Asia-Pacific
Water Forum

Framework Document on Water and Climate Change Adaptation

For Leaders and Policy-makers in the Asia-Pacific Region

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Foreword

It gives me great pleasure to contribute the foreword to this framework document on water and climate change adaptation, specially prepared for the leaders and policy-makers in the Asia-Pacific region.

This framework is the result of inter-disciplinary and multi sectoral work by a regional steering group, composed of climate scientists, adaptation experts, government officials, civil society leaders, and development experts from the Asian Development Bank, World Bank and Japan International Cooperation Agency.

Water security is now recognised as a global security challenge. It has also been recognised that water, food, energy and climate form a nexus. The impact of climate change on water security is accepted as an important issue. Leaders in our region need access to accurate information and sound advice on how best to respond to this challenge, through mitigation and adaptation. This framework document seeks to fulfill this need.

In the coming years, water scarcity will become a pervasive problem in our region. Water conflicts could occur between the neighbours of a shared river or as a result of the discharge of untreated used water into rivers or the environment. The situation is also complicated by the changing weather pattern, resulting in storms and floods. Another complication is the rise of sea levels with all its deleterious effects.

When the steering group started its work, the technical literature on climate change adaptation, in the water sector, was relatively sparse and good case studies were hard to find. Happily, the literature on water and climate change has grown enormously. The steering group's task is increasingly focused on evaluating and synthesizing this literature and identifying from it the good policies and best practices.

The purpose of this framework document is to make these good policies and best practices available to our leaders and policy-makers. It argues the case that effective adaptation and mitigation must be based upon five principles which should be applied in a concerted manner and not with a silo approach. We have to progress simultaneously in the following five areas: useable knowledge, no regret investments, resilience, mitigation and adaptation, and financing.

I commend the framework document to our leaders and policy makers. If we adopt the five principles, and if we can build partnerships involving the government, the private sector and the civil society, I believe that we will succeed in enhancing the water security of our region.

Professor Tommy Koh
Chair, Governing Council
Asia-Pacific Water Forum

Introduction

Recent climate-related catastrophes in Pakistan, the People's Republic of China, Thailand and elsewhere throughout Asia and the Pacific serve to remind us that the most significant —and harmful—impacts of climate change will be experienced through alterations in the water cycle (Figure 1). The countries of Asia and the Pacific already struggle with a plethora of water-related challenges, including flood, drought, seasonal shortages, increasing competition for limited supplies, water pollution, and over-exploitation of groundwater. Climate change adds another formidable challenge, and although the impacts are currently far from certain, they are unlikely to be favorable. Although leaders, decision-makers and water professionals in the Asia-Pacific region are increasingly aware of the risks posed by climate change, appropriate responses are not often easily identified.

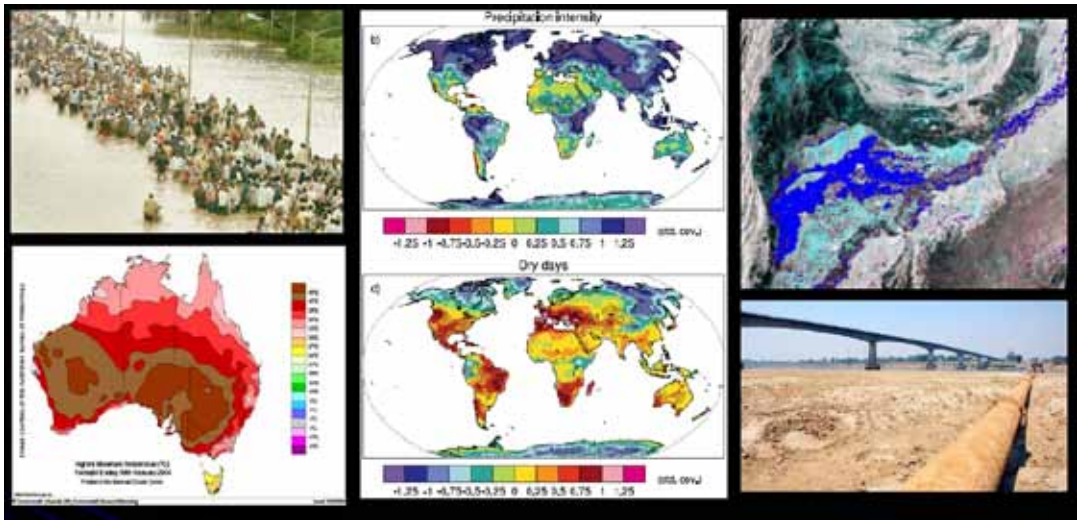
The countries in the Asia-Pacific region encompass a wide diversity of climatic, environmental and socio-economic conditions, each subject to unique impacts and risks as climate changes. Arid mid-continental regions are likely to experience increases in the frequency and severity of floods and droughts; and a decrease in rain-fed agricultural yields. Densely settled river basins, deltas, and other low-lying areas are at increased risk of flooding, and developing Asia already contains nine of the 10 countries with highest estimated flood mortality risk.[1]

