countries suggest a list of recommended actions to adapt to climate change, the main lines of which relate to the sound and sustainable development of the water, agriculture and energy sectors.

Analysis of the list of CCA measures of Central Asian countries shows that 50 per cent of recommended adaptation measures are aimed at improving the system of water use and increasing the efficiency of irrigation. Country-level, adaptation plans are similar in the region, which is not surprising given the similar climatic conditions, applied methods for land and water use and close economic ties between countries. Priority in all five countries was given to the use of surface and ground water, the introduction of water-saving technologies in agriculture, replacing of water-intensive crops with drought-resistant, preventing risks of natural disasters and so on. Some of

these recommendations have already been implemented in the region through medium and small pilot projects.

It is observed that on the level of middle ranking policymakers, i.e., people who not only design policies but also directly affect the implementation, the issues of climate change, and specifically adaptation through DRR, are not taken seriously due to the lack of awareness and lack of instruction from above.

Conclusions and recommendations

Natural events related to climate change and leading to emergencies cause loss and damage to human capital, private and state property and production facilities. They significantly affect food security, contribute to poverty and inhibit sustainable development in the region. Forecasting, early warning and minimization of the consequences of such events is a key element in the strategy of each country in Central Asia and the region as a whole.

A lot of negative consequences can be avoided or hindered by means of timely adaptation activities. The evaluation studies are one of the most important components in development and implementation of the adaptation activities. These evaluations include:

- Assessments of vulnerability to adverse effects of climate change and the loss and damage;
- Cost efficiency and feasibility studies of adaptation measures;
- Adaptation potential taking into consideration economic, social and other significant factors for the state, its economy, population and vulnerable communities; and
- Evaluation of possible consequences of adverse conditions such as droughts, reduction of water resources and other climate risks (financial losses, food security).

Building partnerships within countries and at the regional level is very important for consultations, technology exchange and support for adaptation activities. Besides partnerships on DRR with national agencies and government institutions the close links with such organizations as UNDP, the World Bank and others are presently key.

Distribution of knowledge about DRR and adaptation in general at the local, national and regional levels should be integrated into the development processes at all levels. Activities of the agencies responsible for DRR and response should focus more on prevention through timely monitoring and early warning of major threats in the region such as mudflows and avalanches triggered by the storm rainfalls.

It is necessary to strengthen mudflow protection facilities (such as dams) to protect populations from floods. Early warning systems should be modernized to provide adequate protection. It is necessary to develop the preparedness of relevant organizations to be able to work under the emergencies so they are capable of

helping general public and responding to floods, fires, sharp frosts, heat waves and other climate related natural disasters

Climate change and its impacts call for the necessity of timely response at all levels of political structures and personal efforts by citizens changing the behavioural patterns and the way of life.

For the countries of Central Asia located in the arid climate the most vulnerable sectors to climate change are agriculture, water, energy and health. The effects of climate change on the economies of Central Asia pose a threat to sustainable development, economic growth, poverty reduction and human and ecosystems wellbeing, thus harnessing the capacity to achieve Sustainable Development Goals.

The governments in Central Asia currently focus their efforts on greenhouse gas inventories and emissions reduction whereas adaptation remains little known by decision makers. All countries of Central Asia admit possible adverse effects of climate change and are developing adaptation activities at various scales. However these measures on the country and regional levels are treated as one-time events and are limited by the frames of the local projects. However, adaptation to climate change should not be treated as a project but as a constant long term process.

In all countries of CA the development of Adaptation strategies and Plans should become a priority. The issues of adaptation should be included into the strategic plans of the ministries and other relevant agencies, plans of regional and international cooperation. Because all countries of Central Asia have similar environmental conditions, it is worth developing regional cooperation in adaptation.

Early warning systems are essential to ensure preparedness in the event of extreme weather events and should be developed at the trans-boundary level, creating opportunities for the effective exchange of information. Exchange of information between countries and sectors can help ensure the efficient and effective adaptation to climate change. Data collection, including socio-economic information should cover all aspects of the most vulnerable sectors.

Crucial role in the implementation of effective adaptation plays the institutional capacity at all levels, from local to trans-boundary. The ACC shall be supported by adequate climate and hydrological information systems that can be able to transmit early warnings timely and effectively. The existing institutional gaps should be identified by in-depth analysis and be included in national adaptation strategies.

Proactive adaptation to climate change should become a part of a long-term development programmes of the Central Asian countries, especially in consideration of the risk of damage caused by climate change. Factors of vulnerability to climate change shall be accounted in the preparation of state, sector-wise and regional development programmes to ensure incorporation of adaptation policies to climate change in the strategic planning of the Central Asian states. Implementation of the concept on adaptation will allow identifying and considering in advance some specific

problems pertaining to adjustment of the economy, people and ecosystems to adverse natural events. While implementing some particular investment projects it shall be necessary to assess their effectiveness, determining the criteria of reducing the risks associated with climate change. Adaptation to climate change should be an integral part of governmental programmes in the most vulnerable sectors and territories.

The states should assist each other in building capacity. The importance of the knowledge transfer on capacity building through education and training in formal, informal and relaxed atmosphere cannot be underestimated in the field of trans-border issues related to climate change. Educational programme and strategies of mutual information sharing shall be drawn out and implemented to meet the needs of target groups, taking into account such aspects as age, social role and level of literacy.

Policy-makers should seek to establish an effective system at different levels, involving all stakeholders – individuals, local authorities, stakeholders from relevant sectors and policy-makers at the international level. Various levels of governance shall interact with and support each other through, for example, the creation of consultation mechanisms at national and trans-boundary levels. The joint bodies should have the mandate, capacity and means enabling them to perform functions on the development and coordination of strategies for CCA.

Analysing the current status of DRR and adaptation activities included in the statutory documents in the countries of Central Asia we can conclude that countries should modernize meteorological services and observation systems, improve the early warning systems and preparedness, evaluate potential loss and damage and Relocate the population and the industry to the safe areas. On the regional level, the DRR and response should include the development of the coordination mechanisms for integration of risk reduction activities, creation of the bi-lateral and multi-lateral platforms for choosing the shared approaches to adaptation to climate change, as well as the development of the regional strategies and plans on adaptation.

VIII. Interfaces of Science and Policy for Climate Change Adaptation and Disaster Risk Reduction

WANGLIN YAN[30]

Introduction

Successful science-policy interfaces can enhance the translation of climate scenarios into adaptation policies and contribute to effective global environmental governance. However, the translation of global climate scenarios into regional/local scale interventions, where adaptation is most needed, is problematic notwithstanding the assiduous efforts of the Intergovernmental Panel on Climate Change (IPCC) (Iyalomhe et al. 2013). This is partly considered a reflection of a deepening distrust of environmental scientific outputs such that scientific advice is sometimes resisted by economic and policy actors. In many European countries, public trust in science and technology seems to have decreased in the last 20 years (Spangenberg 2011). A significant indicator of this was the questioning of climate change science sparked by 'Climategate',[31] and the controversy that arose over errors in a 2007 IPCC report. The United Nations Environment Programme report entitled *21 Issues for the 21st Century* highlighted this issue as 'broken bridges' between science and policy, and asserted that the lack of 'meeting points' between scientists and politicians was causing knowledge to remain locked within silos (UNEP 2012, 10). As a result, the link between science and society has been weakened and public confidence in climate science has been eroded (Gaffney 2014).

International communities have recognized the importance of the issue and reacted intensively. The European Union called for a more systematic examination of the various components of "science and governance," particularly for "developing appropriate means for creating scientific references and channelling scientific advice to policymakers and equipping policymakers with tools to assess and manage scientific uncertainty, risk and precaution." The purpose of this initiative is to evolve new consultation mechanisms and to assess the "interaction between experts, industry, civil society and policy makers" (Hove 2007, 810). The United Nations held its first board meeting of scientific experts in 2013 aimed at building new bridges of science and policy. However, the interface of science and policy, its role and how it can be strengthened remain to be defined.

Globally, organizations like IPCC are considered to be models of interfaces bridging scientists and policymakers. The establishment of the Intergovernmental Platform on Biodiversity and Ecosystem Services is an illustration of this movement. However, the Platform constitutes a weak basis for developing a science-policy interface that

[30] Wanglin Yan is a Professor at the Graduate School of Media and Governance at Keio University and is affiliated with the Research Centre for Climate Change Adaptation (RCCCA).
[31] In November 2009, the server at the Climatic Research Unit at the University of East Anglia was hacked. Thousands of emails and other files were copied, and climate change critics and others argued that the emails showed that global warming was a scientific conspiracy, in which they alleged that scientists manipulated climate data and attempted to suppress critics.

can facilitate communication across and between many scales and levels of the international environmental governance landscape. Yet the documents from the Platform show a strong tendency towards a centralized approach, more in keeping with the linear model-based thinking that originally informed the structure of IPCC (Koetz et al. 2011). Obviously, this is not the most appropriate response to the fundamental contention raised by Hulme (2010), pertaining to how climate science is conducted, how the climate debate is framed and how climate policy is being formulated in the wake of Climategate to meet with the broadening public requests.

This issue is not new. Following the accident at the Chernobyl nuclear power plant in the 1980s, the widespread response of societies has been to cast doubt on the capacity of modern science to solve real global problems. Scientists, in turn, have acknowledged the accident as a crisis of the scientific community, as well as that of postmodern society (Beck 1992). Policymakers have increasingly viewed scientific knowledge and expertise as contributing to the production rather than the reduction of risk (Maasen and Lieven 2006). This was recently evidenced by the stagnation of climate change negotiation attributed to IPCC's uncertain scenarios. IPCC assessment reports increase in length year-on-year, with the fifth report exceeding 1,000 pages, the report does not define how knowledge travels and informs decisions (Cicero n.d.). Researchers and communications professionals in European countries have kicked off a project for investigating the use of the scientific knowledge to increase the capacity of environmental research organizations and other intermediary organizations, and transform the information from useful to usable.

Mistrust of science in Japan was never as widespread as in the wake of the devastating nuclear accident that occurred in Fukushima, triggered by a gigantic earthquake and tsunami in 2011. These tragic events demonstrated to Japan and to the world the challenges of applying science, technology and public policy in relation to a crisis with huge environmental and public health implications (Mori 2013). Reconstruction of the country's economy and society begins with rebuilding of the trust. This is a challenge that is entirely different from Japan's cumulative disaster management experience acquired over the past decades.

Statistical data shows that the increase in disasters due to natural hazards over the past 20 years has, for the most part, been caused by meteorological and hydrological events (Birkmann and Teichman 2010). Each decade, great natural disasters set new records globally and the trend toward ever-expanding losses continues. Despite no evidence directly linking a single hazard to global climate change, climate change adaptation (CCA) and disaster risk reduction (DRR) share much in common with problems anticipated from coping with unprecedented events. To date, however, disaster risk management often focused predominantly on sudden-onset hazards, such as fires, floods and storms when dealing with risk mitigation while CCA mostly address slow onset/long-term risks. There has been limited integration of the two communities and it has been a struggle to mainstream them into regular development planning (Mitchell and Aalst 2008). This can be considered a consequence of unsatisfactory communication between these two communities and

with other disciplines, in addition to inadequate translation of theoretical research findings into concrete actions for practical disaster management.

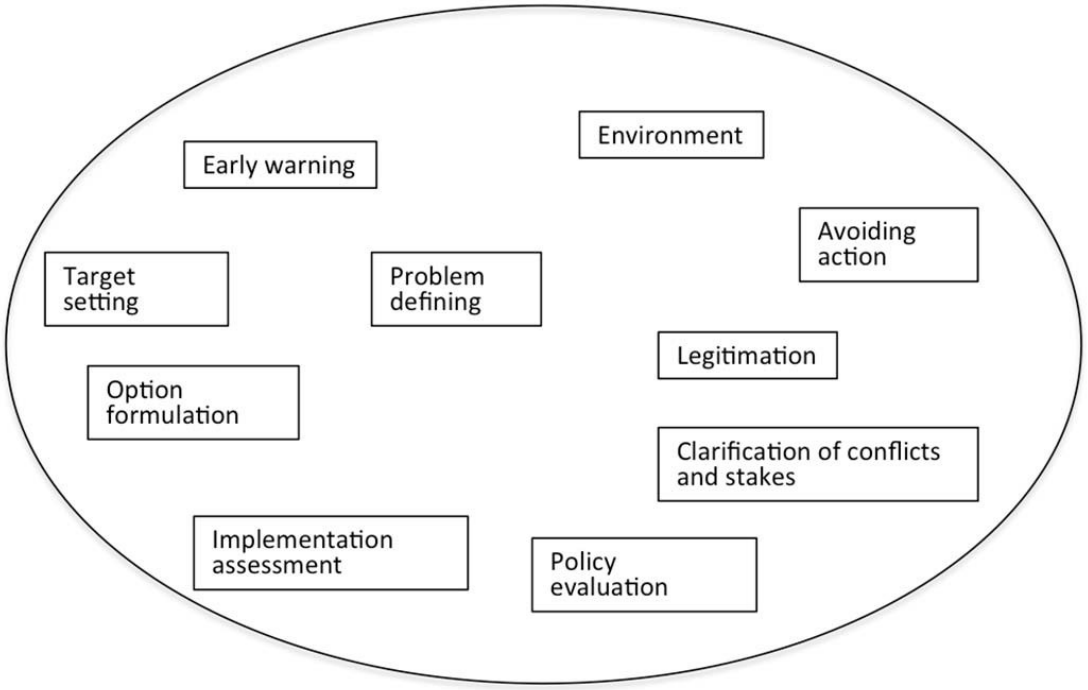
This chapter aims to clarify the definitions and challenges that arise within the ambit of science-policy interfaces and illustrates practical approaches for enhancing these interfaces within CCA and DRR. It explores how gaps and intersections of science and policy coexist in knowledge production and identifies opportunities for bringing the two communities together to evolve better research and policy. To accelerate this process requires a shift from curiosity-driven and disciplinary-based thinking among researchers to issue-oriented and transdisciplinary action for knowledge co-creation. This entails a reflexive learning process that is subject to limits of certainty and capacity for knowledge. Combining communities of practice theory with a project-based learning approach could provide an effective way of involving stakeholders at early stages and producing and delivering knowledge across various disciplines and sectors.

Communicating climate change to policymakers

Gaps between science and policy

Human-environment systems across the globe are undergoing rapid changes. To cope with change, human societies require strategies and policies that are underpinned by strong base of science and evidence. Knowledge in various forms – natural and social sciences, technical and practical – can contribute to policy making and can serve socially relevant functions. The roles of knowledge in policy and society are illustrated in figure 1.

Figure 1. Some policy and socially relevant functions of knowledge



Source: Liberatore, 2001.

However, today many people believe that existing linkages between policy makers and scientific communities are inadequate and are even deteriorating. This broken link is hindering the development of solutions to global environmental change (UNEP 2012, 10). The gaps result mainly from a limited ability to comprehend the complexity of climate change and its interactions with social and political structures and processes (Iyalomhe et al. 2013).

The science-policy gap is defined as the difference in levels of confidence for a given scientific finding expressed by the scientific community and by society (Bradshaw and Borchers 2000). Such gaps exist in multiple areas of scientific research, policymaking and in society. Weichselgartner and Kasperson (2010) clarified three distinct issues that pertain to science-policy interfaces: (1) structural aspects, for example, organizational settings or complex institutions and standards; (2) functional aspects, for example, tested practices, objectives and needs, procedures and scope, and priorities; and (3) social aspects, for example, cultural values, communication, understanding, social networks and uncertainty. The study showed that decision makers' use of available research-based knowledge is insufficient, while researchers often produce knowledge that is not directly usable.

Communication between scientists and policymakers also matters (Yalowitz et al. 2008). Critics argue that scientists know too little about global change to warrant anticipatory policy formulation and assert that current information and levels of certainty fall short of scientific standards for decision-making. Others maintain that science is not the issue and that the indecisiveness of policymakers reflects a shortfall of political willpower (Bradshaw and Borchers 2000; McNie 2007). This is not altogether surprising since scientific results are usually difficult to translate directly into actionable policy options. Even when decision makers are armed with scientific knowledge, communication across specializations and experiences presents challenges for those striving to scientifically inform policy and management decisions (Scarlett 2010). Within the current education system, few scientists are trained to communicate results in a nontechnical way. Decision makers and the public at large, follow a different approach: they need to balance the risk of falling victim to either error (Boykoff 2011). Consequently, their standard is not that of scientific proof, but rather of information quality that is solid enough to act upon. This may be the case long before a proof becomes available, if ever, and constitutes the essence of the precautionary principle (Spangenberg 2011). Campbell et al. (2007) suggest that the relative inaccessibility of scientific results is also a factor that hampers communications. Although scientific outputs are increasing, many of these are embedded in grey literature that is not widely distributed, or published in scientific journals that are too expensive for organizations in developing countries, and for many individuals across the world, to afford. It is also often difficult to retrieve needed data or information dispersed across many institutions and databases (UNEP 2012).

Therefore, bridging these gaps and improving science-policy interfaces require us to rethink the role of science and ways of producing knowledge and communicating with the public. Researchers must learn how to present and advocate their work, not

merely within the scientific community, but also to the larger community of foundations, policymakers, government organizations and the public.

Intersection of science and policy

Notwithstanding the gaps described above, dynamic intersections between science, policymaking and civil society exist within every process of scientific interaction between scientists, policymakers and the public. Hove (2007) has discussed the key domains of the intersections from four aspects: outputs, process, actors and context, as shown in table 1. The multiple aspects of science suggest that when seeking to identify the domains of intersections between science and policy, the outputs, its processes, actors and context should be examined. The existence of these intersections, created through the process of knowledge production, provides a rationale for the development of science-policy interfaces that bridge the gaps between scientists and policymakers.

Table 1. Intersection between science and policy

Aspects of science	Domains of intersection between science and policy
Outputs	Articulation of objective and subjective knowledge Scientific knowledge as an ingredient of policy-making (explanations, predictions). Science contributes to emergence of issues on political agenda.
Processes	
Defining, framing, addressing a problem, designing potential solutions	Pertain to both the scientific and the policy processes.
Organization and funding of research	Science policy is driven by political considerations. Results of science influence policy prioritization.
Quality and validation processes	Scientific validation processes belongs to both science and policy.
Education and training processes	Policy influence on orientation of education and training. Influence of education and training on role of science in policy.
Networking processes	Vehicle to channel scientific input to policy
Actors	Scientific experts in policy processes. Scientific actors influencing policy according to their values and interests.
Context	Technology becomes cause of major policy issues. Politicization of issues impact on the way science is conducted.

Source: Hove, 2007

Science is also a social process, setting within a certain social context and involving actors and institutions. The intersection of science and policy also raises institutional questions (Scarlett 2010). Some scientists argue that scientists must be at the decision table. Others, however, resist this notion, preferring to separate scientific inquiry from policy and management decision-making, because scientists are not always neutral and cannot be divested of their values and interests (Hove 2007).

This raises questions regarding the role of science. The fundamental function of science is to provide explanations of phenomena to society. Another function of scientific output is predictions. Hove stated that the distinction between explanation and prediction is important, because misunderstandings exists about the nature and role of science (Hove 2007). Curiosity-driven science is usually explanatory and tends to be kept at a distance from political decisions. By contrast, applied science is more predictive and deliberately restricted to its contribution to science-policy interfaces and social processes, where exchanges between scientists, decision makers and stakeholders take place (Spangenberg 2011). We may request researchers to verify the facts of their explanations through definitional accuracy. On the other hand, scientific modelling and analyses demonstrate that the effects of a changing climate are complex, with high variability over time, space and species. In fact, there is no certainty for predicting risks related to nonlinear and complex climate issues. These distinctions divide the interests of scientists and policymakers.

Science-policy interfaces to bridge the gaps

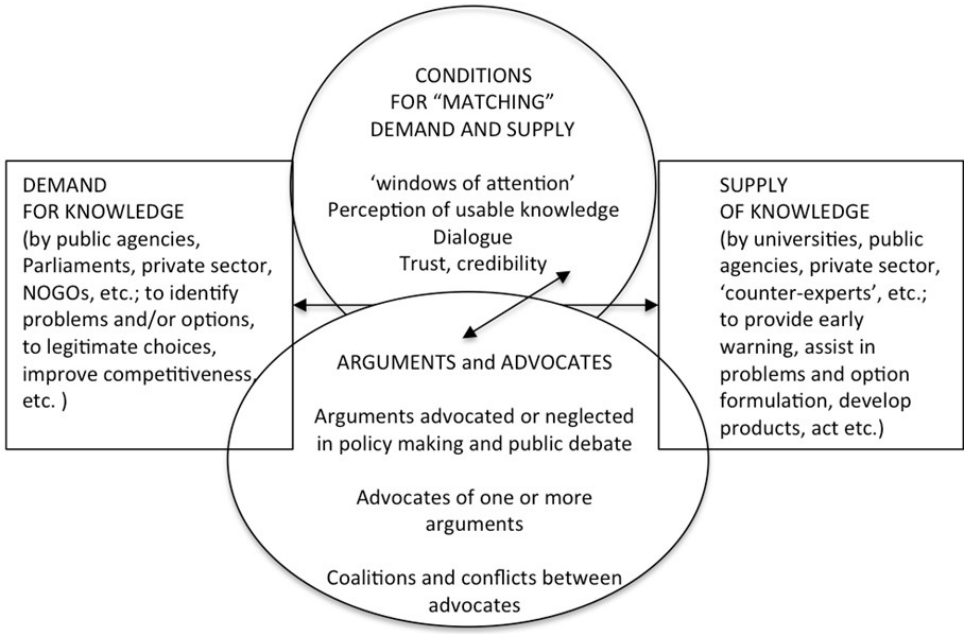
As social processes, science-policy interfaces encompass relations between scientists and other actors in the policy process. Good interfaces "allow for exchanges, co-evolution, and joint construction of knowledge with the aim of enriching decision-making" (Hove, 2007). These interfaces may be the output of scientific activities as the combination of subjective and objective knowledge or policy agendas. Scientists and policymakers interact with each other from the initial stage of defining the problem to the training and implementation stages.

Bridging the gaps between science and policy is a daunting task. Many studies have examined the connection between knowledge development and policy formulation and the factors that influence interactions of science and policy (Iyalomhe et al., 2013). An improved interface between policymakers and the scientific community can contribute to a deeper understanding of the causes and impacts of sustainable development challenges and point to innovative and effective ways of addressing them. The interaction between these two worlds often comes down to what is communicated, how and when, through what channels or at what forums, for what purpose, by and for whom. Inconsistency and the psychological discomfort of cognitive dissonance can be reduced by changing beliefs, values, or behaviour (Bradshaw and Borchers 2000).

Liberatore (2001) developed a simplified illustration of the interfaces between research, policy and society (figure 2). For knowledge to be meaningful and usable, there must be not only a supply and a demand for it, but also suitable conditions, similar to 'context' of Hove (2007). These situations include "windows of attention," or

a perception that available knowledge points not only to (unmanageable) problems, but also to (potential) solutions, as well as forums and procedures for communication and dialogue.

Figure 2. Demand, supply and conditions that apply to science-policy interfaces



Source: Liberatore, 2001

The principle point highlighted by this demand-supply-condition scheme is that research should not only satisfy scientific curiosity, but also the needs of users (Dilling and Lemos 2011). "Better" science portfolios (that is, portfolios viewed as more likely to advance desired societal outcomes, however defined) could be achieved if science policy decisions reflected knowledge about the supply of science, the demand for science and the relationship between the two (Sarewitz and Pielke 2007). This corresponds with the recent recommendations of the Future Earth initiatives (FETT 2012). Scientists should pay particular attention to engaging the users of their research early on in the development of research programmes, for example, by including stakeholders in advisory committees and seeking to ramp up the research community's understanding and practices of working with the business community, governments, non-profit organizations and local communities to identify research priorities. Such inclusive efforts could help in the search for solutions to global environmental challenges. Demand-driven research entails a transdisciplinary approach that encourages participation of stakeholders from an early stage of problem solving by identifying problems, sharing models based on stakeholders' needs and developing mechanisms for better communication to ensure that bottom up inputs are solicited.

Overcoming the challenges

Policymaking is fundamentally about values. The process considers questions such as “how do we want our children to live in the future?”. Scientific information, per se, cannot determine what people desire or prefer. Regarding the distinction between explanation and prediction, understanding “what is” is not the same as exploring and illuminating responses to the questions “where do we want to go?” and “what do we have to do?”. This is the most distinctive challenge that arises in relation to any interface of science and policy. With this general context as a backdrop, finding solutions within the science-policy interface presents particular challenges for researchers and decision makers.

Uncertainty and complexity

Scientific uncertainty is one of the most difficult aspects of translating science into policy. The science featured in the interfaces of science and policy has to deal with and live with uncertainty and complexity. Uncertainty is a state of having limited knowledge, making it impossible to exactly describe an existing state, future outcome, or more than one possible outcome (Lindley 2006). Although some of the uncertainties are reducible through research, others are inherent to the systems under consideration and/or the scientific process (Bradshaw and Borchers 2000). Complexity corresponds to the situations for which it is not possible to precisely know the initial conditions of a system. For instance, the attribution of a single hazard event or specific losses to climate change is difficult, if not impossible, because of the complexity of factors that generate disaster losses. The variable effects of a changing climate complicate decision-making so that rendering scenario planning, adaptive management and other management learning tools are increasingly important. The very complexity of these effects presents particularly difficult challenges for policymakers and resource managers, because the available science is often highly uncertain (Scarlett 2010).

Whereas scientists are familiar with uncertainty and complexity, the public and policymakers often seek certainty and deterministic solutions (Bradshaw and Borchers 2000; Sarewitz and Pielke 2007). Policymakers are becoming increasingly aware that environmental policies require scientific expertise, but are uneasy in their recognition that this expertise does not equal certainty. Instead, most environmental knowledge is inherently uncertain, forcing policymakers to look for ways of making decisions under conditions of uncertainty (Engels 2005). IPCC reports represent a wealth of both accumulated knowledge and uncertainty. Unlike more tractable, data-rich scientific problems that readily yield understanding from statistical analyses, the science presented in the IPCC report appears to have confounded policymakers who prefer more “certain” and contained estimates of risks.

Credibility and legitimacy

To accomplish the task of strengthening or rebuilding bridges between science and policy requires a new look at the way science is organized and how the science-society-policy interface can be improved (Hulme 2010; UNEP 2012). The first new component in the current relationship between knowledge and decision-making is the

paradox of science's increasingly legitimating function in relation to political decisions, while its own legitimacy as the source of truth is decreasing (Liberatore 2001). While science strives to approximate the truth as much as possible (based on scientific evidence), policies are often based on political compromise and trade-offs. Taking the latest scientific findings into account may not reflect a "perfect reality" in terms of a given environmental issue. Developments are based on policy agendas that are influenced by many inputs (technical and political), of which research is only one component.

A second element of novelty has been the partial shift of both knowledge production and decision-making from the public to the private sector, while societal problems (for example, health and protection of the environment) continue to be public issues. Scientists and practitioners can have very different notions of what constitutes 'legitimate' knowledge. Many scientists are inclined to err on the side of caution and uncertainty by first vetting their findings through the peer review process, while decision makers frequently have unrealistic expectations as to how soon decision-specific information can be made available.

A third element of novelty has been the diffusion of participatory approaches that may either enrich or further destabilize the already vulnerable relationship and contested boundaries (Jasanoff 1987) between science and policymaking (Liberatore 2001). Scientists frequently assume that knowledge that has emerged as a result of a rigorous process of data gathering, hypothesis testing, empirical or model verification and peer review is regarded as the 'truth' (or at least a superior truth), because of the expert nature of scientific knowledge, and is, therefore, ready for transfer to and use by end users. For practitioners, legitimacy may be derived from considering and addressing key values and concerns of stakeholders, including non-scientific knowledge.

Behind these elements of novelty is the penetration of the Internet and the accessibility of various data, information and knowledge. Academia is considered to have lost its monopoly on knowledge production (Engels 2005), and a new mode of knowledge production is evolving, co-designed and co-created with stakeholders (FETT 2012).

Communication

Lack of adequate communication between the science and policy fields is one of the main bottlenecks hampering the effective transfer of results or information. Real science-policy interfaces rarely involve personal communication between scientists and high-ranking policymakers. Building effective communication is time consuming and much of the necessary relationship-building that makes this communication effective occurs in the background and is not directly rewarded. Moreover, while many in the scientific community hope that their research is relevant and some conduct research that is use-inspired, traditional applied science tends to be associated with less prestige and rewards than pure curiosity-driven basic science (Quevauviller 2013; Vogel et al. 2007). Scientific expertise cannot replace policymaking, however, the crucial question is how best to conceptualize and

organise their interfaces to provide an environment in which rational policies can emerge (Engels 2005). In both cases, there have been few efforts to digest relevant information and make it readable by the various actors. Thus, there is a need for intermediaries who are able to translate research outputs into inputs that can be used by policymakers. Without this process of translation, much useful knowledge is likely to remain inaccessible.

Gaillard and Mercer (2012) laid out a road map for integrating knowledge and action for DRR. They identified three key requirements for improvement: consensual tools; practical frameworks; and changes in national policies. A number of initiatives have been launched to help countries to strengthen their capacities to respond to the changing climate, but many of these are being undertaken independently of each other. For instance, the Adaptation Knowledge Platform has actively sought to address this challenge within the Asia-Pacific region by building bridges between initiatives, researchers, policymakers, business leaders and those working on CCA on the ground (http://www.climateadapt.asia). Projects for mainstreaming CCA have been implemented in areas ranging from the flood plains of Bangladesh and Vietnam to mountainous Himalayan regions and agricultural areas in Thailand and China. Yet, the outcomes of such activities are difficult to evaluate because most of the projects have been conducted at a local scale for the purpose of knowledge dissemination.

To influence decision-making, scientists must understand the underlying causes of environmental change and the process of decision-making. Although sound science is necessary for informed public policy and decision-making, it is insufficient. We must also identify the problem and the associated policy choices, implement those policy choices and subsequently monitor and evaluate their effects. Furthermore, we need to recognize that decision-making processes are highly value-laden, combining political and technocratic elements, and operating at a range of spatial scales from the village to the global level. To have any chance of being effective, they must be transparent and participatory, involving all relevant stakeholders (Watson, 2005). Involvement and participation in the process are important. An emerging approach is knowledge brokerage, in which knowledge brokers play a key role by being deeply engaged in multiple processes and communicating with stakeholders.

Knowledge to action

Generating actions to counteract the problems identified by scientific research has proved to be a more difficult task. Scientific knowledge is often used to guide our actions because it can provide understanding. However, there is a difference between understanding and acting. “One often understands situations without being able to act: this is the case of the man in a flood who climbs on the roof of his house when water level rises. In other cases, one acts effectively without really understanding why” (Hove 2007, 810). Therefore, it is true that scientific knowledge provides a basis of action. However, claiming that is “useful” only is insufficient. It appears, however, that most environmental research is still instigated, designed and delivered by scientists with little appreciation for how it can be useful for policymaking (UNEP, 2012). To deal with this challenge, critical advances in basic knowledge, in humankind’s social and technological capacities to use it and in the political will to

turn that knowledge and know-how into action are needed. This issue relates to the long-standing debate between advocates of “science for science” (curiosity-driven science) and “science for action” (issue-driven science). Sustainability science must be aimed at providing integrated analyses and assessments. Integrated assessment, as a reflective and iterative participatory process, links knowledge (science) and action (policy) relating to complex science and technology issues (Spangenberg 2011).

Both “action” and “knowledge” are multifaceted words. Gillard and Mercer (2012) described the top-down and bottom-up processes from the spheres of knowledge to action for DRR at multiple scales. Pace et al. (2010) focused on the public involvement and efforts of researchers, individuals, or groups, but in the absence of proper evaluation structures and rewards in current merit systems. Lebel (2012) reviewed studies of how local knowledge contributes to adaptation to climate and climate change in the Asia-Pacific region. These studies have focused on traditional ecological or indigenous knowledge and adaptation actions have varied with time scales of interest, ranging from dealing with disaster risks from extreme weather events, slow onset changes such as seasonal droughts, to long-term multiple year climatic shifts. Hammill, Harvey, and Echeverria (2013) investigated the online services of knowledge platforms for action and concluded that these services did not radically change the way users initiated information searches. In short, integrating knowledge, actions and stakeholders is a difficult prospect in policy and practice, because of the lack of trust that prevails between stakeholders who interact, often autonomously, at different scales (Gaillard and Mercer 2012). Most researchers position themselves as observers or experts who deliver/excavate knowledge, or provide solutions for research purposes. Whether top-down or bottom-up, this approach is considered to be a “mode-1” variety of knowledge production (Hessels and van Lente 2008; Regeer and Bunders 2009; Spangenberg 2011). The effects of enhancing communication between science and policy by this mode are expectable but limited because of the distrust that exists between scientists and other stakeholders. Scientists are required to face a fundamental challenge when performing research related to complex systems. The most important aspect of this challenge entails a change in their mind set from being an expert to a learner, and a change in our attitude from a focus on knowledge for action to one of knowledge of action.

Scope for the science-policy interface

Challenges relating to global issues like climate change include the need for epistemologies that are capable of dealing with complex socio-ecological systems and ramifying relationships. A number of approaches deal, on a more practical level, with linkages between science and politics. These include involvement of intermediate actors or institutions, knowledge brokers and various forms of facilitation (Weiland, Weiss and Turnpenny 2013). Hereafter the focus of this chapter is the scope of knowledge integration, information tools and brokers as the main dimensions for developing science-policy interfaces.

Knowledge integration

Over the past several decades, as societies have struggled to address the gap between science, policy and society, communicative models from a range of fields have emerged to replace the traditional, linear, one-way notions that previously underlay science-practice interactions. These models have provided more democratic forms of communication in which different experts, risk-bearers and local communities all have something to bring to the table (Vogel et al. 2007). Lubchenco (1998) stressed that "in a rapidly changing world, the role of science could not be confined to its "traditional" roles of discovering (explaining), communicating and applying knowledge (supporting action), and training the next generation of scientists". He proposed the formulation of a new "social contract" by the scientific community. This contract, he stated, should recognize the extent of human domination of the planet. It should express a commitment to harness the full power of the scientific enterprise in discovering new knowledge, in communicating existing and new understanding to the public and policymakers, and in helping society move toward establishing a more sustainable biosphere. The concept of a social contract provides a broader perspective on knowledge and the practice of science as guiding principles of sustainability that emphasize: an issue-driven agenda, co-production of knowledge, interdisciplinary and transdisciplinary approaches, acknowledging earth system complexity, focusing communication and research activities at the local level and on social learning rather than definitive answers (Clarke et al. 2013).

"Trans-disciplinarity" is key to this concept. This word is often used as a synonym for research in the context of real world problems that is characterized by a participatory and integrative process of knowledge production, and is, thus, capable of bridging the gap between science and politics/society (Axelsson 2010). It is regarded as being more than a way of producing new knowledge, entailing an ethic of being open minded, while theorizing from a broad context-oriented perspective that includes different disciplinary and non-academic views and transdisciplinary thinking. Trans-disciplinarity, therefore, is considered a new form of learning and problem solving that helps to meet complex challenges of society, such as sustainable development (Mauser et al. 2013; Regeer and Bunders 2003; 2009).

The use of science in the policy process depends on several factors, which include the type of policy problem, the phase in the policy cycle, and the national or international context (Engels 2005). Understanding the type of policy problem and identifying the stage of the policy cycle may be helpful in guiding the organization of science-policy interfaces. This can only be achieved through the integration of disciplines and the cooperation of all of the stakeholders. Here, integration refers particularly to the design and production of knowledge across scientific borders, across national boundaries and with the involvement of knowledge users. In other words, integration must be interdisciplinary, transdisciplinary and truly global in nature (FETT 2012). Two types of knowledge integration have been discussed (Regeer and Bunders 2009). The first type is assumed to be a combination of different and independent "pieces" of explicit knowledge, often involving scientists on a piecemeal basis. For example, a project of water resource development would require scientists, to conduct archaeological research and water modelling and

landscape experts to investigate how things used to be and what they should become. A second perspective on knowledge integration assumes that people acquire knowledge and assign meaning to this knowledge through participation in social practices. This entails a reflexive learning process from problem identification to problem solving through the full-fledged interaction of stakeholders. This is known as the "mode-2" approach of knowledge production, which Regeer and Bunders (2009) refer to as knowledge co-creation.

Information and tools

Policymakers are dependent upon scientific knowledge. However, scientific results cannot be applied straightforwardly in practical decision-making. Assessment indicators or criteria and communication tools of information technology are useful for improving the quality of the interfaces. Jones et al. (1999) summarized the following four necessary conditions for the integration of scientific information with policymaking processes:

- Research results must be relevant to currently pending decisions;
- Research results must be compatible with existing policymaking processes and models;
- Research results must be accessible to the appropriate policymakers; and
- Policymakers must be receptive to the research results.

Regarding the use of scientific assessments for climate change and risk management, *vulnerability* indicators are widely seen as the media of choice for bridging academic work and political need. Political organizations often recommend the development of indicators and the commissioning of teams of consultants and academics to carry out this task. Indeed, indicators, by their very nature, seem to be useful media, because they synthesize complex situations such as the vulnerability of regions, households, or countries into a single number that can then be easily used by policymakers. At the same time, there is an increasing body of literature that is critical of many of the attempts that have been made to develop vulnerability indicators that are viewed as not being scientifically sound or policy relevant (Hinkel 2011).

The science-policy lag is evidenced by the length of time required for a given scientific finding to be assimilated into a society. In part, this lag can be attributed to the rate of information dissemination. During this cognition phase, scientific information is disseminated by various media, for example, the Internet, science magazines and television (Bradshaw and Borchers 2000; Painter 2013). Mass media, as a tool for communicating with the public, plays the important roles of reporting, addressing, analysing and discussing relevant issues, but not of answering them. Over the past few decades the dynamics of North American science and politics have clearly shaped media coverage of climate change. The media has been a key vehicle by which climate change contrarianism has travelled (Boykoff and Roberts 2008; Boykoff 2007; 2008). Long-run media coverage is considered to have contributed to the 2013 "State of the Union" address of President Barack Obama in the United States. Its call(s) for action were strong enough to appease most climate advocates, even those who had said in the days leading up to the speech that they

wanted Obama to lay out a detailed plan of attack (Boykoff and Goodman 2013). This was also evidenced in Japan where mass media driven by key renewable energy promoters led the discussion on renewable energy policy after the nuclear power plant accident and accelerated the implementation of the Feed-in Tariff that started in July 2012.

The importance and performance of social media have been widely highlighted since the occurrence of Hurricane Katrina in 2005 (Fraustino et al. 2012; Wei et al. 2012). With its five key characteristics of collectivity, connectedness, completeness, clarity and collaboration, social media lends itself to increasingly being used to support crisis management functions (Christopher, n.d.). Investigations of recent disasters reveal the use of online social media as an emergent, significant and often accurate form of public participation and backchannel communication (Palen 2008; Fraustino et al. 2012). However, social media's function in relation to creeping change remains uncertain as a slow onset disaster in insidious situations like a famine or global warming provides little immediate and dramatic footage of damage and suffering to attract people's attention.

Knowledge delivery and brokerage

Linking science to practice is not a simple task. Evidently, a great deal of information is available now on any subject whatsoever in books, journals and on the Internet. However, the ways in which scientific knowledge is transported and translated across the boundaries of different disciplinary worlds has not been fully explored. Easy access to the Web does not consequently lead us to think that (social) scientists can easily frame their (local) work in the global context. The abundantly available information needs to be translated into knowledge (Liberatore 2001). This involves a variety of possible pathways and players, but always depends on a spirit of partnership and, perhaps, on a convergence of interests. One alternative is an increase in salience that helps to keep an individual from being overwhelmed by information overload. A second alternative pertains to the responsibility for making this linkage work through mutual necessity. The latter rests on the shoulders of those within both the scientific and practitioner communities. This is recognized as the need for a new division of labour involving social scientists who are active at local levels assisted by knowledge brokers who link "local" research with globally available information (Regeer and Bunders 2003). Their job is to move knowledge around and create connections between researchers and their various audiences (Meyer 2010). Knowledge brokers (also known as boundary agents), operating in the knowledge governance space, play an important role by developing influential relationships, building trust, communicating information needs and facilitating the bridging of gaps that exist among various stakeholders (Clarke et al. 2013).

Knowledge brokers, active in "boundary work" as defined by Chaudhury et al. (2012), aims to assess the extent to which scientific knowledge can be translated into something tangible and useful for decision makers formulating new policies, rules and regulations. Narrowly defined, it attempts to span the divide that often exists between science and non-science disciplines and sectors. More broadly, boundary work can be facilitated by organizations or individuals that act as knowledge brokers,

encouraging full participation by people from various disciplines and backgrounds and helping them to communicate with each other and jointly design problem-solving actions.

Cash et al. (2003) concluded three principles that underpin successful boundary work conducted by knowledge brokers. The first, credibility, which is the perceived technical quality or adequacy of technical evidence and arguments, needs to be established. The second, salience, which refers to the perceived relevance of the technical information provided to decision makers, is critical. This entails assessing whether the information provided is needed by those taking action on it and whether it is in a form that is understandable and can be used in a timely manner. The third, which relates to the legitimacy of the process of generating information and perspectives, is an important consideration as it determines whether the process is viewed by all concerned as being fair, inclusive and unbiased. Establishing credibility, salience and legitimacy requires good communication, translation and mediation efforts. Fostering knowledge probers, as described above, requires a fundamental change in training and education (Koetz et al. 2011). However, so far, the emphasis in terms of capacity building has primarily been on training people in the methods of modern science. This training method is more consistent with a linear approach, adhering to the presumption that the authority to speak must be derived either from political designation or scientific objectivity. To move beyond legitimacy principles that are anchored in linear model thinking, capacity building efforts would need to be expanded to include training in interdisciplinary science methods, knowledge brokering techniques and sensitivity to the global diversity of knowledge systems. In particular, they would need to include training developed for transdisciplinary actors.

Knowledge co-creation and the community of practice

While knowledge production was previously located primarily within scientific institutions, structured by scientific disciplines, current streams of transdisciplinary research are much more heterogeneous in their locations, principles and practices (Hessels and van Lente 2008). Although there is still no clear consensus on what trans-disciplinarity is, or how it can be evaluated in terms of its quality (Wickson et al. 2006), it is clear that transdisciplinary approaches for developing science-policy interfaces must be participatory and issue oriented. They must also entail a reflexive learning process that extends beyond interdisciplinary research and involves both academics and non-academics, for example, stakeholders and decision makers within the realms of policy, society and the economy. Transdisciplinary scientists are more reflexive than disciplinary scientists and operate according to different quality criteria compared with disciplinary peer review evaluation criteria. Wenger's (1998) concept of a community of practice is envisaged as providing a flexible approach for managing, communicating and producing knowledge that is considered useful for enhancing science-policy interfaces.

The conceptual approach of communities of practice is considered analogous to this process. Such a community is characterized, first, by mutual commitment on the part of all the participants (in contrast to the formalized structure of a project team);

second, by a common goal that is jointly decided upon by all the participants; and lastly, by a shared repertoire of resources that are developed during the course of the project to give meaning or create knowledge, including routines, words, instruments, ways of acting, stories, symbols and gestures (Wenger 1998). Knowledge development is a communicative process that takes place within a shared practice. Moreover, knowledge, communication and behaviour are inseparably linked with each other: they in fact create one another. From this perspective, the four components of science-policy intersections described by Hova (2007), depicted in Figure 11, cannot be viewed as being separate from practice or context. Rather, they are acquired or gain meaning within a community of practice.

An important characteristic of a community of practice is that it entails the creation and confirmation of meaning through a collective and reiterative process. In contrast to a static event during which new knowledge may or may not gain acceptance, this is a dynamic process in which new knowledge and insights arise. This elucidation provides a different perspective on the relationship between ourselves, the world around us and the knowledge claims that we make.

Best practice

Workshops for developing an understanding of mismatches

Since the occurrence of the Great East Japan Earthquake on 11 March 2011, Japan has faced a number of challenges in its recovery process. This disaster triggered an honest reassessment of many decades-old policies and social standards that the country had taken for granted. The largest gap was revealed between knowledge and action. Thus, while the understanding of the situation is better now, the way forward is still hard to conceptualize.

The most pressing role of science-policy interfaces is that of bridging this gap. A variety of conferences including forums, workshops and/or symposia are of crucial importance in this regard. They are necessary not only to ensure that supply and demand information is effectively shared, but also to develop—and test the degree of—trust and credibility that enables the “matching” of supply and demand.

Keio University has organized annual symposiums on environmental innovators since 2010 (http://ei.sfc.keio.ac.jp). Topics of the symposiums were specifically focused on resilience building in context of CCA and DRR with interdisciplinary and transdisciplinary approaches. The sessions of each symposium were deliberately designed to include a mix of researchers, officials and practitioners for sharing diverse knowledge and delving into opportunities.

Following the disaster, the Japanese government established the Reconstruction Agency to interact with various stakeholders both within and outside of the government. The establishment of this new organization after the disaster may have been for political reasons. However, the organization’s staff work together with representatives from all of the ministries, people from the affected regions, as well as the private sector. In this sense, The Reconstruction Agency, per se, is a kind of

interfaces. Its role is to sort through confused situations and resolve mismatches of needs and supplies.

The notion of a mismatch is a crucial one. For instance, people from the disaster-stricken area, where there were rules with regard to land use regulation, believe that the rules must be reformulated and put in place to meet the dynamic post-disaster situation. However, the government and institutes may not perceive their importance and urgency. How to put the rules in place, even in advance of disasters, is another institutional issue. There have always been mismatches between local needs and those that the central government is aware of, with an added time lag constraint. The organization of Japanese society is based on specialized rules by discipline and sector. People who are good at certain things work in the areas of their expertise and this approach has been regarded as the most efficient one. Networking is very important for connecting people and matching demand and supply in a timely manner. This cannot be accomplished through a centralized system such as that of the Prime Minister's office soon after the occurrence of a disaster based on limited information resources available through the pyramid structure of the current administrative system.

Discussions at the symposia convinced us that we need dynamic changes during the post-disaster transition phase. Conferences provide venues for communicating with diverse people with different needs. However, while providing feasible and often fruitful occasions for dialogue, they remain jus" a kind of meeting and talking. Different mechanisms and processes need to be worked out to ensure continued and sustained interaction between researchers, policymakers and citizens (Liberatore, 2001). Fortunately, some ideas on how to do so were developed further after the symposia. The discussion on mismatch, for instance, extended to the formation of a transdisciplinary committee, members of which included university researchers, business leaders, municipal officials and citizens in Kesennuma City with the purpose of connecting internal needs and external supplies. After deliberations stretching over a year, the committee concluded that an intermediate platform is needed to bridge internal and external information flows and facilitate the provision of various resources for supporting reconstruction creatively. It is, therefore, evident that problems change in the course of processes initiated to solve them and that the forms of the interfaces should adapt to such changes accordingly.

Information tools for knowledge brokerage

Mongolia is vulnerable to the impact of climate change on water and forage resources. It will continue to experience dramatic changes in seasonality, amplitude and variability of temperature and precipitation regimes, leading to degradation and desertification of dry land. Mongolia also has been undergoing economic transition toward the market system since the democratization in the 1990s. Households are the basic economic unit, and many are engaged in grazing livestock. Herders have the right to decide how many animals to graze and how to increase their productivity. *Soem*, the administrative government at the local level, is the interface between herders and the upper level of government, implementing national policies and assisting herders to prevent disasters.

Under the combined pressure of climate change and intensive human use of natural resources, the natural environment and human lives are changing rapidly in Mongolia. These changes include Gobi desertification, permafrost melting, biodiversity losses, growing poverty of nomadic herders, livestock losses, decreased water sources due to evaporation from semi-arid land, degradation of pastureland, overgrazing and migration to urban areas, to name a few. Between 1999 and 2002 and between 2009 and 2010, millions of livestock died of starvation owing to a *dzud*, a severe winter. There is a strong and recognized need to apply Geographic Information Systems (GIS) and remote sensing for climate monitoring and analysis and to improve adaptive capacities against climate change at multiple levels in the country. Geospatial data have been observed and stored in databases with international assistance through the provision of programmes such as the Global Livestock Early Warning System developed by Texas A&M University and weather information systems provided by the Norwegian Meteorological Research Institute since the 1970s (http://www.glews.net). However, beyond the confines of several government reports and academic papers that are available, such information has rarely been delivered directly to herders.

Information and communication technology (ICT), especially cell phones, have brought opportunities for Mongolian herders to engage with contemporary science. Keio University has developed an early warning system for herders using geo-databases and mobile phones. The system extracts daily forage information from the Global Livestock Early Warning System and NMRI and weather data from the Norwegian Meteorological Research Institute. This information is used to create short messages in Mongolian characters, transmitted weekly to mobile phone users via short message service (SMS). The weekly SMS includes minimum and maximum temperatures over the forthcoming seven days, as well as forage availability observed at stations in the vicinities of herders. This service was developed based on interviews with herders and discussions held at academic symposia. Technical training was conducted for local herders before operation of the service commenced. Feedback obtained from herders confirms that the system is appreciated very much. Nevertheless, discussion and comments from scientists raised critical issues on the use of information. First, how much of the loss of animals can be attributed to the *dzud*? Can we provide a real picture of what is actually happening? Based on relatively short-term meteorological data, can we really draw conclusions about the causes and impacts of extreme weather?

Scientific findings were that farmers reported increasing drought and land degradation had been occurring over the past 30 to 40 years. When the analysis is extended to the past 100 years, it was clear that in fact there has been an increase in precipitation and rainfall. Ultimately, we concluded that the loss of animals was not because of meteorological influences, but because of the impact of humans leading to land degradation. Economic motivation drives herders to increase their livestock. This, in turn, raises grazing pressure relative to the carrying capacity of pastureland.

Second, most herders are unaware of the impact of increasing livestock numbers in terms of carrying capacity and overgrazing. After the situation was explained to them using scientific data, they were gradually enlightened. However, questions of what the carrying capacity is and how to manage the pastoral system remain. People frequently talk about livestock carrying capacity, but this term is mostly used to emphasize demand and supply over a short timescale. From the perspective of an ecological timescale, longer-term sustainability must be considered. To learn how herders can adapt to the carrying capacity of the ecosystem, a thorough understanding of the ecological carrying capacity concept is needed so it can be defined and measured properly. Information provided to local communities must be both credible and accessible to help them increase their social adaptability.

Third, the credibility of the data source and information are critical, but how do we judge credibility and address risk with the information provided? When information is delivered to the public, to locals, or to any others, we should, of course, be aware that any data has limited accuracy. Herders could understand and react differently if provided with precise information about *dzuds* without having to take much risk. They would follow such advice and possibly slaughter their herds and store the meat for sale at the market rather than allow the herd to starve during the *dzud*.

GIS is mostly a historical information tool for explaining the past. Meteorologically, climate modelling can make predictions, but currently there is insufficient knowledge about the mechanism of *dzuds*. It is imperative to explain the limits of science to herders.

Fourth, with regard to accuracy, what scientists understand could differ significantly from the understanding of governments. Scientific understanding in the absence of suitable translation or commentary could mislead government officials receiving the information. Suppose, for example, that scientists in the United States predict 50 mm rainfall and forecast a subsequent of degree of flooding in a certain city. This calculation is considered very accurate in terms of scientific standards. Because of uncertainties, however, the actual event differs from the forecast by about a metre of rainfall. Based on the scientists' prediction, however, the government prepared for only 50 mm rainfall, and as a result of the actual 55 mm rainfall the whole city is flooded. Who bears responsibility for the failure? Scientists should always consider the use of available information in real decision-making, not only what has happened but also what could happen, and also the limits of scientific information for individual decision-making.

Therefore, we must be meticulous when using information and delivering ICT tools for use in knowledge brokerage. Effective knowledge brokerage needs time. Rushed timescales cannot deliver effective plans or strategic assessments and can even militate against effective engagement. As Sheate and Partidário (2010) argued, timescales driven by strong political pressure are likely to be associated with legitimacy and public trust problems.

Transdisciplinary education programmes for fostering environmental leaders

Solving complex problems requires different approaches, innovative thinking, strong leadership and the ability to take action. However, new actors cannot educated by only teaching science, technology, engineering and mathematics. In the words of Terry Newell,

> "why are we continually surprised by these crises of complexity? Why do we struggle so much to address them? Poor leadership clearly contributes. We lack those with sufficient foresight and political skills to collaborate effectively across divergent and strident differences to find solutions. Poor management also contributes. We often can't seem to do things right, even when we figure out the right thing to do. We need to do a much better job of educating for leadership and management and of finding the right methods of getting capable people into positions of responsibility and the right incentives and approaches to help them succeed" (Newell 2013).

In responding to this new trend of society toward leadership, The United States-based American Association for the Advancement of Science and the National Science Foundation, along with many universities, have begun to implement various practical training programmes for scientists on how to interact with journalists and other non-academic audiences. These programmes tend to be taught by practitioners and focus on establishing best practices among scientists for interacting with lay audiences or journalists. They typically build up a little capacity for long-term or short-term empirical evaluations of the outcomes of these *ad hoc* communication efforts (Scheufele 2013). UNEP initiated the Asia-Pacific Adaptation Network (APAN) in 2010 and, more recently, the Global Adaptation Network (http://www.apan-gan.org). These networks have connected universities and institutions for enhancing national science-policy dialogues and regional knowledge sharing strategies and training. The science-policy dialogues are designed to address the need for better interaction and communication at the science-policy interface on climate change issues, particularly those regarding adaptation.

Keio University opened its fifth campus in Shonan Fujisawa in 1990. Its mission from its inception was to offer education and research within a genuinely multidisciplinary, interdisciplinary and transdisciplinary setting, with an emphasis on practical outputs. Building on that base, this future-oriented campus seeks to make the best use of its highly advanced information technology infrastructure to train students within a broad spectrum of academic fields. The campus in Shonan Fujisawa consists of three faculties and two graduate schools. The three faculties are Policy Management, Environment and Information Studies and Nursing and Medical Care. The two graduate schools are Media and Governance and Health Management. The Graduate School of Media and Governance, established in 1994, organizes faculty members and students within several academic programmes that cover a range of disciplines. One of these programmes, for environmental innovators aims to provide a global home to support environmental leaders who are dedicated to entrepreneurship. The curriculum of the Environmental Innovators programme bridges four units: eco-business, environmental policy/planning, architectural and urban design and social entrepreneurship, which are fully integrated to enable

students to evolve study models that match their career paths. The ambition of the programme is to develop methodologies and practices in pursuit of the balance of private profit and public interest for mitigation of and adaptation to climate change. Students of the programme are encouraged to acquire knowledge and skills in more than one specialized area, depending on their individual interests. They are expected to study several courses covering fundamental concepts, skills and methodologies designed to assist them in their research efforts.

The basic principle of education at the campus in Shonan Fujisawa is to train students in the resolution of complex social problems by integrating technology, science, design and policy. In other words, we place emphasis on multidisciplinary project-based education. After 11 March, many of the staff and students of Shonan Fujisawa visited the disaster sites and worked to support reconstruction of the urban districts and villages in Kesennuma City, Miyagi Prefecture. The activities were reported at the Environmental Innovators Symposia and within the Kesennuma Reconstruction Proposal Project. More than 50 students in the Environmental Innovators course, led by an undergraduate student from Kesennuma City and professors of rural planning, architecture and urban planning, made several visits to the city to survey the damage and potential resources that remained within communities, and to conduct workshops with local residents to understand the communities' short- and long-term needs. GIS technology was used to measure the extent of the damage, historical planning precedents were studied and current needs were assessed through interviews and observation. Additionally, social networking tools like Twitter helped to establish a committed relationship with local partners to ensure sustainable support of the city's long-term reconstruction.

The key conceptual approach that the campus in Shonan Fujisawa has adopted to instil interdisciplinarity and trans-disciplinarity is *project-based learning*. This was integrated into the curriculum with the establishment of the campus, but has roots in the spirit of Keio University that extend back more than 150 years as the educational theory of *learning by practice* established by the university's founder, Yukichi Fukuzawa. In project-based learning, each student, actor, or leader of his/her project, is regarded a future leader who will be the interface of science, policy and society.

Community of practice and project-based learning approach

Transdisciplinary research and knowledge creation are always about connecting people. However, the people thus connected do not necessarily engage mutually and intensively over a longer duration to shape a community of practice and be able to interact meaningfully in a sustained way. Wenger's (1998) concept of communities of practice provides us with a level of study that is particularly appropriate for understanding these types of concerns and interactions (Regeer and Bunders 2003).

This concept holds promise for supporting the development of the social context in which CCA projects often exist. This is because it revolves around three key and connected concepts: joint enterprise, community and shared practice that collectively lend meaning to participation and mutual knowledge sharing and creation (Wenger, 1998). According to this conceptual approach, two or more individuals can create a

community of practice for the purpose of conversation and information exchange, possibly even leading to action; the development of new ideas and processes. Participation is purely voluntary and will wax and wane with the level of interest of the participants. Communities of practice primarily build capacity. They attract individuals who are willing to share their expertise in exchange for acquiring expertise from others. The principal driver of these individuals is the desire to strengthen their own skills for their own objectives more than a desire to work together on common objectives. Communities of practice can exist within an organization or be independent of any organization; they can be on-site or virtual/online (Creech 2005).

Given these characteristics, it is apparent that a community of practice engages in project-based practice. Communities of practice present a promising approach for establishing a social context in which project-based activities and analyses can evolve. Iyalomhe et al. (2013) examined the communities of practice theory from a new angle. Their investigation of two model cases highlighted potential opportunities and contentions with the theory and sought to develop understanding of how a successful science-policy interface within CCA projects could be envisioned as a community of practice. The assumption is that the social contexts in which projects are often embedded could be established through the application of the "communities of practice" concept, which defines activities in a social and historical context that structures the engagements of participants. Vigorous and dynamic communities of practice promise to nurture a social context in which participants in adaptation projects are potentially engaged and thus provide provisional support to a science-policy interface.

The education and practice within SFC closely demonstrate the features of community of practice. The most important feature of SFC is its emphasis on developing practical knowledge. SFC prioritizes students' own research topics which form the core of their academic study. Similarly, students are encouraged to choose their advisors and tailor their curriculum in support of their own research interests. As part of their study, they are exposed to actual research practices early on in their programmes and are given many opportunities that extend beyond the campus, even outside of Japan, to test their knowledge. All of these activities are conducted according to a project-based learning approach, which is used both at the undergraduate and graduate levels. A project is undertaken by one or two faculty members along with several students. Its members are then bound by a common research interest, while simultaneously being encouraged to develop and pursue their own specific interests. Faculty members and graduate students work together to support the performance of each student. This method of collaboration ensures that each student gains much needed exposure to diverse modes of thinking and analytical styles. The interactions between students secure opportunities for each of them to reinforce their study habits and, more importantly, provide the foundation for future partnerships as they individually pursue postgraduate careers. The organization of Environmental Innovators Symposia, the Kesennuma Reconstruction Project and the Mongolia Early Adaptation Project exemplify the practice of this educational system.

Fostering communities of practice is a dynamic process in which new knowledge and understanding emerges rather than perpetuating a static state of affairs that may or may not result in the adoption of knowledge from the outside. The significance is created through an iterative process of learning, negotiation and action (Regeer and Bunders 2009). The communities of practice concept, coupled with project-based learning, could provide a strong framework for the practice of transdisciplinary research and the development of science and policy interfaces.

Recommendations

This chapter has discussed how science-policy interfaces for scientific communities working on CCA and DRR can be enhanced through interdisciplinary and transdisciplinary research and actions. In a time of climate change, the DRR community should focus increasing attention on creeping changes and hazards that are very likely to occur or intensify due to climate change. CCA concepts and strategies would also benefit from a comprehensive consideration of long-term experiences of DRR in dealing with adverse events and disasters that are linked to extreme conditions and natural hazards.

Four components are considered fundamental to the concept of science-policy interfaces: outputs, processes, actors and context. Of these, actors, as the "people," are the driving force of a successful interface. Regarding outputs, basic Newtonian science can be seen to rest upon a search for universal knowledge free from political and societal influence. However, policies that engage with applied science in areas such as CCA and risk management place scientific results in the service of society or sometimes industry and hence should be more concerned with the use of scientific findings (Weiland et al. 2013). Most findings will be integrated as interdisciplinary and transdisciplinary knowledge.

Taking action to improve communication, access to scientific information and other underlying causes of broken bridges, will foster an atmosphere in which the scientific community can better respond to the needs of society. Through the implementation of iterative communication processes, policymakers will become better informed and the public will benefit from evidence-based policies. The scientific community will take its rightful place as an integral part of society, providing valuable contributions for handling climate change and environmental degradation, the pressing issues of the day (UNEP 2012). Eventually, tensions between science, policy and society will be reduced. Decision makers will have adequate knowledge to be able to effectively intervene in environmental problems, scientists will have more incentives to make their outputs policy-relevant and the public will support the intervention expenses. In sum, society will be more equipped and successful in managing the risks of global environmental change.

Knowledge production and brokerage are reflexive learning processes for which organizations and technology tools are necessary supporting elements as demonstrated by the aforementioned practices. Reflexivity is used here with reference to society's response to the unintended consequences of technological

development, which entails careful consideration of the limitations of the available information, the diversity of viewpoints and the multiplicity of possible policy options (Krayer 2005). It is essential that we become aware of the limitations of what we know and what we do not know. Stakeholders involved in decision-making have to change their attitudes towards uncertainties and mismatches. A proactive attitude that recognizes and accounts for uncertainty is required and mismatches must be perceived as a learning opportunity rather than as a battle to be fought and won.

Science is essentially a social process of knowledge production, subject to its own social and cultural biases (Krayer 2005). As researchers of climate issues, rather than aiming to provide an optimal technical answer, our role should be to participate in the collective effort of producing, evaluating and applying knowledge; considering the interests at stake and making necessarily provisional decisions. This requires a shift in researchers from being curiosity-driven and disciplinary-focused in their thinking to adopting an issue-oriented transdisciplinary approach. The concept of trans-disciplinarity and the theory of communities of practice provide us with a powerful approach for the transformation of knowledge production and dissemination. As a society becomes more aware of the complexity of the problems it faces and of the difficulties of addressing these problems through scientific approaches, the precautionary principle can be expected to gain influence.

While universities are and will remain key knowledge production systems, their potential for solving societal problems has not been fully mobilized (Thompson Klein 2004). If knowledge acquisition, selection, management and collaboration are to expand at all levels, deficits of human, structural-organizational, client and stakeholder capital must be overcome, and disciplinary, institutional and community resources must be integrated. Simply adding new lectures or training exercises within disciplinary courses is not enough. A secondary structure is needed to establish trans-disciplinarity and its reflexive power as “basic” education. The project-based learning approach that is practiced in the SFC curriculum demonstrates a new model of education and learning, although making the new model more competitive is still to be accomplished. Ways of rewarding researchers who dedicate themselves to evolving innovative approaches must be found, while policymakers, community leaders and enterprises should focus on strategic thinking rather than short-term economic returns.

Conclusions

Based on its overview of discourses on science-policy interfaces for climate change and disaster risk management, this chapter has clarified the definition and challenges of these interfaces and delineated a potential framework for building them through the adoption of trans-disciplinarity and the communities of practice concept.

Science and policy are inseparable from our postmodern society. Intersections of science and policy exist within every process of scientific research and political decision-making: outputs, processes, actors and contexts. There is no single defining model of these interfaces. Organizations like IPCC and the Intergovernmental

Platform on Biodiversity and Ecosystem Services can be viewed as examples of interfaces, but are limited in their scope. Information tools, conferences (including forums, symposia and workshop), people and facilities committed to strengthening communication between stakeholders are all relevant interfaces. Bringing together stakeholders at an early stage of knowledge production activities, including defining problems, designing processes, producing outputs and disseminating knowledge, is critical for addressing the challenges posed by uncertain and complex issues.

The development of interfaces requires researchers and policymakers to shift their focus from numbers of peer-reviewed papers to the outcomes of practices. The accomplishment of such a shift would consolidate interdisciplinary and transdisciplinary approaches. Based on our experience in the education field, we suggest that the communities of practice concept, coupled with the project-based learning approach, can provide a framework for developing effective science and policy interfaces.

The focus of this chapter has been on climate and disaster issues, but its discussion of concepts and methods for engaging with them also applies to many of the challenges humanity is currently facing. CCA and DRR are the most urgent issues for every individual and institution on this planet to engage with, and the most worthy subjects of interdisciplinary and transdisciplinary study aimed at attaining the future earth that we desire.

IX. Communicating Climate Change in the Hindu Kush Himalayas: Examples from Bhutan, India and Nepal

ANMOL JAIN,[32] DHRUPAD CHOUDHURY[33] AND NEERA SHRESTHA PRADHAN[34]

Background

Starting from the mid to late 1980s growing concern over climate change and variation has fuelled the need for communication of climate change (Moser 2010). There was a growing realization that climate change communication was essential for climate change adaptation (CCA), for increasing awareness and understanding and for engaging policymakers and the general public (Moser and Ekstrom 2010). However, much of the early climate change communication revolved around scientific research and reporting of extreme weather events, conferences or policy meetings (Weart 2003). In recent years, CCA stakeholders are increasingly engaged through multiple communications methods like Twitter, Facebook and other social networks.

The Adaptation Exchange page of the UNFCCC on Facebook, aims to provide a space for dialogue on adaptation to the impacts of climate change at all stages of adaptation planning and implementation. The Asia Pacific Adaptation Network's portal has also seen a growth in interest and so have many other groups that distribute information on climate change. However, it is realized that during this unprecedented time in history is seeing heavy competition for people's attention. However, it is not easy as different audiences need to hear the message in different ways and sometime who gives the message is as important as what is actually being said.

Climate change involves long time periods and is beset with complexities and uncertainties (Field et al. 2004) and these attributes make climate change communication a difficult process. It is argued that due to its complex nature, responding to climate change requires multiple knowledge sources for understanding the drivers, impacts and identifying responses to it (Hammill, Harvey, and Echeverria 2013).

Although climate impacts and adaptation actions are broadly local in nature, government actions help in enabling local initiatives for responding to climate change. Effective communication therefore assumes greater importance for responding to climate change (Renouf and Maibach 2010; Newig 2011).

Flow of information and knowledge from the grassroots to policymakers at state or national levels is essential for designing effective policies and programmes to

[32] Mr. Anmol Jain, (consultant) International Centre for Integrated Mountain Development (ICIMOD).
[33] Dr. Dhrupad Choudhury, Programme Manager, Adaptation to Change, ICIMOD.
[34] Ms. Neera Shrestha Pradhan, Water and Adaptation Specialist, ICIMOD.

enhance adaptation. However, knowledge gaps, particularly with regard to impacts of climate change, community based adaptation (CBA) and science and adaptation options continue to be a serious concern for policymakers with these gaps constraining their ability to design effective policy action and programmes.

In the context of the Hindu Kush Himalayas (HKH), geo-physical inaccessibility and socio-economic diversities among mountain communities pose challenges for effective communication between different stakeholders, particularly between state actors at local, state and national levels.

The lack of an effective flow of information and knowledge, thus, has emerged as a critical challenge for policymakers in ensuring effective policy action and practice to address adaptation needs of mountain communities. To bridge this information and knowledge gap, it is critical that effective communication approaches are identified and strengthened. In this regard, this study has assessed, documented and identified gaps and challenges in climate change communication in Bhutan, India and Nepal. It has also provided recommendations to meet these gaps and unmet needs.

This chapter is based primarily on desk-based research wherein data collection was done through an online questionnaire survey, and on a review of secondary literature. Interviews with key policymakers and planners were also conducted during various events. This chapter also reflects views and recommendations proposed at the conference on "Supporting Climate Change Adaptation Policy and Action in the HKH Region: Strengthening Communication Approaches for Science-Policy-Practice Interfacing" organized by the International Centre for Integrated Mountain Development (ICIMOD) and APAN in December 2013 in Kathmandu. This study was partially supported by core funds of ICIMOD, contributed by the governments of Afghanistan, Australia, Austria, Bangladesh, Bhutan, China, India, Myanmar, Nepal, Norway, Pakistan, Switzerland and the United Kingdom.

This assessment gathered inputs from decision makers, policymakers, development practitioners and planners at the district, state and national levels in their respective countries. Moreover, researchers and academicians engaged in CCA related research also formed a part of the survey. 25 respondents were surveyed online, out of which, six were from Bhutan, nine from India and ten from Nepal. Besides that, five key informants were interviewed during various workshops and events organized in India and Nepal.

The major data collected through online questionnaire survey and secondary data were categorized into need of climate change communication at various level of decision making, availability of information and source of information, what and how. A gap analysis was conducted to find out the major gaps in climate change communication. The study also showcases a successful case to communicate CCA from local to sub-national and national level. Based on these data, recommendations were derived to ensure regular flow of information specifically related to climate change.

Results and discussions

This section analyses the current nature and status of communication and also the perceived gaps.

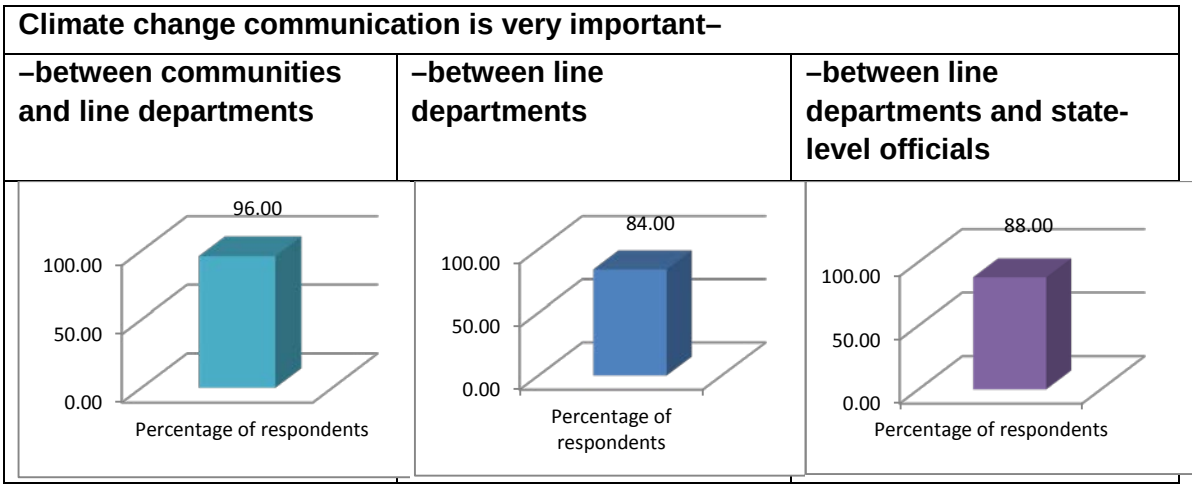
Climate change communication need assessment

The respondents of the online interaction highlighted the need for climate change communication and in fact all the respondents mentioned that communication was important in the context of climate change.

When asked about the need for climate change communication at various levels including that between communities and line departments, between line departments and also between line departments and state level officials the vast majority of respondents declared that climate change communication was very important (figure 1).

Moreover, 100 per cent of the respondents of the online survey stressed upon the need to improve climate change communication in Bhutan, India and Nepal.

Figure 1. Need for climate change communication at various levels



The outcome of the workshop held in December 2013 at ICIMOD also emphasized that good climate change communication between policymakers, scientists and practitioners can assist in understanding issues and making informed decisions.

Availability of information

According to the respondents, currently available information related to climate change at the national level in Bhutan, India and Nepal is overly generic and cannot be applied for adaptation at the local level. Findings indicate that information currently available at the National level broadly comprises:

a) Information on international climate policy, related to the United Nations Framework Convention on Climate Change (UNFCCC), and Intergovernmental Panel on Climate Change (IPCC) pertaining to global climate change;

b) National level data such as temperature, precipitation, carbon emissions and so on and broad trends of impacts of climate change on water resources, sea level, coastal areas, forests and agriculture; and
c) Hydro-meteorological, climatic and natural disaster-related information and data.

Some 16 per cent of the respondents also indicated that national-level data related to site-specific yet generalized information may be available. Such data pertain to local level climatic impacts and/or adaptation initiatives – generally based on assessments conducted by research organizations and NGOs. According to one respondent from India, information on climate change available at the National level was very broad and conceptual and at times it was not readily accessible to those who need it.

Little information is available to officials at the state (India) and district levels (Dzongkhag administrative district in Bhutan). Apart from disjointed information pertaining to global trends and global and national policies, district and state level officials were found to have very little information on climate change.

In the case of India, although the majority of states have prepared State Action Plans on Climate Change (SAPCC), these plans have little information pertaining to local level vulnerability and adaptation. It was however found that in Nepal[35] and Bhutan, assessments conducted under Local Adaptation Plans of Action (LAPAs) provide some information pertaining to vulnerability to climate change in some parts of the country but even this information could be deemed inadequate.

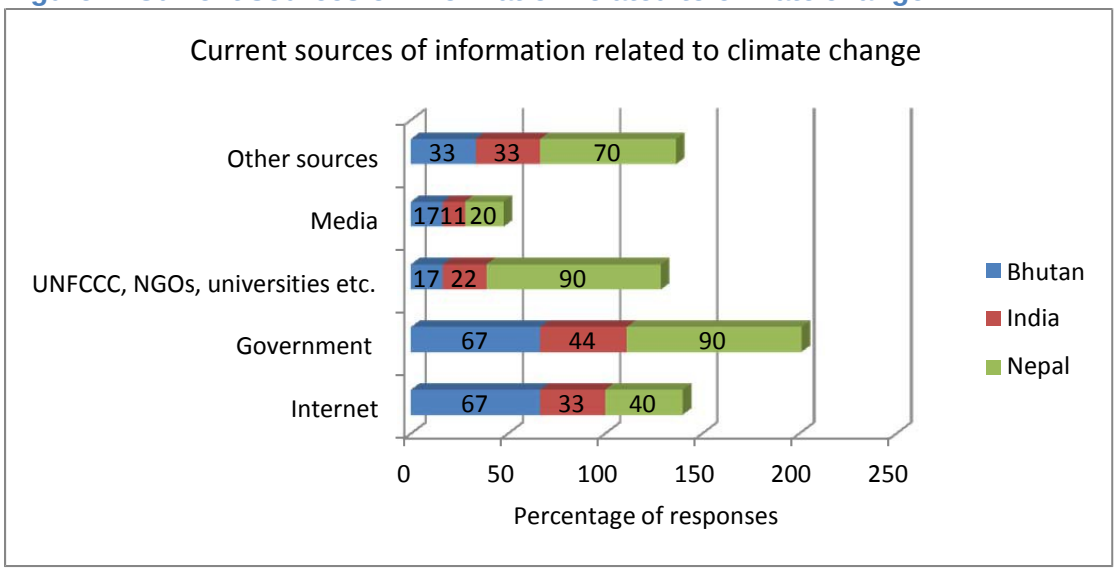
It was also discussed during the workshop held in December 2013 at ICIMOD that the data gap is a major problem in this region as mentioned in IPCC's AR4. Besides this, fragmentation of available data and data sharing is also a difficult issue to overcome in these countries.

Sources of information

Major sources of information on climate change at the national levels as well as sub-national levels in the three countries have been examined. Figure 2 indicates that 90 per cent of respondents in Nepal get information either from the Government or UNFCCC documents, NGOs and Universities. Likewise, 67 per cent of the respondents in India get information either from the Government or Internet resources and 44 per cent of respondents in Bhutan get information from the Government. This shows that the dependency of respondents on archive information is with the Government institutions, which maybe because Government resources are considered to be authentic and official. The availability of data at various levels is provided in the following sections.

[35] In Nepal, a vulnerability index has been developed for 70 Village Development Committees across 14 districts.

Figure 2. Current sources of information related to climate change



Notes: Other sources of information include media reports, seminars, workshops and consultations. The percentage of responses indicates that one respondent can provide more than one choices.

- ***At the national level***

For decision makers at the national level, 12 per cent of the respondents mentioned that UNFCCC and IPCC are an important source for information pertaining to climate change with a global perspective. Findings also indicate that in the context of India, the National Action Plan for Climate Change (NAPCC) provides the overall framework for Climate Change, including that of knowledge management activities. In Nepal and Bhutan the National Adaptation Plan for Action (NAPA) provides information relating to priority adaptation activities and projects (16 per cent of respondents).

In addition, 64 per cent of the respondents of the online survey reported that at the national level environment and forest ministries and departments,[36] hydrology and meteorological departments and disaster management agencies[37] are the main sources of information related to national level information on climate change and climate induced disasters.

16 per cent of the respondents mentioned media – including print and electronic media as well as social media – as an important source of providing information related to climate change.

Moreover, policymakers at the national level also mentioned having limited access to research reports by academic and research institutions focusing on global, regional and national level climate change concerns and issues. About 20 per cent of the respondents (mostly national level policymakers and planners) also mentioned that they were invited to participate in various climate change related workshops, programmes, consultations and discussions held by organizations such as United

[36] National Environment Commission (NEC) in Bhutan, Ministry of Environment and Forest (MoEF) in India and Ministry of Science, Technology and Environment in Nepal.
[37] Department of Disaster Management in Bhutan, National Disaster Management Authority in India and National Centre for Disaster Management in Nepal.

Nations Development Programme (UNDP), ICIMOD, World Wildlife Fund and the Energy and Research Institute, where they can learn about climate change.

The workshop held in December 2013 at ICIMOD discussed that most of the primary data are available with the respective Government departments, however, data management and access is difficult. The research institutes produce scientific information, but it needs to be translated into simple language so that decision makers at various levels can use it for informed decision making.

- ***At state and district levels***

At the State and District levels the sources of information related to climate change are rather limited comprising mainly of information flow through disaster management departments, hydro-meteorological departments and also agriculture department (particularly in the case of India). In case of India the SAPCCs (20 per cent of respondents from India) and in case of Bhutan (40 per cent of respondents from Bhutan) and Nepal (30 per cent of respondents from Nepal) the LAPAs also provide broad framework for climate change interventions to be implemented at local level.

However, district level officers in particular reported getting very limited opportunities for participating in workshops/seminars related to climate change and also reported having little access to national and global research on climate change. Although the decision makers at this level reported having access to Internet most of them stated that they rarely browsed the web for looking up climate change related information.

Existing flow of information

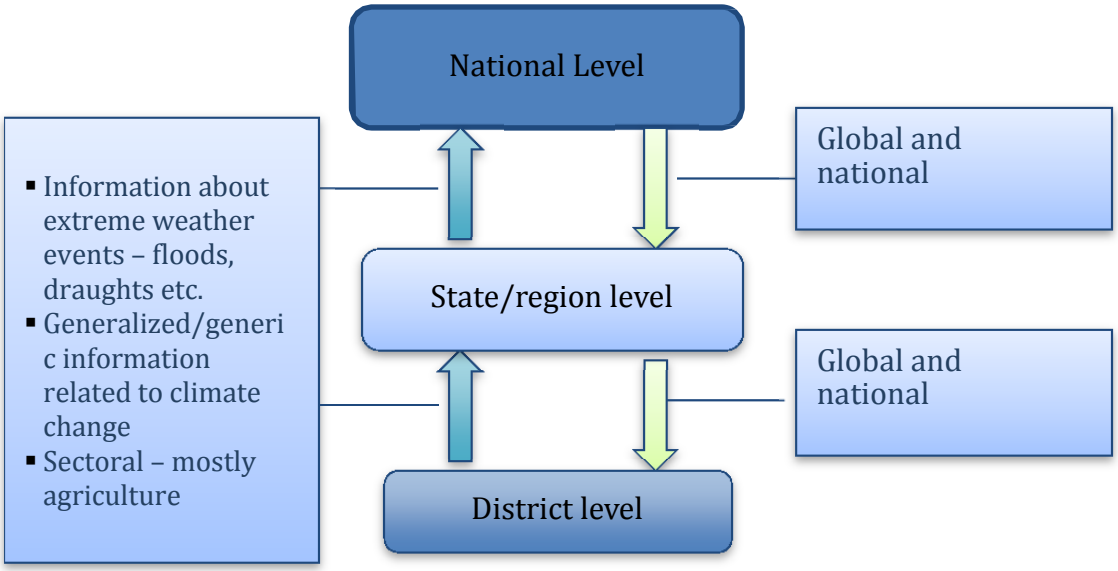
Findings indicate that the current flow of climate related information between the District levels to the National level in the study region mainly focuses on information about extreme weather events and natural disasters, particularly floods and droughts. This information flow for extreme events is frequently through mobile phone, SMS and television.

As far as other flows of information related to climate change between district level and national level is concerned, the information flow is rather weak and mostly generic in nature, focusing on information such as heavy rains, increase in temperatures during summers, lack of rainfall during certain months.

Analysis of sector-wise flow of information between the district level and national level reveals that whatever climate change related information is communicated it is mostly for the agriculture sector (figure 3).

Findings reveal that it is primarily the global and national climatic concerns which are communicated from the national level to the state level (in case of India) and to the district levels. However, such information flows have been reported to be quite sporadic and in many cases not simplified enough in order to enhance the understanding for decision makers at the district level.

Figure 3. Existing flow of climate change related information



Science-policy-practice interfacing and communication needs

The need for an effective interface between science-policy-practice and effective communication between scientists, policymakers and also local communities was stressed upon during the conference on "Supporting Climate Change Adaptation Policy and Action in the HKH Region: Strengthening Communication Approaches for Science-Policy-Practice Interfacing."[38]

A major emphasis was laid on the need for simplified interpretation of scientific findings for policymakers and the general public and the need to build capacities of those who can simplify scientific findings into easy to understand language in order to lead to better policy formulation. In this regard one of the respondents mentioned that scientists needed support of specialized people who could translate complicated scientific messages to customized packages targeting different pool of audiences. The need for scientists to have direct communication with policymakers was also emphasized. However, scientists also cautioned against oversimplification of scientific information, which they believed could lead to simplistic policy formulation.

The need for channels for effective communication between scientists and policymakers was also stressed upon by the respondents who encouraged dialogue between policymakers and scientists through policy drafting bodies within government.

The role of media was also emphasized by scientists and policymakers who mentioned that media could lay a major role in communicating climate change to policymakers and to the general public. While highlighting the need for capacity building of media, it was also suggested that there was a need for media houses to have an effective communication team wherein the communicators had proven capacities to be able to make a story interesting out of various events.

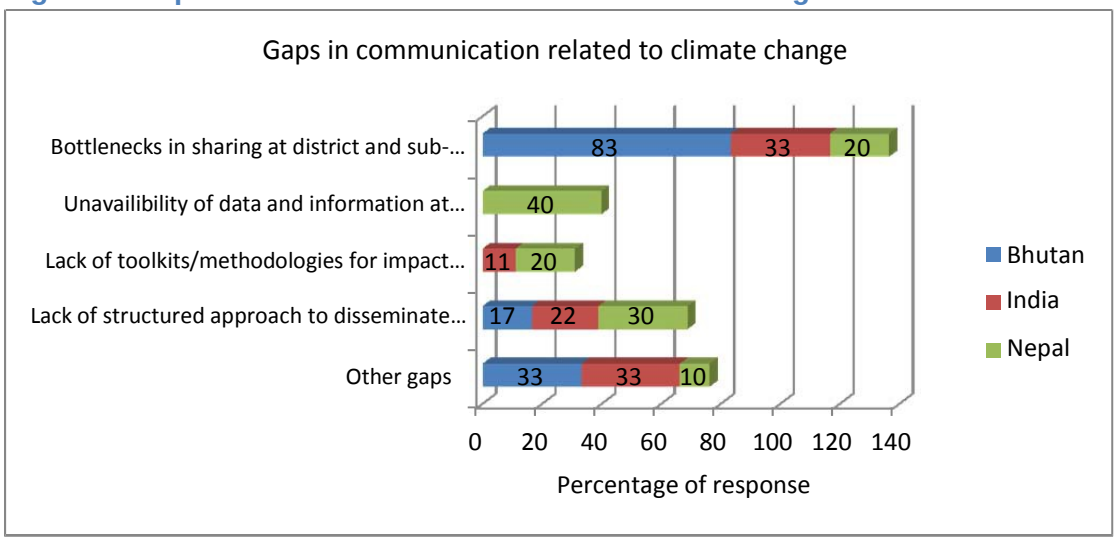
[38] This section is based on deliberations at a workshop organized by APAN and ICIMOD on 3-4 December 2013 in Kathmandu.

Gap analysis

Besides the communication gap at the "science-policy-practice" interface, the findings of the online survey also showed that information sharing at district and sub-district level is a major bottleneck (figure 3). This was noted in Bhutan where 83 per cent of respondents emphasized it as a problem, followed by 33 per cent in India and 20 per cent in Nepal. As mentioned by the respondents in Bhutan, this might be because the government officials at the district and *gewog* level are rarely involved or are provided opportunity to participate in national/regional forums nor the information from these forums trickles down at their level.

In Nepal, unavailability of data and information at the national level were of major concern for the respondents (40 per cent). Other gaps as raised by 33 per cent of respondents from Bhutan and India both include lack of adequate budget for climate change research and communication, absence of well-defined mechanisms to link research with development, sharing of recycled information and limited sharing of information by the media.

Figure 4. Gaps in communication related to climate change



Considering the responses from the online survey, key informant interviews and various workshops, the communication gap can be categorized into two broad components a) message to be communicated; and, b) manner in which is it communicated. This section looks at the gaps in existing pattern climate change communication with respect to these two broad aspects. The gaps relating to the nature of communicated information are being referred to as "Information gaps" and those relating to the manner in which they are communicated as "Process gaps." Some of the key points that came out from the survey are presented in table 2.

Table 2. Gap analysis at national and district and state levels

Available information	Information gaps	Process gaps
National level		
▪ Information on international climate policy ▪ National level data such as temperature, precipitation, carbon emissions and broad trends of impacts of climate change ▪ Impact of climate change on water resources, agriculture, forests ▪ Hydro-meteorological, climatic and natural disaster related information and data ▪ Site-specific but generalized information pertaining to local level climatic impacts	▪ Lack of availability of data and information at the policy formulating sections ▪ Circulation of recycled data and information ▪ Non-availability of comprehensive climate risk information ▪ Lack of Sector and region specific climate change vulnerability assessments ▪ Deficiency of reliable climate data ▪ Lack of adequate number of adaptation technologies	▪ Absence of intra-department institutional mechanisms for two-way flow of information related to climate change ▪ Lack of inter-sectoral coordination at the national level and inter-departmental coordination at the sub-national levels
District and state levels		
▪ Little information pertaining to local level vulnerability and adaptation (through SAPCCs in India and LAPAs in Bhutan and Nepal) ▪ Information pertaining to global climate change, global and national policy	▪ Lack conceptual clarity on climate change ▪ Uncertainty about the present and potential impacts ▪ Deficiency of reliable climate data ▪ Lack of climate prediction for long term climatic conditions at sub-district, district and state levels ▪ Non-availability of comprehensive district level climate change vulnerability assessments ▪ Little awareness about local level adaptation to climate change ▪ Absence of documenting and sharing of best practices	▪ Absence of intra-departmental institutional mechanisms for capturing local adaptation ▪ Weak extension programmes of agriculture and allied departments ▪ Weak interface between scientists and policymakers

Source: Online survey and interactions

Information gaps at the district and state levels

Although climate change is a much discussed and debated issue, the online survey and interactions indicate that there exist significant gaps with regards to awareness and understanding related to climate change among decision makers at the district (Bhutan, Nepal and India) and state levels (India). District and state level officials seemed to lack conceptual clarity even about the broader concept of climate change and some of them were even not sure about the present and potential impacts of climate change.

Respondents working at the district level in Bhutan reported that there was little information available at the district level and that climate change issues were only

discussed at the national level. It was also opined that many people at the district level felt that climate change was a natural process.

Findings highlight an urgent need to develop a coherent understanding of the sectoral impacts of climate change at the sub-district, district and state levels. Moreover, the following sections highlight specific information gaps at the district and state levels.

- ***Availability of climatic data***

Findings indicate that there is lack of reliable climate data at the district level. Respondents indicated that micro-level climate data – pertaining to temperature, precipitation, weather forecasts and hydrological flows basins – was not available for a majority of districts. For example, in case of Uttarakhand, India the state meteorological department only has 4 observatories across the state and none of these observatories is located at high altitudes (above 3000 metres above sea level) meaning reliable climate data is not generated at the district level. Findings indicated that the hill regions of Nepal had a much better network of meteorological stations as compared to India.

Decision makers and development practitioners working at the district and state levels also mentioned that the climate prediction models have not been scaled down to predict long term climatic conditions at sub-district, district and state levels.

- ***Vulnerability assessments and local adaptation***

Non-availability of comprehensive district level climate change vulnerability assessments has emerged as another key information gap. It was however, reported that in some districts of the study regions (particularly in Nepal) vulnerability assessments have been conducted in some areas. But it was also reported that even the available vulnerability assessments do not cover all sectors.

Among the various departments at the district and state levels there is little awareness about local level adaptation to climate change. Across the various sectors such as water, agriculture and horticulture there have been little efforts at the departmental level to document local adaptation and this was identified by the respondents of the online survey.

Information gaps at the national level

The findings of the online survey and interactions clearly established that the policymakers and planners at the national level had limited access to village, sub-district and district level information pertaining to climate change and its impacts. It was highlighted that there was a lack of an institutional process for documenting and disseminating information about climate change and its impacts from the district level to national level.

According to one of the key respondents from Nepal, the broad information gaps at the national level included a lack of availability of data and information at the policy

formulating sections, circulation of “recycled data and information” as well as the fact that problems and issues were being unnecessarily linked to climate change.

However, more specifically the respondents highlighted the following as the information gaps at the national level:

- ***Climate risk information and vulnerability assessments***

It has been observed that there is a general lack of comprehensive climate risk information at the national level. Current and projected socio-economic and ecological impacts of climate change at district, state and national levels have not been documented and collated.

Respondents from India and Nepal stated that sector and region specific climate change vulnerability assessments were not available at the national level. In fact it was felt that for preparing national vulnerability assessments there was a need to first prepare district level vulnerability assessments.

- ***National level climate data and adaptation technologies***

Respondents highlighted the need for reliable climate data at the national level. It was felt that the biggest gap was the non-availability of reliable micro-level climate data from across the country that could then be collated at the national level. The lack of an adequate network of meteorological stations at the district and sub-district level (particularly in the hill districts of India) and also an absence of adequate mechanisms to interpret climate data was also mentioned.

At the national level the lack of adequate number of adaptation technologies was recognized and the limited integration of CCA strategies into sectoral policies was a cause of concern.

Process gaps

- ***Mechanism for climate change communication***

First and foremost, it has been found that apart from the disaster management department there are no institutional mechanisms within the various departments for two-way flow of information related to climate change. There is little percolation of climate change related information from the National level downwards and similarly there is no vertical flow of information from the districts to the national level.

In all countries, extension programmes of agriculture and allied departments have been found to be quite weak which has meant that mountain farmers are unable to get accurate and timely information for adapting to climate change. Moreover, this also results in significantly reducing the opportunities for capturing feedback from the mountain farmers related to climate change impacts, coping and adaptation. One of the respondents from India was of the opinion that there was considerable room for sharing of appropriate and related information, from the National to sub-national, regional, district, sub-district and community organization level.

- ***Inter-sectoral convergence***

At present there is a lack of inter-sectoral coordination at the national level and inter-departmental coordination at the sub-national levels for adapting to climate change. In fact, agriculture and allied departments (e.g. horticulture, soil and water conservation, irrigation, fishery, forest and watershed departments) have been found to be working in isolation and there is very little inter-departmental communication and sharing, particularly on issues related to climate change. Such a situation is preventing the formulation and implementation of integrated strategies for adaptation to change.

- ***Climate change adaptation***

It was found that there is heavy reliance on studies conducted by universities, NGOs and researchers in order to get information pertaining to CBA initiatives. However, it was reported from Nepal that there was no established mechanism to incorporate the research findings into the policy making process.

There is also a lack of sound intra-departmental institutional mechanisms for capturing local adaptation in Bhutan, India as well as in Nepal. This has meant that documentation and sharing of community-based adaptation remains an area of concern.

- ***Science-policy interface***

Respondents have reported poor communication between scientists and policymakers from all the three study regions. In the case of India, it was reported that there was very limited interaction between district level officials of agriculture and allied departments and the *Krishi Vigyan Kendras*.[39] Moreover, decision makers (particularly those at the district level) informed that whatever information was provided by scientists was complex and not easily understood by them.

Showcasing of good practices: Adaptation Learning Highway

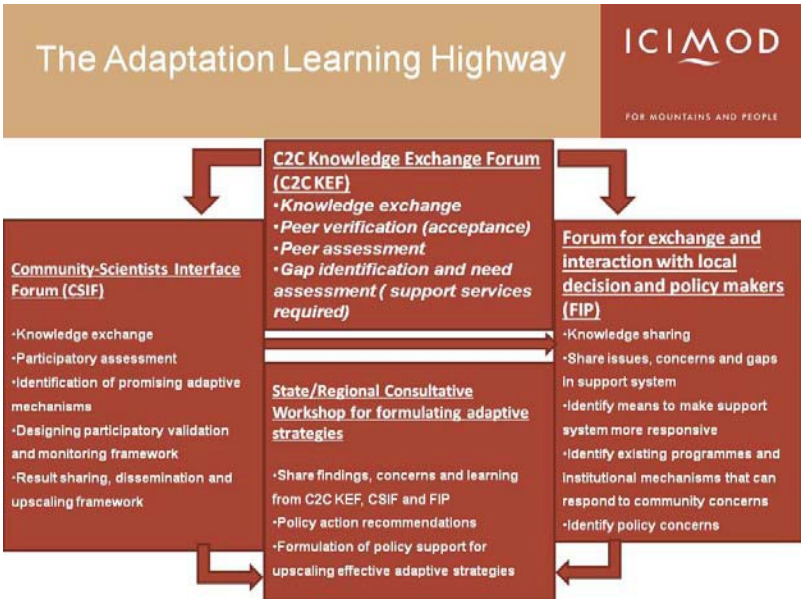
In the year 2010–2011 ICIMOD had successfully piloted a unique initiative to foster communication between communities, scientists and policymakers in a bid to contribute towards making planned adaptation more inclusive. Termed the "Adaptation Learning Highway" (ALH) this initiative was taken up in select districts in India (Uttarakhand and north-east India) and Nepal.

The ALH process

The ALH process aimed to capture, assess and disseminate autonomous adaptation mechanisms through cross exchange of knowledge between communities, scientists and policymakers. A diagram of the process is presented in figure 5.

[39] District level farm science centres established by the Indian Council for Agricultural Research (ICAR) for transfer of technology to the farmers.

Figure 5. The ALH process



- ***Community to Community Knowledge Exchange Fora***

This is the first stage in the ALH process wherein Community to Community Knowledge Exchange Fora were organized. The fora involved key informants from community groups drawn from different villages or village clusters as the main actors. Representatives from technical agencies, research institutions and line departments attended as observers, participating in the exchanges only when their expert opinion was sought. Knowledge exchanges were executed through focused group discussions facilitated by a mentor/facilitator.

Each forum focused on an identified theme (such as water stress, pest stress, temperature stress) and the facilitation encouraged community members to share impacts and concerns resultant of the identified stress and to draw out coping responses and adaptation mechanisms adopted by the community. The process resulted in a participatory verification, assessment and peer evaluation of the coping and adaptation mechanisms. Participants discussed scaling up promising adaptation initiatives, identified gaps in support services. They discussed the need to prioritize the help required from different agencies at local and higher levels. For a wider dissemination and effective exchange at subsequent meetings, the proceedings of the fora were captured through audio-visual recordings by a process documenter.

- ***Community-Scientists Interface Fora***

The second stage in the ALH process was the facilitation of interfaces between communities and the scientific and technical fraternity, the establishment of the Community-Scientists Interface Fora. The main objective of the initiative was to stimulate dialogue and exchanges between community members and scientists on the coping and adaptive mechanisms documented during the Community to Community Knowledge Exchange Fora and to initiate a participatory assessment of the adaptive mechanisms.

The Interface Fora consists of community representatives, particularly knowledge innovators (developers of promising adaptation mechanisms, and hence, the key informants identified during the community exchanges), representatives of technical line departments who were participants in the knowledge exchange fora and members of the scientific community (from relevant research organizations), together with representatives of civil society organizations.

Promising adaptive mechanisms identified during the community exchanges were introduced in the interface for discussion and evaluation. The merits (or demerits) of each identified adaptive mechanism were drawn out, encouraging viewpoints from both community and the scientific fraternity, in order to make objective assessments of each adaptive mechanism, and in the process, move towards identification of selected mechanisms for subsequent scientific validation. The result was the establishment of a sharing framework so that dissemination and up scaling strategy of validated mechanisms becomes incorporated in the process.

- ***Forum for interaction and exchange with policymakers (FIP)***

The third stage in ALH is the establishment of a mechanism for regular interaction and exchange with policy and decision makers at the local or district governance level. This process was based upon the reporting from the Community to Community Knowledge Exchange Fora and Community-Scientists Interface processes, sharing the opinions expressed about the promising adaptation mechanisms and innovations identified during different thematic exchanges and also highlighting issues, concerns and gaps in support systems that had been brought out during the exchanges. This interchange with policy and decision makers helped in identifying ways in which supportive services can be made more responsive as well as to identify existing programmes and institutional mechanisms that are designed to address such concerns but need to be made more pro-active and responsive. This forum also identified areas that require the action and attention of higher authorities if delivery mechanisms are to be made more effective and efficient.

- ***State/regional consultation workshop for the formulation of adaptive strategies***

The fourth and final stage of ALH is the State/regional level consultation workshop that brought together knowledge innovators, members of the scientific and technical community and representatives of local administration and line departments as well as the facilitating project partners.

The objectives of this workshop were:

(i) To share findings and lessons from all the forum;
(ii) To present of validation assessments by scientists;
(iii) To request policy action recommendations from policymakers based upon the different interactions; and
(iv) To use the platform for formulation of policy support for up scaling identified/promising and effective adaptive strategies in thematic areas.

The primary objective of this workshop was to set in motion a process that results in the formulation of adaptation strategies to respond to stress resultant to change. The

consultation helped in highlighting promising adaptation strategies developed autonomously as well as raise concerns identified in regard to up scaling of such promising mechanisms. The forum also sought to identify mechanisms required to translate such autonomous mechanisms into the formal planned adaptive strategies. Overall, the forum contributed towards policy refinement and formulation that supports building upon autonomous adaptation and thereby making planned adaptation more responsive.

Effectiveness of the ALH process

The ALH process emerged as a prolific 'process' tool for participatory discussions on the concerns and needs of mountain farmers in the aftermath of climate-induced stresses. ALH process provided for three levels of platform to engage all the stakeholders (community, scientist/technical experts and government) for dialogue and knowledge sharing, each interacting both horizontally (community to community dialogue) and vertically (between community and scientist or community and policymakers).

The ALH process:

- Increased farmers' awareness of climate change;
- Enabled mountain women to raise concerns and discuss their needs and priorities related to climate induced stresses;
- Helped to identify ways indigenous people are coping with and adapting to climate change (particularly through Community to Community exchanges);
- Validated local coping mechanisms and adaptation responses to climate change;
- Revealed gaps and constraints in the existing support systems. Processes should be examined further. Instead of 'lab to land' approach, we should rather follow the 'land to lab' approach and C2C and CSI platforms can be very useful to achieve this objective;
- Created awareness among scientists, line department officials and policymakers relating to the impact of climate change on mountain farmers; and
- Helped to sensitize the state machinery also about the problems being faced by farmers owing to climate change/variability.

Recommendations

Based on the opinions and perceptions of the respondents of the online survey several recommendations are being made in order to improve the flow of information and communication in order to ensuring effective policy action and practice to address adaptation needs of mountain communities in the HKH.

Capacity building and sensitization

It has been found that sensitization and capacity building of decision makers and line department officials at the district level (in particular) and state level is imperative in order to improve climate change communication. A capacity-building assessment of the requirements of decision makers, policy planners and implementers is taken up at the national level and also at the state level (in the context of India). The following

are some specific capacity building needs that have emerged at the district/state level:

- Government officials need to be sensitized about the present and potential impacts of climate change in order for them to realize and accept change;
- Capacity building in conducting vulnerability assessments and in examining and analysing the impacts of climate change on mountain communities;
- Enhanced capacities for identifying and capturing CBA initiatives and in facilitating the validation of such initiatives by the scientific community; and
- Providing opportunities for district level officials to attend workshop and seminars on climate change.

Knowledge platform

Interactions with national level policymakers highlight the need for a single window system for pooling and sharing climate change related information. It is recommended that there should be a knowledge platform at the national level to collate information from various organizations and sources and then disseminate at various levels and across all sectors. Such a national level institution could have its roots at the state and district levels such that a two-way communication mechanism is established.

In fact, in some of the SAPCCs in India the need for established "Climate Change Cells" within each department at the state/district level has been proposed. Perhaps such cells could then be linked at the national level with the knowledge platform.

Such an institution could have the following roles:

- Collection of information related to climate data, climate change impacts, vulnerability, adaptation and best practices from the district levels;
- Sector-wise compilation of information regarding climate change impacts and adaptation;
- Transfer generic information related to climate change to the districts as well as about related policies and programmes;
- Communicate to the districts about best practices and adaptation initiatives in various parts of the nation; and
- Periodically send theme based data and information, briefing notes and other desired information to identified institutions.

Regional cooperation

In the HKH region it is essential to move beyond the political confines and to establish a platform for sharing of information related to climate change at the regional level. Such a platform could help in:

- Sharing of valuable data and information – climate change vulnerability, impacts and risk analysis; and
- Sharing of adaptation technologies across the HKH region.

Departmental convergence

In order to have climate resilient development starting from the lowest levels departmental convergence is recommended. It is felt imperative for agriculture and

allied departments to shift from sectoral approach to an integrated approach based. Although this may be a challenging task but concerted efforts need to be made.

Science-policy-community interface

It is essential to improve the interface between scientists, policymakers and the communities. Dialogue between policymakers and scientists must be strengthened and simplified. For the mountain communities, the extension units of various departments (agriculture department in particular) need to be closely linked with scientific institutions for transfer of scientific information to the farmers.

For example, India has *Krishi Vigyan Kendras* and it is recommended that these district-level farm science centres need to use the extension units of agriculture and allied departments to disseminate information to the farmers.

At the same time the extension units of agriculture and allied departments need to be further strengthened by providing them more manpower and also sensitization of existing staff on climate change issues.

Local governance included in communication system

The three tiers of Panchayati Raj Institutions in India and the Village Development Committees in Nepal could be the appropriate vehicle for advancing the two-way communication systems related to climate change.

Emphasis on collection of quality climate data

There is a need to have a better data collection infrastructural and institutional mechanism in the study countries. The need is collect climate data at the district and sub-district levels through a wide network of meteorological stations and then based on the data develop climate prediction models – preferably scaled down to predict long term climatic conditions at sub-district, district and state levels. In fact, under the National Mission for Sustainable Himalayan Ecosystem of Government of India, “Doppler radars” have been proposed in the mountain states for accurate climate forecasting.

Vulnerability assessments part of district level planning process

Climate change vulnerability assessments are extremely important and they should be made part of the district level planning process so that periodic assessments are done and are shared with policymakers at the national level.

Empowering media

Media has an important role in communicating about climate change. However, findings indicate that media persons – especially those based in small towns in the mountains – do not have clear understanding and adequate capacities to report climate change or climate change related events. On many occasions problems may be unnecessary linked to climate change in the media reports and at times major climate issues may be ignored. There is a need to take up capacity building and sensitization workshops for the media in order for them to better communicate climate change to the public.

Conclusion

Climate change communication is an essential prerequisite for enabling climate resilient development, particularly in the context of mountain regions which are characterized by ecological fragility coupled with their remote geo-physical inaccessibility and socio-economic diversity.

It is imperative for policymakers and planners to internalize the issues of climate change prior to the planning process; the district and state level officials need more information and enhanced capacities for implementing and mainstreaming CCA; and, mountain communities need to be strengthened to demand CCA activities in local level programmes and plans.

However, findings have indicated that a major weakness of the current development paradigm in the mountain regions of Bhutan, India and Nepal is the lack of adequate communication between communities, line department officials and national level policymakers and planners.

It has been observed that a linear model of communication and policy development is being followed and policymakers are not aware of the ground realities. In the current context, bottom up communication comprising of impacts of climate change at the grassroots, community vulnerability to change, local level climate data and CBA initiatives seem to be non-existent.

On the other hand, the decision makers at sub-national levels have limited capacities and conceptual understanding about the concept of climate change and the present and potential impacts of climate change.

It therefore seems imperative that urgent efforts may be made to improve the flow of information and communication related to climate change in the region. While there is a strong need to establish linkages between local, national, regional and international adaptation efforts it is also deemed necessary that a non-linear policy process is adopted. For this there is a need for two-way flow of information between the sub-district and district levels to the national level and a need for enabling institutional mechanisms needs to be explored. Moreover, efficient and meaningful interface between scientists, policymakers and communities must be achieved,

At the regional level, the countries in the HKH region need to move beyond their national boundaries and establish a regional platform for communication and sharing of information pertaining to climate change.

X. Monitoring and Evaluation of Climate Change Adaptation Initiatives in South-East Asia

CATHERINE B. DIOMAMPO[40]

Key messages

- Monitoring and evaluation (M&E) of climate change adaptation (CCA) initiatives is still an emerging field. Frameworks, tools and approaches have been developed and are still being developed in order to address challenges to M&E posed by the inherent characteristics of adaptation initiatives.
- All countries in South-East Asia recognize the importance of M&E but they differ in terms of developing M&E systems for CCA initiatives at the national level. Some are in the final stages while several countries are still in the initial or conceptual stages. To date, no M&E system has been put in place in the region.
- Establishment of an M&E system for CCA is closely linked with each country's progress in adapting to climate change. That is, countries which spend (receive) a considerable amount of adaptation financing (more experienced in implementing CCA initiatives), are more likely to be ahead in developing an overarching M&E system.
- While there are a number of issues relating to M&E of CCA initiatives, the more cross-cutting challenges in CCA supersede these M&E issues. Common CCA challenges in South-East Asia include lack of coordination among ministries, poor execution of written plans/strategies and lack of resources (e.g. financial and technical).
- The most commonly used M&E tool at the national level in South-East Asia is the Theory of Change, while different frameworks are being adopted by some countries.
- Information on countries' efforts to monitor and evaluate their CCA programmes and projects in an integrated manner is very limited. Therefore, there remains a high potential for augmenting capacity building and knowledge transfer on CCA M&E in the region.

Background

South-East Asia has been identified as being one of the most highly vulnerable regions to the impacts of climate change. This vulnerability has been attributed to various factors:

- Geographical – as a tropical region which is prone to monsoon rains and typhoons, high sensitivity to increase in average temperature, coastal urban cities;

[40] Ms. Catherine B. Diomampo, Project Officer, ICLEI Local Governments for Sustainability - Southeast Asia Secretariat (ICLEI SEAS).

- Geological – low-lying archipelagos exposed to sea level rise (Indonesia, Malaysia and the Philippines); shared Mekong river basin (Cambodia, Lao PDR, Thailand and Vietnam);
- Economic – many developing economies with main livelihoods dependent on climate-sensitive natural resources; and
- Social factors – poverty, continuously growing populations and lack of adaptive capacity (Lian and Bhullar 2010, Resurreccion *et al.* 2008).

South-East Asia is exposed to the impacts of climate change, which have been evident in severe flooding, drought, forest fires, coastal erosion and rain-induced landslides. With climate change impacts expected to worsen, there is a need for vulnerable countries to adapt in order to prevent further economic and social losses.

Countries in the region have recognized the importance of CCA and have started to respond to its challenges. Institutions and policies are already in place and programmes and projects aimed at increasing climate resilience have been implemented. In fact, around 17 per cent of climate financing sources for CCA have been mobilized to aid vulnerable South-East Asian countries in meeting the high costs of adaptation (Climate Funds Update 2013). Various development agencies, international organizations and academic institutions also assist in capacity-building, technology transfer and research that contribute to informed decision-making. Yet, this information is not enough. The next important questions are:

- What would justify the effective use of these funds?
- How do we know if these efforts were actually yielding the desired outcomes?
- How do we measure the effectiveness of these interventions?
- What would be the indicators that would demonstrate an increase in resiliency and/or adaptive capacity of the vulnerable population?

These questions can be addressed by M&E.

The establishment of an M&E framework for CCA is challenging because of the complex 'nature of adaptation, a lack of agreed metrics, the difficulty in attributing cause and effect and unintended negative side effects' (UNFCCC 2010). CCA initiatives are cross-cutting in nature and some interventions are sector-specific, which require more customized set of indicators.

The good news is, various frameworks and tools for M&E have been developed by donor agencies, research institutes and international organizations in order to aid policy-makers for better and more effective delivery of CCA interventions. However, at present "no systematic M&E system for CCA has been put in place by any South-East Asian country" (IGES, SEARCA 2013, 32). This stresses the need to examine the current situation in order to identify barriers in setting up an M&E system in the region and to explore various options for monitoring and evaluating CCA initiatives available so that governments would be guided when preparing their CCA M&E system.

This chapter delves into the relevance of M&E of CCA initiatives under the following sub-sections:

- Developments of CCA in South-East Asian countries;
- Regional trends in terms of adaptation priorities and strategies in CCA;
- CCA M&E – issues, frameworks, approaches and tools (identification and analysis);
- South-East Asian countries' updates in developing CCA M&E systems; and
- Gaps and challenges of M&E of CCA in South-East Asia and recommendations.

The first two subsections are aimed at illustrating the level of progress of South-East Asian countries in terms of adapting to climate change. This is important because the status of CCA and regional trends is closely linked with how M&E can be operationalized in the region. The discussion on CCA M&E aims to broaden the understanding of the issues as well as the various approaches, tools and frameworks regarding CCA M&E. At the same time, an overview of how these complexities are being addressed through various approaches, tools and frameworks regarding the subject matter. This section aims to provide useful information on what and/or how to use various M&E instruments and under what circumstances. This will also give base knowledge for the discussion on the CCA M&E systems being developed in South-East Asian countries. Through the analysis and discussion of available information on M&E of CCA in the region, gaps and needs will be determined and these can be used as valuable input for future recommendations.

The methodologies used include a desk review of government reports (e.g. National Adaptation Programmes of Action (NAPAs) and National Communications to the UNFCCC), conference presentations and an online survey distributed by ICLEI South-East Asia to the climate change focal points of each South-East Asia country. However, the very low response rate in the survey led to high reliance on secondary data, which became the limitation of this study. This is very critical especially for Brunei Darussalam and Timor Leste as these countries have very limited available information on their climate change actions. In particular, Brunei has yet to submit its Initial National Communication.

CCA trends in the region

South-East Asian countries have demonstrated increasing active participation in addressing climate change. All countries in the region are signatories of the UNFCCC, which signifies their recognition of the 'common but differentiated responsibilities' and their commitment to respond to the challenges of climate change in terms of both mitigation and adaptation. Among the South-East Asian countries, Brunei Darussalam and Timor Leste are the newest signatories, having ratified the treaty only in 2007 and 2006 respectively (UNFCCC 2013a). Each country is required to periodically submit its National Communication that would provide the country's progress in addressing climate change. Least developed countries (LDCs) which include Cambodia, Lao PDR, Myanmar and Timor Leste have also submitted

their NAPAs, with Myanmar making the most recent submission only in 2013 (UNFCCC 2013b).

In many South-East Asian countries, formal institutions in charge of climate change exist and these were established either as independent bodies directly under the head of state (president or prime minister) or as special divisions within the ministry of environment. Though the names of these institutions vary, several of these are independent and are supported by and/or composed of representatives from several ministries, thus acknowledging the cross-cutting nature of climate change.

In terms of policy and planning, the majority of countries in the region have progressed in mainstreaming climate change in their development plans and also in creating their Climate Change Strategic/Action Plans. In several cases, CCA plans and strategies are combined with strategies for mitigation. In Indonesia and the Philippines, specific CCA action plans/strategies have been developed in addition to the overall climate change plans - Indonesia's National Action Plan for CCA (RAN-API) and the Philippine Strategy on CCA (2010–2022).

However, there are a few countries which have yet to develop their CCA plans and strategies. Brunei must first conduct its vulnerability/impact assessment to be able to formulate its climate change plans/strategies (Yusra 2013). Similarly, “no previous studies on the vulnerability of Myanmar to climate change have been undertaken, and hence no adaptation strategy or action plan has been developed” (Ministry of Environmental Conservation and Forestry 2012, xv). For LDCs in the region, the submission of their NAPA is an important step towards forwarding CCA efforts. For Myanmar and Timor Leste, which submitted their NAPAs at a later stage, priority CCA actions have been identified, but specific adaptation action plans and policies still have to be developed.

The core CCA priority sectors in the region include Agriculture, Water Resources, Coastal/Marine Resources, Forestry, Biodiversity and Health, according to the review of countries’ National Communications to the UNFCCC and NAPAs (table 1). The three most common priorities among South-East Asian countries (excluding Brunei) are Cross-Sectoral, Water Resources and Health. Agriculture and Water Resources remain important sectors both for livelihood and food security, thus becoming high CCA priorities for a majority of the countries in the region. This is especially true for countries with high percentages (more than 50 per cent) of labour force engaged in agricultural activities such as Timor Leste, Cambodia, Lao PDR and Vietnam.

As expected, CCA priority sectors reflect the characteristics and vulnerabilities of each country. For example, agriculture and forestry are not priority sectors for Singapore – being a highly urbanized island-state with very small land area. Instead, it identified the Urban Heat Island effect as a priority due to high population density and energy-intensive manufacturing-driven economy. Similarly, Lao PDR did not identify coastal/marine sectors as one of its priorities because it is landlocked. Water resources account for management of the Mekong river.

Table 1. CCA priorities in South-East Asia

Country	Agriculture	Water resources	Coastal/ marine resources	Forestry and biodiversity	Health	Energy/ industry and transport	Infrastructure	Urban heat island	Cross-sectoral
Brunei				✓					
Cambodia	✓	✓	✓	✓	✓				✓
Indonesia	✓	✓	✓	✓	✓				✓
Lao PDR	✓	✓		✓	✓				✓
Malaysia	✓	✓	✓	✓	✓	✓			✓
Myanmar	✓	✓	✓	✓	✓	✓			✓
Philippines	✓	✓	✓	✓	✓				✓
Singapore		✓	✓		✓			✓	✓
Thailand	✓	✓	✓	✓	✓				✓
Timor Leste	✓	✓	✓	✓	✓	✓	✓		✓
Vietnam	✓	✓	✓	✓	✓	✓			✓

Note 1. Brunei has an incomplete listing because it still has to prepare its CCA plan of action.
Note 2. Cross-sectoral refers to activities that are applicable to more than one sector such as capacity-building, policy mainstreaming and awareness-raising.
Source: ICLEI SEA

Adaptation initiatives

Several countries have explicitly stated in national communications that they will adopt adaptation strategies with win-win outcomes. This is accurate to the normative statement by the Global Environment Facility (GEF) (2011) stating that "adaptation projects include trade-offs and synergies with sustainable development objectives, so there should be priority to no-regrets and low-regrets measures, preventing maladaptation measures and accounting for the environmental and social impact of the adaptation measures themselves." This means that they implement adaptation actions that would bring other benefits aside from reduced vulnerability or increased resilience to climate change

An investigation of existing and planned actions for each priority sector in each country reveals common adaptation strategies in the region (table 2). The table was created by adopting the 12 broader adaptation actions identified by Institute of Development Studies (Hedger et al. 2008). A widely-implemented win-win adaptation strategy, 'improving infrastructure', is being applied in almost all sectors identified. Other common strategies include changing practices, developing planning systems, raising awareness and establishing monitoring/warning systems.

Table 2. Adaptation strategies for each priority sector

Adaptation Strategy	Sectors									
	Agriculture	Water Resources	Coastal / Marine Resources	Forestry	Biodiversity	Health	Energy and Transport	Infrastructure	UHI	Cross-sectoral
Changing Natural Resources Management Practices	X	X	X	X	X	X	X			
Building Institutions	X	X	X	X		X				X
Launching Planning Processes	X	X	X		X	X	X		X	X
Raising Awareness	X	X	X	X		X	X			X
Promoting Technology Change	X	X	X	X		X	X			
Establishing Monitoring / Early Warning Systems	X	X	X	X		X	X			X
Changing Agricultural Practices	X	X	X	X						
Empowering People	X		X	X			X			X
Promoting Policy Change	X	X		X				X		
Improving Infrastructure	X	X	X	X		X	X	X	X	X
Providing Social Protection	X		X							X
Other Strategies	X	X	X	X	X	X	X		X	X

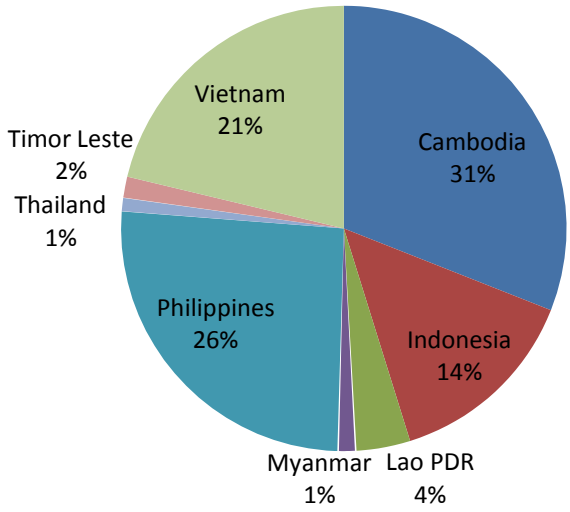
Note: 'Other strategies' include providing other incentives, distributing wooden boats, inter-basin water transfer, establishing conservation corridors and gene banks.
Source: ICLEI SEA.

Financing CCA

Governments have begun to act but most the high cost of adaption is a challenge. Bilateral and multilateral financing sources for CCA are available to aid vulnerable countries in South-East Asia in increasing their resilience and adaptive capacity. A majority of funds are delivered as grants in the form of official development assistance (Climate Funds Update 2013).

At present, Cambodia is the top recipient of CCA financing in the region (figure 1). Being an LDC and having submitted its NAPA early, it was eligible to apply for adaptation financing from several sources. The next top recipients are the Philippines, Vietnam and Indonesia, which are each highly vulnerable to the impacts of climate change (e.g. extreme weather events, flooding and sea level rise). On the other hand, Brunei, Malaysia and Singapore have received negligible CCA funding, most probably due to their middle to high-income status.

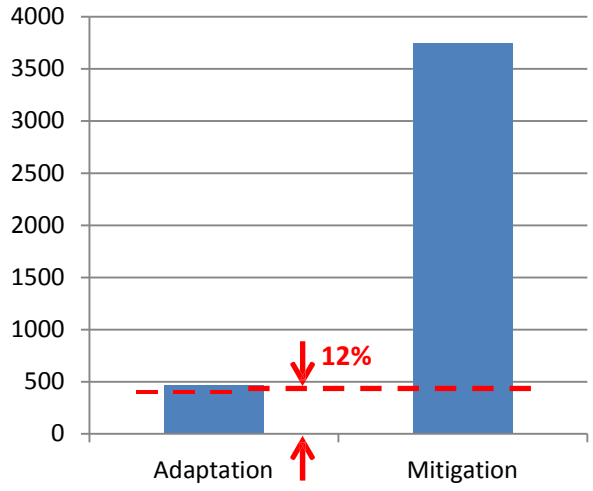
Figure 1. Country distribution of CCA funds



Source: Climate Funds Update (2013)

Adaptation financing in the region still entails efforts to be able to achieve its full potential. It accounts for only around 12 per cent of financing being used for mitigation (figure 2).

Figure 2. Thematic distribution of climate funds



Source: Climate Funds Update (2013)

Furthermore, high reliance on public sources (grants) is not sustainable as these are limited and unlikely to meet high adaptation costs. Thus, governments are encouraged to be more open in accepting loans "empower local government units, mobilize funding, engage private sector, and seek alternative financing options" (IGES and ICLEIa 2013).

Since there is a significant amount of climate financing that flows into countries like Cambodia and Indonesia (mostly for mitigation), there have been efforts to ensure that these resources are being accounted and used accordingly. At present, these two countries have established trust funds responsible for mobilizing climate change financing to advance both mitigation and adaptation initiatives. Cambodia Climate Change Alliance Trust Fund is focused on mobilizing funds for capacity building at the national and local governments (CCD-MOE 2013a). On the other hand, Indonesia Climate Change Trust Fund combines international with national funding while attracting investment even from the private sector (ICCTF 2012).

Common barriers in the region

In spite of the progress of South-East Asian countries in promoting CCA, several challenges still remain. A summary of the common challenges being faced in the region is summarized in table 3, based on country reports to UNFCCC. While there are countries that are advanced in their CCA interventions, there are still some that lag behind.

Countries at the initial stages of implementing CCA initiatives (e.g. East Timor, Myanmar and Brunei), still lack the climate change institutional and legal framework, while others have limited assessment of climate change impacts. Lack of these measures demonstrates a huge potential in advancing CCA in these countries. It is worth noting that Brunei, even if it has the financial resources, seems to be trailing behind compared to its neighbouring countries.

Countries with relatively longer experience of implementing CCA initiatives already have formal institutions, plans and policies in place. However, the most common problems encountered are lack of coordination and integration. This is important because climate change issues cut across many sectors and involve different levels of government. Other challenges include fragmented or sometimes overlapping responsibilities between, for example, the ministry of environment and an autonomous climate change office performing similar functions and roles.

Also, in most countries in the region there is insufficient knowledge, technology and human and financial resources. As many countries in South-East Asia are still developing, CCA has to compete with other development priorities for budget allocations. This presents an opportunity to further enhance the integration of CCA into development agendas as the cost of failing to adapt to climate change would be higher (Withey *et al.* 2009) in terms of loss and damages.

Moreover, although not included in the country reports, South-East Asian countries also face numerous challenges at the local level. Brommelhorster (2009) stresses the need "to better understand climate change challenges, in particular at the local level" for provision of better interventions. In spite of the existence of CCA initiatives at the local level, it is important to further augment education, capacity building and involvement of local governments and the

community/public in the issues of climate change as they will be the most impacted. Equally crucial is improving the coordination between national and local governments.

Table 3. CCA challenges in South-East Asia

Category	Specific challenges
Institutional	• Lack of multi-sectoral cooperation and collaboration • Lack of coordination among ministries/agencies • No climate change unit/secretariat (Myanmar, Timor Leste) • Fragmentation of responsibilities (e.g. for climate change, natural resource management, and disaster risk reduction)
Policy/Planning	• Weak national communication • Lack regulatory framework: no specific climate change laws/regulations/policies and plans/programmes (Myanmar, Brunei) • Limited integration of climate change in national policies and programmes like sustainable development plans; need for a holistic approach for poverty reduction and CCA • Poor integration of vulnerability and adaptation strategies (e.g. climate scenarios and new analytical approaches) into various sectors • Uncoordinated planning and tends to be short-term • Limited programmes for developing/disseminating climate forecast • Lack of on-the-ground adaptation intervention demonstrations • Lack of effective M&E actions and measures in policy/planning
Capacity	• Limited public awareness on climate change issue • Lack of community awareness and knowledge of climate change • Limited public participation and community-based initiatives • Lack of skills/ expertise in climate science, modelling, forecasting and socio-economic impact assessment especially in government agencies • Poor understanding of CCA benefits • Lacks institutional and administrative capacity, technology development and transfer, education, training
Technical	• Shortage of technical experts/skills, limited technical capacity of national and local stakeholders • Difficult to downscale available data (global/regional to local scenarios) • Lack of scientific and technical data (climate data) or incomplete database (especially locally relevant and useful info) • Difficulty in accessing data • Lack of methodologies, development models and tools for technological needs: impact assessment/V&A and adaptation measures development • High uncertainties and limitations of climate scenarios/simulation • Need to develop techniques and technologies for specific CCA interventions
Financial	• Inadequate financial resources • Significant upfront investment for technologies

Source: ICLEI SEA (compiled from UNFCCC reports).

M&E of CCA interventions

Overview

The Organisation for Economic Co-operation and Development (OECD) defines monitoring as "a continuing function that uses systematic collection of data" in order to gauge the progress of an intervention, while evaluation is "the systematic and objective assessment of an ongoing or completed project, programme or policy, its design, implementation, and results" (OECD 2002). M&E is important because it can check and assess whether an intervention is on the right track in meeting its objectives and it can serve as a guide on what should be done next. That is to say, the main aim of M&E is ensuring targeted actions for the achievement of identified outputs and outcomes.

'The complexity of adaptation actions across scales and context means that monitoring and learning are important components of effective adaptation' (IPCC 2014). Indeed, M&E in the context of CCA is crucial and this has been recognized. In fact, there has been a sudden interest in CCA M&E in the past couple of years and this may be attributed to the influx of CCA financing aimed at mobilizing $100 billion each year until 2020 as agreed by developed countries under the Cancun Agreements (UNFCCC 2012). This significant increase in financial support makes CCA M&E a 'headline issue' (Villanueva 2011, 9). Other reasons that emphasise the importance of CCA M&E include: "gathering political momentum, evolving approaches to evaluation of development assistance and increasing understanding of adaptation and its relationship with development" (Hedger, et al. 2013).

CCA M&E would be able to "evaluate effectiveness, assess efficiency, understand equity, provide accountability, assess outcomes, improve learning, improve future interventions and compare with other similar interventions" (UKCIP 2011). In a nutshell, M&E for CCA is a tool for learning because it can identify if things are being done properly or if the proper things are being done for a better and more informed decision-making (UKCIP 2011). More importantly, M&E is crucial at the present context because "national, sectoral, and project-based adaptation plans and policies now emerging are largely in their infancy and relatively untested" (Spearman and McGray 2011). This role is vital especially in a challenging area where more needs to be learned.

Challenges of CCA M&E

"Monitoring and evaluation of adaptation is one of the weakest areas of adaptation practice" (GSDRC 2013). A great deal of attention has been given to better address the issues and challenges of CCA M&E. It is worth noting that CCA M&E was chosen to be the focus of the first workshop organized by UNFCCC. This is only one of the numerous efforts dedicated to understanding of the topic. South-East Asia Change – An Asian Community of Practice for M&E of climate change Interventions – spearheads CCA M&E knowledge management and generation and has been emphasising the need for improvement, especially in the Asian region.

The challenges of CCA M&E can be attributed to the inherent characteristics of CCA, which make it unique from other interventions. These challenges are:

- **Uncertainties related to future events:** This refers to the progress of climate change, the shift of natural and human systems and factors that would affect vulnerability over time. These uncertainties may lead to 'moving targets' or 'shifting baseline'.
- **Lack of agreement on the definition of 'successful' adaptation:** There are various definitions of effective adaptation, as shown by different criteria for 'success' (table 4). There is no blanket solution for everybody. One successful adaptation intervention in one area might not be as effective (or might even increase the vulnerability) in other areas (UKCIP 2011). This makes benchmarking (determining what should be measured) difficult.

Table 4. Criteria for measuring adaptation

Document	Criteria for 'successful' adaptation
UNFCCC	Effectiveness, relevance
IDS	Effectiveness, flexibility, equity, efficiency, sustainability
IIED	Feasibility, efficacy/effectiveness, acceptability/legitimacy, equity, sustainability
GEF	Relevance, effectiveness, efficiency, results, sustainability
SCR	Effectiveness, efficiency, equity, legitimacy and sustainability

Source: ICLEI SEA.

- **Broad range of adaptation options:** Adaptation strategies are cross-cutting in nature. It is being planned and implemented at different levels, various scales and across sectors. Thus, an effective M&E would need a strong coordination among all related stakeholders. Moreover, this makes measurement and aggregation of indicators difficult.
- **Different timescales:** Several adaptation actions implemented at present may only take effect in the future (long timescale). This makes M&E implementation difficult because it should also consider periods well beyond a project's cycle.
- **Need for counterfactuals:** In some cases, success of an adaptation strategy is based on a negative event not happening (impacts are avoided). Dealing with counterfactuals is difficult and this makes M&E complicated.
- **Fuzzy cause and effect (attribution):** Many adaptation interventions fall in between the adaptation-development spectrum. It is difficult to separate the stand-alone effect(s) of an adaptation intervention from what would have happened anyway. Making things more complicated is the accounting of unintended consequences (GSDRC 2013, Spearman and McGray 2011, Bours et al. 2013, and UNFCCC 2010).

On top of these, common CCA challenges include lack of resources (financial, human and technical), low capacities, lack or unavailability of data and historic trends, as well as insufficient information dissemination and sharing among relevant stakeholders (GSDRC 2013). Moreover, segmented governance, conflicting values, lack of adaptation champions are some constraints to CCA implementation that highlight the importance of recognising adaptation as a complex social process (IPCC 2014).

Photo credit: ICLEI SEA

Frameworks and tools for M&E of CCA interventions

There has been a proliferation of studies that identify and discuss complex issues involved in M&E in the context of CCA. Various frameworks, tools and approaches have been developed in order to aid policy-makers and practitioners in dealing with the complexities and challenges of monitoring and evaluating CCA interventions. South-East Asia Change and the United Kingdom Climate Impacts Programmes (UKCIP) recently released a comprehensive report compiling 16 relevant frameworks, tools and approaches that have been established so far (Bours et al. 2013). The aim of the report was to "help M&E practitioners and CCA programme managers understand the state of play of CCA M&E, and also provide guidance in choosing which materials are best suited to the needs at hand." The report briefly describes the purpose, summarizes the content/approach and explains the applicability and contribution of each study. It also provides a summary of target sector and users, type of resource, method/approach used, content details and level of applicability. The studies reviewed are listed in table 5.

Many studies on CCA M&E emerged only within the last two years, the same period when the first phase of several fast start financing (bilateral agreements such as the Hatoyama Initiative (Japan) and the International Climate Change Adaptation Initiative (Australia)) ended (in 2012). The earlier frameworks developed by the United Nations Development Programme (UNDP) (2007) and the Institute of Development Studies (2008) provided a good conceptual base for subsequent studies (Bours et al. 2013). The development of the studies through time suggests a process of learning where later studies critique shortcomings and learn from earlier works – identifying "how to better approach CCA M&E" and defining principles of "effective" adaptation.

However, this does not imply that later works are better than earlier ones. It depends on the particular purpose of the study and its contribution to the broad debate. A quick look at the overview of the characteristics of each study shows that each has a distinct feature, wherein no two studies have the same set of checkmarks. This means that each study is unique in its own way – although some might have similar content, each would still have a different approach or focus. Some studies are innovative, while others are simple but provocative. Some are time-consuming (8), while others are resource intensive (12).

Table 5. Studies about CCA M&E

Title	Institution/Organization	Date released/ published
1. M&E framework for adaptation to climate change	UNDP	July 2007
2. Evaluation of adaptation to climate change from a development perspective	Institute of Development Studies	August 2008
3. Learning to ADAPT	Strengthening Climate Resilience (SCR) – prepared for the Institute of Development Studies, Christian Aid and Plan	September 2010
4. Making adaptation count	Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ), Bundesministerium fur wirtschaftliche Zusammenarbeit und Entwicklung (BMZ) and World Resources Institute	July 2011
5. Tracking progress for effective action	Global Environment Facility – Evaluation Office (GEF-EO)	August 2011
6. M&E for adaptation	OECD	November 2011
7. AdaptME Toolkit	UKCIP	November 2011
8. Tracking adaptation and measuring development (TAMD)	International Institute for Environment and Development (IIED)	November 2011
9. Climate change adaptation monitoring and assessment tool (AMAT)	GEF	June 2012
10. Participatory monitoring, evaluation, reflection and learning (PMERL) project for community-based adaptation	CARE	June 2012
11. Climate resilience framework training manuals	Institute for Social and Environmental Transition (ISET)	2012
12. Adaptation made to measure	GIZ and BMZ	August 2012
13. M&E for community-based adaptation	Action Research for Community Adaptation in Bangladesh (ARCAB)	December 2012
14. Adaptation M&E discussion papers	UNFCCC	March 2013
15. The TANGO approach to livelihoods resilience measurement and evaluation	Technical Assistance to Non-Governmental Organizations (TANGO)	March 2013
16. Community-based resilience assessment (CoBRA) conceptual framework and methodology	UNDP	April 2013

Source: Bours et al. 2013.

The majority of the studies targeted all sectors, but a few were linked with specific themes such as DRR (3), rural livelihoods (8), climate vulnerable poor communities (16), poverty reduction (10), climate resilience (4)(15)(16), resilience in urban setting (9), transformed resilience (12), bilateral/multi-funded programmes/projects (5), gender mainstreaming (8), resilience to food security (15), community-based adaptation (8)(12)(16), top-down (7) and bottom-up (12). Two studies emphasized the multi-level CCA (2) (14) across sectors (14). Another two studies categorized adaptation initiatives into broader actions (1) (2).

The studies were also varied in their target users depending on how the report was designed and written (e.g. degree of expertise, technicality and details). For example, some reports are very easy to understand while others may require experience or expertise with the issues raised. They also took different approaches. Some used guiding questions for flexibility versus strict guidelines (log frame and pre-defined indicators) (7). Other studies employed concrete examples or case studies to emphasize 'learning by doing'. Yet others focused on indicator development and tackled challenges related to it (4) (5) (14 with clusters).

Overall, these frameworks and tools carry normative opinions of what is important and essential in CCA M&E. Each contributes to the debate of how to better deal with CCA in spite of its challenges. Tracing the conceptual core of each framework/tool, the study identified "an evolution of thinking about climate change adaptation from resilience to adaptability to transformation" (Bours et al. 2013, 60) and an increasing trend of having more practical (field-friendly) tools than conceptual ones. It is worth noting that results-based management and the accompanying log frame are the most common M&E approaches used for adaptation by development agencies (Lamhauge et al. 2012). Among the frameworks and tools presented, three common features are: focus on inputs/outputs not processes; most approaches remain static rather than dynamic; and effectiveness and efficiency predominate as key principles (Villanueva 2011, 7).

Furthermore, it is important to note that more than half of the frameworks discuss the development of either a theory of change or a logic model. Employing these tools in the evaluation of CCA programmes and projects is significant because nearly all funders demand one of these and these tools can greatly improve programme design and evaluation (Clark and Anderson 2004). How a theory of change differs from a logic model is summarized in table 6.

It can be seen that theories of change put more emphasis on causal links – articulating key assumptions (hypothesis) that explain causality and explaining preconditions needed for the achievement of goals. In turn, this can describe how and why an intervention works. When managing a multi-scenario intervention (common in adaptation initiatives due to inherent uncertainties), theory of change can be used to "identify and correct false assumptions, integrate new information into new strategy, or pinpoint the reasons for achievements or failures" (Spearman and McGray 2011, 10).

Table 6. Differentiating logic models from theories of change

Logic models	Theories of Change
Representation Clearly identify outcomes, inputs and activities	Critical Thinking Link outcomes and activities to explain how and why the desired change is expected to come about
List of components See at a glance if outcomes are out of sync with inputs and activities	Pathway of change Need to articulate the hypothesis behind the causal relationship
Descriptive Do not always identify indicators	Explanatory Require identifying indicators Need to know how well a precondition needs to be met in order to get to the next goal
Usually start with a programme and illustrate its components	Best when starting with a goal before deciding what programmatic approaches are needed

Source: Clark and Anderson 2004.

Photo credit: ICLEI SEA

M&E of CCA interventions in South-East Asia: Country updates

Cambodia

As shown in figure 2, Cambodia receives the largest share of adaptation financing in the region and thus there is pressure to assess the success of funded adaptation interventions. In November 2013, the government launched the Cambodia Climate Change Strategic Plan for 2014–2023, which identified the development of a national M&E framework as one of the priorities (CCD-MOE 2013b). It also outlined the importance of M&E in doing the following:

- Measure to what extent adaptation efforts have been effective in maintaining development on track in a changing climate;
- Monitor CCM action and low carbon development policies;
- Generate evidence and lessons to inform future policy-making;
- Facilitate the coherent integration of M&E of climate change in national development planning and key sectors; and
- Provide the information required to fulfil the reporting obligations towards the UNFCCC and development partners (CCD-MOE 2013b).

As a starting point in initiating the development of the 'National Climate Change M&E Framework', the Climate Change Department, the Cambodia Climate Change Alliance in partnership with the International Institute for Environment and Development (IIED), conducted a workshop in December 2013 to enhance awareness and knowledge of key stakeholders on CCA M&E, share relevant experiences and obtain a common understanding of the national framework being developed (CCD-MOE 2013b). Mid-2014 was the tentative target for finishing the framework. The development of the framework would consider the following points:

- Keeping development on track (as an objective);
- Using national systems and procedures;
- Mainstreaming M&E of climate change response in national and sub-national development processes;
- Strengthening accountability, equity and transparency;
- Tracking change processes and promoting learning; and
- Addressing gender issues (Neth 2013).

The proposed framework follows the framework Tracking Adaptation and Measuring Development (CCD-MOE 2013b) and contains details about the theory of change, indicators framework with baseline and targets for tracking, data collection methods, analysis and reporting requirements, guidelines for integrating M&E systems, institutional arrangements and coordination mechanisms. At present, two categories of indicators have been identified: upstream (tracking effectiveness of climate risk assessment); and downstream (tracking changes in the development situation, emissions and climate vulnerability of communities and ecosystems). A more extensive set of process indicators with a focus on institutions, policies and capacities will be included in the Cambodia Climate Change Strategic Plan and sectorial climate change Strategic Plans (Neth 2013).

The Climate Change Department under the Ministry of Environment is coordinating development and implementation of the framework and serves as the NCCC secretariat. An M&E sub-group under the climate change technical team will be established to coordinate data exchange and mainstream the framework within line ministries.

Future actions include developing the national climate change M&E framework, identifying indicators for different sectors and setting a baseline for the development of the climate change action plan. Other future actions include capacity-building on improving data collection methods/procedures, training ministries about M&E through workshops and developing Theory

of Change, and mainstreaming climate change within the National Strategic Development Plan. Coordination with line ministries will continue to be a key priority.

Indonesia

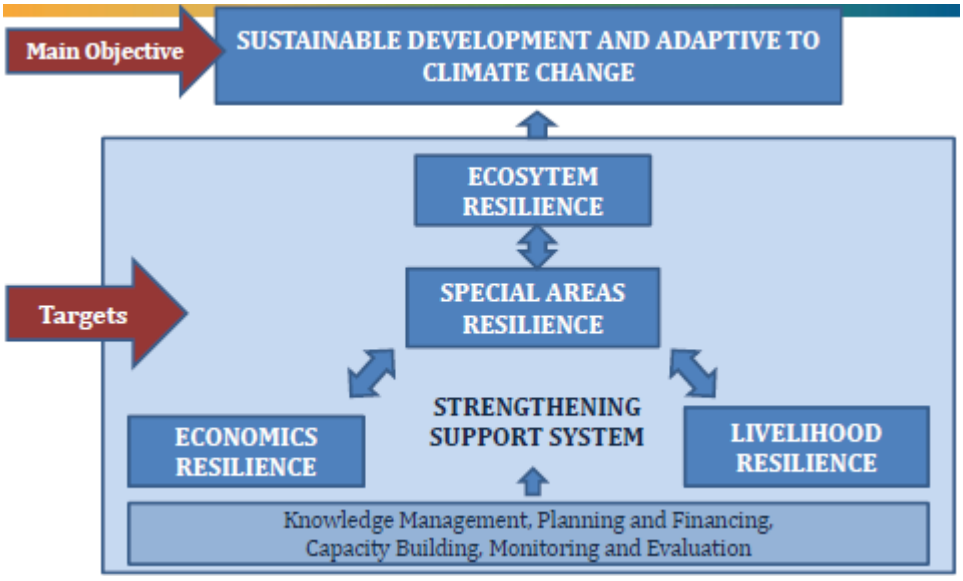
The National Development Planning Agency (BAPPENAS), the Ministry of Environment, the National Council on Climate Change Indonesia and the Geophysical, Climatology and Meteorology Agency, are preparing the National Climate Change Adaptation Action Plan (RAN-API) which includes M&E to support targets for the achievement sustainable development and CCA (figure 3).

The M&E framework is a work in progress and must be finalized through consultation with local governments for follow-up at the local/regional levels. It adopts the Theory of Change for the indicator system.

The steps followed in preparing the M&E System in the RAN-API include:

- Output level M&E based on existing system;
- Agreement on mechanism and indicators based on available data. There is still a need to clarify data collection methods (e.g. factsheet indicator);
- Identify timeframe;
- Mobilize resources for the M&E process; and
- Determine those responsible for collecting, compiling, analysing data, documenting and disseminating M&E results (Virgiyanti 2013).

Figure 3. RAN-API targets framework

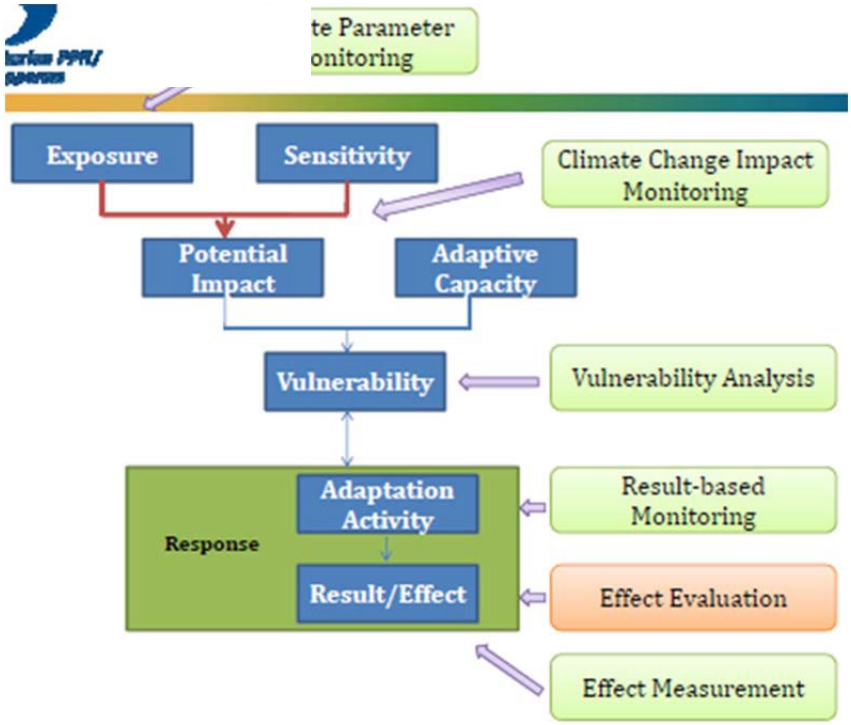


Source: Virgiyanti 2013.

Monitoring will take place in every step of the proposed M&E framework, while evaluation will take place during the response/intervention (figure 4). Local governments and related line ministries will conduct monitoring and report periodically to the Head of BAPPENAS. In turn,

BAPPENAS will conduct the evaluation and review in coordination with the line ministries and local governments. The accuracy and targeting of RAN-API will be updated according to M&E results.

Figure 4. Indonesia's M&E implementation



Source: Virgiyanti 2013.

Philippines

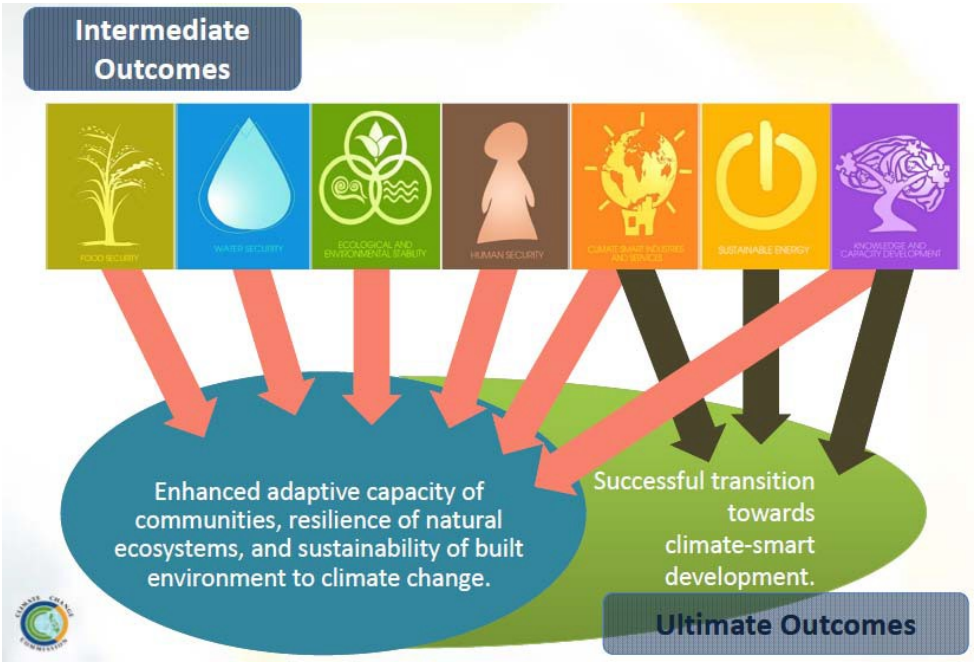
The National Climate Change Action Plan (NCCAP) (2011–2028) is the overarching climate change strategy of the Philippines prepared by the Climate Change Commission. The plan recognises the importance of M&E. It adopts the Results-based M&E System (RBMES) and the Theory of Change as it recognizes "the importance of convergence planning and M&E by learning what has been done and by focusing on efficiency, effectiveness to determine when necessary changes can be made when plans are not working and when circumstances have changed" (Segayo and Gaddi 2013). The framework is also useful in uniting various stakeholders under a common goal of addressing concerns on climate change in the country.

Implementation of M&E is the responsibility of the Climate Change Commission. The scope of M&E includes current climate change actions and future NCCAP-driven results-based climate change actions. Monitoring will be conducted annually to check directions in terms of priorities and budget, while evaluation (focused on efficiency, effectiveness and impact) is scheduled every three years.

Indicators were identified for each output under each intermediate outcome (priority sector) (figure 5). Selection of indicators was based on the following criteria: "ability to measure or represent incremental change in outcome, availability of data collected, representativeness of

the chosen indicator as proxy for the pattern or variability of other indicators used, and commonness as indicator for many outputs/outcomes" (Segayo 2013). The description, interpretation, metrics and timescale (frequency of measurement, necessary resources, baseline and geographical coverage) were identified for each indicator.

Figure 5. NCCAP Outcomes



Source: Climate Change Commission 2011.

NCCAP RBMES is in the final stages of finalization. This entails: 1) coaching and mentoring session for the M&E technical working group as part of capacity development (test run the RBMES by populating with available data, generate evaluation findings and conclusion, mainstreaming RBMES); and 2) developing a framework to bridge the gap between what could be monitored in the national level and the autonomous interventions applied at the local level (Segayo and Gaddi 2013).

Vietnam

At present, Vietnam does not have a specific M&E framework for CCA initiatives. However, the Department of Meteorology, Hydrology and Climate Change is developing a proposal for "The tool box serving in M&E implementation of National Climate Change Strategy." Its approval is expected in 2014 (Nguyen 2013).

There is, however, an existing institutional framework for M&E (Decision No.158/QĐ-TTg dated 2 December 2008 of the Prime Minister, NTP-RCC). According to this mandate, data collection, monitoring and reporting will be done by the Division of Natural Resources and Environment and People's Committee at the district level, by Department of Natural Resources and Environment and People's Committee at the provincial/city level and by ministries/sectors at the district, provincial/city and national levels (Pham 2013).

Lao PDR

CCA projects and programmes are in place. In fact, the Government of Lao PDR has integrated the National climate change Strategy into sectoral and national development policies and planning. However, the government also recognizes the need to have an effective (overall and comprehensive) M&E system that would integrate adaptation actions carried out by different agencies. Besides this, M&E has not been mentioned in the Second National Communication and thus, it may not have reached the stage of adaptation analysis for specific sectors/regions.

In terms of institutions in-charge, sectors at each level are responsible for implementation, M&E, reporting, assessment and drawing lessons for the implementation of priority projects at regular time intervals (Lao PDR 2009).

Malaysia

Based on its Second National Communication to the UNFCCC secretariat, the country presented detailed sectorial vulnerabilities and planned adaptation initiatives. It then recognizes the importance of M&E: “The next step would not only be implementation of some of the more urgent recommendations, but continuous monitoring and evaluation” (Second National Communication to UNFCCC, 66).

There is very limited data online on the country’s M&E of CCA initiatives. Monitoring was only mentioned in the National Policy on Climate Change (2009).

Myanmar and Timor Leste

M&E of adaptation initiatives and institutions involved were not mentioned in the countries’ NAPAs. The NAPA Project Steering Committee in East Timor is in-charge of NAPA implementation.

Singapore

M&E is part of the country’s approach to adaptation. The Adaptation Framework (figure 6), will be implemented by the Resilience Working Group under the National Climate Change Secretariat (National Climate Change Strategy 2013, 73).

Figure 6. Singapore's Adaptation Framework

Source: National Climate Change Secretariat 2012.

Thailand

The Thailand Climate Change Master Plan (2012–2050) is still being finalized, and the Thailand Adaptation Plan (2014–2018) is being prepared (Tatichara 2013). The Master Plan lays out the guiding principles and strategies in addressing climate change: adaptation, mitigation and capacity building.

M&E is explicitly mentioned as part of the Master Plan. Operation will be periodically reviewed and evaluated and the Plan itself will be revised accordingly every 10 years (Pipitsombat 2012). M&E is aimed at assessing the achievement of identified objectives, readiness of local governments, knowledge level and gaps and needs to address climate change Some of the criteria to be used include timeliness, project success and error (Tatichara 2013). However, details were not provided on the framework/tools or the responsible institutions.

Analysis and discussion

From the country updates, there is a general recognition of the value of M&E as a crucial part of CCA programmes and projects as demonstrated by the mention of M&E in their official reports. However, South-East Asian countries are at different stages of progress in developing national M&E system for CCA initiatives. Some countries are in the final stage of developing M&E systems, while others are still in the conceptual stage, starting with the recognition of the importance of M&E for CCA interventions. The Philippines and Indonesia, followed by Cambodia and Vietnam are leading in terms of having concrete actions in institutionalising national CCA M&E. Singapore and Thailand have explicitly integrated M&E in their strategic plans for climate change while, Lao PDR and Malaysia mentioned the importance of an M&E

system in their official reports. However, details with regards to the development of an M&E system (frameworks/tools to be used, frequency of M&E) were not specified.

Many factors contribute to the discrepancy in the level of CCA M&E development between countries, including the amount of adaptation financing, which is evident in table 7.

Table 7. Status of CCA M&E development in terms of advancement in implementing CCA

Country	Share of CCA financing in South-East Asia	M&E in plan/ strategy	Responsible institution	Tools/ frameworks used	Current status
Cambodia	31	Cambodia Climate Change Strategic Plan (draft)	Climate Change Department (in Ministry of Environment)	Theory of change, tracking adaptation and measuring development	Developing the M&E framework
Indonesia	14	National CCA Action Plan	National Development Planning Agency	Theory of change, targets' framework, M&E implementation flow	Working on M&E framework
Philippines	26	NCCAP	Climate Change Commission	Theory of change, RBMES	Final stage: training and test run
Vietnam	21	National Target Program to Respond to Climate Change (NTP)(2013–2015)	Department of Meteorology, Hydrology and Climate Change		Submitted proposal to develop an M&E framework

Source: ICLEI SEA

It can be seen that the four countries which lead in advancing CCA M&E account for around 92 per cent of CCA financing in the region. Since most adaptation financing in the region come from public sources (Climate Funds Update 2013), it is understandable for countries which receive more funding to have more incentive to develop their M&E systems as required by funding agencies for transparency and accountability (similar to the emergence of CCA M&E literature). Other probable factors include the level of experience in handling and implementing adaptation programmes/project, levels of knowledge and capacity in implementing adaptation initiatives, vulnerability of the country to the impacts of climate change and political commitment, among others. It is worth noting that economic status and the number of years of being a signatory of UNFCCC are poor predictors of progress in developing national CCA M&E system.

Most countries that are in the process of developing their M&E systems have adopted the Theory of Change. This emphasises the increasing recognition that context-based, flexible and incremental M&E is needed to achieve desired outcomes. By contrast, Singapore and Malaysia use a stage-wise cycle wherein M&E is located at the end part of the model for programmes and projects.

Another important point to note is that more than half of the countries in the region have very little data on CCA M&E because data are not normally included in formal/official reports. Most of the data gathered for this study are from presentations in regional conferences or workshops done by country representatives and from responses from the survey conducted by ICLEI SEA. Limited information about CCA M&E in South-East Asia may be explained by three assumptions below.

(1) Countries may not have developed an M&E system yet. Some countries in the region are still at the early stages of implementing CCA initiatives. Brunei and Myanmar have yet to conduct their respective vulnerability assessments and thus, have not formulated any climate change plan or strategy. Also, Myanmar and Timor Leste have just submitted NAPAs within the last two years (UNFCCC 2013b), which indicate that they have just started to implement CCA initiatives. In addition, the challenges cited by countries in their national communications (in table 3) signify more of the actual compounding challenges that add up to the inherent challenges of CCA. All these signify that there is still a huge space for CCA M&E learning in South-East Asian countries, in general.
(2) Countries are developing an M&E system but it may have not reached a stage where it can be disclosed to the public.
(3) M&E is deemed as an internal matter which is not normally included in official reports.

Since many countries are still in the early stages of implementing adaptation initiatives, there is a high possibility that these countries are also in the conceptual stages of developing an overarching M&E system for their CCA activities. That is to say, it is highly probable that the countries with very limited available information on CCA M&E are still yet to develop their M&E systems especially because M&E is an emerging field itself, it is complex and needs a high degree of understanding of CCA. In addition to the apparent lack of information, this presents certain gaps that need to be addressed and also an opportunity to further advance CCA M&E in the region.

Gaps and challenges

From an output of APAN's workshop about M&E of CCA initiatives (IGES and ICLEI 2013b) and from the answers in a survey questionnaire, identified challenges by South-East Asian country representatives are summarized below:

- Poor coordination among national and sub-national sectors/stakeholders overlapping roles that cause confusion; difficult to mobilize stakeholders (seriousness and commitment);
- Fragmented climate change strategic plans and policies (across government agencies and sub-national sectors); weak and unrealistic action plans; having an agreed overarching

overall outcome; incomplete or inconsistent policies/legal documents (e.g. no risk assessment);

- Lack of knowledge/skill (e.g. indicator development, evaluation); low awareness, capacity and expertise in CCA M&E from central to district levels; poor indicators;
- Lack of resources (financial, technical, methodologies/tools); unavailability or lack of baseline data; lack of studies/research (e.g. vulnerability assessment);
- Political barriers: change of politicians or decision-maker's views; and
- Difficult to measure success because of various definitions; uncertainties of climate change and future development.

While the literature refers to various issues in terms of difficulties in M&E of CCA, challenges provided by country representatives reflect more common CCA challenges which can be classified as institutional, technical, political, knowledge and conceptual barriers (Table 4). This shows that the region still has a lot to improve in terms of implementing CCA and as such, these supersede the challenges of implementing CCA M&E. This is supported by the findings in the previous section which showed that many South-East Asian countries are still in the initial stages of developing their M&E system for CCA.

Although CCA projects have been implemented in the region and most likely M&E systems at the project level have been developed, the progress of creating an integrated M&E system in the countries seem to have lagged behind for numerous reasons. This presents a huge opportunity for interventions as it is better to start doing M&E at the onset in order to take into account as many programmes/projects as possible into the M&E system. This is necessary for more targeted approaches which would lead to the achievement of desired results. This is especially true and daunting for those countries which have just started to implement CCA initiatives like Myanmar and Timor Leste. For these countries, emphasis should be made on the need to further enhance awareness and understanding of both CCA and M&E of CCA initiatives at all levels and across sectors.

Moreover, the lack of data on M&E of CCA initiatives at the national level presents a gap in one way or another (with regards to the three assumptions presented). In the case wherein the lack of available data was due to confidentiality, it is worth considering that country representatives of the Philippines and Indonesian presented their frameworks and tools even though their M&E systems were still in draft forms. Since CCA M&E is still an emerging field with many challenges, information sharing is very important (Bours et al. 2013). Had the countries been open to sharing their experiences and updates, identification of challenges and corresponding solutions could have been forwarded. Furthermore, there are still opportunities to further enhance regional engagement wherein countries can share and learn from each other.

Recommendations

CCA M&E is still an emerging area of study. Studies have been increasing and many tools, frameworks and approaches have been developed in order to aid policy-makers and program/project managers in assessing the effectiveness, efficiency and degree of success of

CCA initiatives. However, the pursuit for learning is continuous while many uncertainties and unanswered questions still remain as to how to measure the success of an adaptation initiative.

In South-East Asia, while some countries are still in the early or conceptual stages of developing an M&E system for their CCA initiatives at the national level, many countries have a high likelihood that they are yet to initiate the development of their integrated M&E systems. The current situation presents a huge opportunity for capacity building for those countries which still need to recognise both the importance and need for an integrated M&E system, especially those which have just started to implement CCA initiatives. More support is required for Lao PDR, Myanmar and Timor Leste which are LDCs and at the same time are relative beginners in CCA as they share only a meagre 7 per cent (Climate Funds Update 2013) of the adaptation financing in the region.

In order to aid in advancing CCA M&E in South-East Asia, as a starting point, a training-workshop that would provide a better understanding of the importance and issues of CCA M&E is highly recommended. This workshop should include a step-by-step process of how to develop an M&E system at the national level (e.g. exercises on indicator development, developing the theory of change). By being aware and trying out available M&E tools and frameworks for monitoring and evaluating CCA initiatives, countries would have a stronger grasp and would enhance skills that could enable translation of learning into practice. As additional assistance to LDCs who are still beginners in CCA, another recommendation is to develop an M&E framework/tool especially tailored to their context and needs so that they can better understand CCA itself and the complexities of its M&E.

Some national representatives from South-East Asia suggested having a common set of indicators in the region, however, this would not be easy because countries have different types and levels of vulnerabilities and adaptive strategies and no universal set of indicators would fit these divergent contexts (Bours et al. 2014). Instead, it would be more practical to train M&E practitioners on how to develop context specific CCA indicators and this can be part of the recommended training.

On the other hand, South-East Asian governments are highly encouraged to develop their national M&E systems for their CCA actions (for those which have not initiated anything yet). Funding is not a limitation as the Philippines and Cambodia were able to seek support and guidance from partner agencies such as GIZ and IIED (Segayo and Gaddi 2013, CCD-MOE 2013b). Therefore, both national and local governments are urged to tap available resources such as climate financing to fund initiatives that would establish an overarching M&E system, which includes all levels across agencies and different sectors. In addition, they are advised to review existing legal documents and roles/functions on climate change and integrate policies, programmes and activities of all levels across sectors for identification of common CCA goals.

It is also worth noting that M&E frameworks being adopted in the region vary among countries (where available), depending on the partners involved. For example, the Philippines adopted RBMES (developed by GIZ) with support from the same agency and Cambodia adopted the

framework Tracking Adaptation and Measuring Development (developed by IIED) with help from the same institute. Similarly, projects and programmes at the local level are following or will most likely follow M&E frameworks/tools or format forwarded by funding agencies/partners. Whether this has certain positive or negative impacts and whether employing various frameworks and tools affect evaluation of CCA initiatives at the national level, can be topics for future studies or research.

Another challenge that needs to be addressed is the lack of information among countries in terms of CCA M&E. This is important because "Monitoring and evaluation of CCA can and should serve not only to document and demonstrate the effectiveness of interventions but also to generate knowledge, learning and evidence to inform this emerging area of policy and programming" (Bours et al. 2013, 59). As much as possible, governments are encouraged to share their knowledge and experiences and take more active participation in regional meetings and conferences (e.g. researches, presentation of activities/initiatives). They are also advised to include M&E in official reports for transparency, accountability and knowledge sharing. Lastly, greater regional collaboration and more information exchange platforms are recommended, especially with the participation of Timor Leste which demonstrated remarkable improvement – being the latest signatory of the UNFCCC in South-East Asia in 2006 and still it was able to submit its NAPA in 2011.

Conclusion

Each country in South-East Asia has recognized the need to address climate change and has implemented actions based on its characteristics and needs. Since all eleven countries are parties to UNFCCC, an investigation of each country's most recent National Communication and if applicable its NAPAs reveals current trends in adaptation interventions in the region.

All countries have established institutions responsible for climate change affairs (e.g. climate change offices) either found within the Ministry of Environment or directly under the Head of State as an independent body, composed of representatives from various government agencies. With regards to policy, plans and tools, almost all countries have climate change action plans/strategies mostly linked to the country's development strategy. Priority sectors in the region include water resources, health and cross-sectoral initiatives. Common challenges include lack of coordination among ministries, execution of written plans/strategies and lack of resources (e.g., financial and technical).

Therefore, CCA interventions have been implemented and are still being implemented. The question is whether these interventions have increased the adaptive capacity or have reduced the vulnerabilities of the countries in the region. The way to find out is through M&E. M&E of CCA differs from other fields because it faces challenges such as high levels of uncertainty, long timeframes, blurred causal relationship and the need to deal with counterfactuals. Several tools, approaches and frameworks are already available and these can aid countries in formulating their own M&E systems. Each tool/framework presented is unique in terms of content, target audience, applicability, among others. The commonly adopted M&E tool is the

Theory of Change, while countries adopt different frameworks, depending on the partner agency.

CCA M&E in South-East Asia is still in its early stages. In terms of the progress of each country in developing their M&E systems, three groups have been identified: Group 1 (Final Stage) includes Indonesia and the Philippines, Group 2 (Initial Stage) includes Cambodia and Vietnam which have started or will start drafting their M&E, and Group 3 includes all other countries with very limited information.

The study suggests that countries which spend or receive a considerable amounts on adaptation (high probability of having more experience in implementing CCA), are more likely to have developed a more advanced M&E system at the national level. Also, since many countries have just started or are about to start to implement CCA initiatives, there is a high possibility that these countries have yet to begin to develop an overarching M&E system for their CCA activities. One probable explanation is that CCA M&E itself is an emerging field: it is complex, it needs a high degree of understanding of CCA, and it still has many challenges to overcome.

The lag in developing M&E systems for CCA in South-East Asia, coupled with the apparent lack of information among countries, presents a high potential for advancing CCA M&E learning through capacity building and knowledge sharing in the region. This is especially important for LDCs which are still at the early stages of implementing CCA initiatives. On a positive note, this may be seen as an advantage for prospective interventions in terms of timeliness because understanding CCA M&E at an early stage can enable better management of actions and outcomes.

XI. Overall Conclusions

BRIAN HARDING

Climate change adaptation (CCA) must be a crucial element of any sensible, sustainable development strategy. While this may already be happening in many ways, certain critical and explicit steps must be taken to begin dealing effectively with the emerging climate change impacts.

Those who work in this area are finding better ways to integrate CCA into national development strategies. In Asia and the Pacific, national development strategies continue to be heavily focused on GDP growth. This problem has been highlighted in a number of areas of the chapters – that people may not get equitable distribution of resources when governments focus so determinedly on growth that aim to create more jobs and reduce people's vulnerability. The focus on GDP growth also tends to translate into focus on higher production in sectors such as agriculture and manufacturing, without ensuring that the higher production is being achieved in a sustainable and climate resilient manner.

The debate on examining the sustainability of the current rates of relatively higher growth in the region is often peripheral and generally does not find its way into strategic planning for economic development. A material difference in how governments deliver on equitable and fair national development, is when CCA, alongside discussions on green growth, low emission and climate resilient development are truly integrated into economic growth planning.

Some countries in Asia and the Pacific have initiated this undertaking. There has been a greater increase in finding methodologies to mainstream CCA through national budgets and indicate how much climate sensitive sectors (e.g. agriculture) is already spending on integrating CCA. This is allowing for a useful way of monitoring how much money, apart from the allocations for CCA specific programmes, is being spent on integrating adaptation into overall national development priorities.

The methodologies that lead to better national development outcomes, typically start within sections of government responsible for particular areas. Chapters on climate smart agriculture, DRR, water management demonstrate and climate risk insurance demonstrate some of the innovative ways that climate change can be better integrated into areas of government, lead to a reduction of climate vulnerabilities at the local level and also contribute to a reduction in greenhouse gas emissions. In the Pacific, it is pointed out that discussions which enhance the interfaces for the scientific communities of CCA and DRR by interdisciplinary and transdisciplinary research and actions are imperative.

Climate change is also allowing for renewed discussions on governance structures and appropriate measures to address the problem. For example, all national plans and strategies of South Asian nations identify improved governance as a major priority when dealing with climate

change. There has been a growing realization that the capacity of administrative units at all levels must improve their ability in formulating plans, executing them and monitoring and evaluating their success. Ensuring that citizens have a voice in assessing CCA both during all of these stages is imperative. One of the major weaknesses of administration in all Asia and Pacific countries is weak or non-existent coordination among departments and the realization that it must improve. Climate change requires a whole of government approach.

Such discussions on governance have led to a recognition that decentralization of decision making powers and greater public participation in official decision making are an essential ingredient of achieving efficiency when carrying out CCA. Several governments in the region are providing frameworks for decentralization and public participation in governance and administration (e.g. LAPA in Nepal). However, many of these initiatives have not been fully utilized due to inadequate financial devolution of powers. Thus, while on paper decentralization may have been achieved, it is not yet fully operational on the ground. Yet the benefit is clear, a fully operational and decentralized governance and administrative mechanism would also lead to stronger local institutions and empowered communities that would be able to effectively integrate CCA into ongoing development efforts in the region.

The realization of the need for bottom up approaches, that link to an overall guiding national strategy is seeing CCA being undertaken by communities either on their own or facilitated by NGOs. Some of these initiatives have gained global recognition. However, on their own, these initiatives are perhaps insignificant and while pointing towards a direction that is promising, do not make an impact that would make a material difference at scale. There is a need to draw lessons from such initiatives and examine how they can be scaled up and implemented nationally or regionally. This needs to be coupled with a much improved system of monitoring and evaluation that sees CCA as a leader in integrating theory of change methodologies into all work undertaken.

One success such breed another and there is still a great need for even more organizations advocating for CCA at multiple levels. This is most likely to happen if local people who suffer from climate extremes also realize the benefit of adaptation measures and demand their wide availability. Such requests offer up many opportunities for NGO's and the private sector to assist in the region. It also inevitably leads to CCA practitioners becoming more involved in larger societal debates, for example as advocated in Chapter 3 on the science and policy interface.

Scaling up such initiatives has led to a much greater appreciation of the role of financing in CCA in the region. For example, for climate smart agriculture to take-off and eventually flourish, there is a need to solve the concern on problem of scale and financing. Bottom-up demand for climate financing means that national governments as well as the international community must find mechanisms for enhanced deployment of financial resources as well as creating and enabling environment for increasing the absorption capacity of such resources in the region.

While scaling up is imperative, a people centric approach should underpin all CCA actions. The elements of climate justice, which see equity and the rights of the most vulnerable, especially

poor and marginalized women should be built into CCA programmes around the world. Asia and Pacific based organizations must continue to play a leading role in this.

Recommendations

The recommendations here are overarching recommendations that complement the recommendations made within each of the chapters. They are broken down into four core areas: 1) policy; 2) research and development; 3) communications; and 4) implementation.

Policy

Develop innovative ways to integrate CCA to national development in the Asia and Pacific region. Ultimately, this should result in enhanced integrated, systems based approaches, strategies and institutional arrangements that span across different sectors, ministries and intergovernmental organizations;

Promote international cooperation and avoid unilateral measures, such as export bans. There are many aspects of CCA, such as trans-boundary river basin management, that need to be dealt with regionally. There are, at present, many water sharing arrangements between different countries in South Asia. While they may have served a useful purpose, the problem of climate change requires a new approach towards holistic river basin management for which a beginning must be made at a regional level. Such examples are numerous and offer up ideal diplomatic and business opportunities for Asia and Pacific governments.

Encourage private sector investment in CCA. For example, in funding transitional programmes that enable eventual private sector investment.

Research and development

Increase the visibility, opportunities and scale for CCA to be built into agricultural systems. This is typically country specific but could involve instituting enabling policies as a foundation for climate smart agriculture to flourish and address some of the issues on bringing such practices to scale. It is imperative to link such actions to the international discussions (e.g. UNFCCC).

Assist in the formation of partnerships between the private sector and farmers/farmer groups and cooperative to promote the production of high quality products. Partnership that can enhance knowledge sharing between stakeholders, including scientists, farmers, private sector, civil society and governments, with participatory agenda setting, for example, through initiatives such as the Global Research Alliance.

The lag in developing M&E systems for CCA in South-East Asia, coupled with the apparent lack of information among countries, presents a high potential for advancing CCA M&E learning through capacity building and knowledge sharing in the region. There is a need for a greater understanding CCA M&E to enable better management of actions and outcomes.

Communications

Strengthen the knowledge base on sustainable practices, as well as on financial and policy options that would enable countries and communities to meet their food, water and nutritional security and development goals.

Improve farmers' access to and awareness of knowledge services on finance, agricultural inputs, rights (for example, land tenure rights) as well as advocate for increases in the availability of these resources.

Creating platforms/learning hubs (such as knowledge platforms) and bring together communities at the grassroots level to facilitate dialogue, knowledge sharing and capacity building to innovate on CCA.

In the Pacific, Distribution of knowledge about DRR and adaptation in general at the local, national and regional levels should be integrated into the development processes at all levels.

The countries in Asia and the Pacific should assist each other in building capacity. The importance of the knowledge transfer on capacity building through education and training in formal, informal and relaxed atmosphere cannot be underestimated in the field of trans-border issues related to climate change.

Implementation

Implement and scale-up innovative successful programmes and best practices that combine sustainable agriculture and land use, forestry and sustainable fisheries and aquaculture, through local, regional, sub-regional and national programmes and institutions, as a matter of priority

Sharing existing technologies off the shelf and into the hands of (small holder) farmers and other groups dependent on natural resources, thereby improving their access to information and technical knowledge. There is a need to have a better data collection infrastructural and institutional mechanism in the study countries. The need is collect climate data at the district and sub-district levels through a wide network of meteorological stations and then based on the data develop climate prediction models – preferably scaled down to predict long term climatic conditions at sub-district, district and state levels.

To complement all CCA measures, early warning systems should be modernized to provide adequate protection. Furthermore, it is necessary to develop the preparedness of relevant organizations to react to emergencies so they are capable of helping general public and responding to floods, fires, sharp frosts, heat waves and other climate related natural disasters.

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