Coastal areas are vulnerable to intensified typhoons, storm surges and sea level rise. Over 450 million Asians live within the low-elevation coastal zone, including almost 20% of the region's urban residents.[2] Coastal aquifers are also at risk of salinization due to sea

[1] United Nations International Strategy for Disaster Reduction (UNISDR), 2009 Global Assessment Report on Disaster Risk Reduction.

[2] McGranahan, Balk and Anderson, 2007. The Rising Tide: Assessing the Risks of Climate Change and Human Settlements in Low Elevation Coastal Zones. Environment and Urbanization 19: 17 – 37. Low elevation coastal zones are defined as contiguous areas along a coastline with elevation less than 10 meters above sea level. Population figures refer to 2000.

Figure 1. Recent climate-related catastrophes including the severe floods in India, 2005 (upper left) and in Pakistan, 2010 (upper right) and the severe droughts in Australia, 2006-2007 (lower left) and in Mekong, 2010.



IPCC projections of the increase of floods (upper center) and droughts (lower center) suggests possibility of repetition of such events (even more intense) in future due to climate change.

level rise. Over one billion Asians inhabit river basins dependent on glacial and snowpack storage, and the Himalayas and other regional "water towers" face increasing risks from glacial outburst floods in the near term; and reduced dry season flows and increasing water stress in the longer term. Small islands are vulnerable to decreasing water security as groundwater lenses are diminished by erratic precipitation and sea level rise; and to typhoons, storm surges, and other extreme weather events.

Socio-economic diversity within the region is equally high, with the world's fastest growing economies existing alongside its greatest concentrations of poverty. While Asians' per capita incomes have roughly doubled over the last decade,[3] growth has in many instances

[3] Source: Asian Development Bank, Key Indicators for Asia and the Pacific 2010, Table 2.2. Within developing member countries, regional average per capita GDP in current purchasing power parity (PPP) terms was $2490 in 2000, increasing to $5489 in 2009.

been neither equitable nor sustainable. Diversity in economic development status is reflected in the extreme inequality in water security, as exemplified by access to improved water supply and sanitation – a key target under the Millennium Development Goals (MDG). While citizens of Singapore, Japan and other developed Asian economies universally enjoy high levels of water supply and sanitation, in many other nations only a minority do. Of 2.6 billion people globally lacking access to improved sanitation, 72% are Asians.[4]

Those who lack water security (including security from water-related disasters) are overwhelmingly likely to be poor, to live in geographically isolated, disaster-prone or ecologically degraded locations, and to lack the benefits of effective local government and infrastructure. It is these communities who will experience the most severe impacts of climate change, and who have the greatest susceptibility to harm. And, although access to water and sanitation are increasingly recognized as basic human rights, efforts to translate these rights into tangible improvements in water services and security for the poor will be encumbered by climate-related risks, and will often require reforms in policies and practices. Asian economies are also struggling to maintain security in food and energy, both of which are inextricably linked to water. Climate change thus poses a "triple threat" to regional development and security through the water-food-energy nexus.

This document is intended to provide a framework for managing the water-related risks associated with climate change to leaders and policy-makers in the Asia-Pacific region. Building on existing documents addressing the global challenges of climate change and development, including the Nairobi Guiding Principles, we propose a framework within which priorities for action within Asia and the Pacific can be identified and implemented in a manner that acknowledges the region's uniqueness and diversity. Action is vital, as there is a high cost to inaction in the face of climate change.

As we adapt, we must maintain a holistic view of the continuity between climate change adaptation, environmentally sustainable development and enhanced resilience as development themes that enhance our progress toward the Millennium Development Goals. And in doing so, it is critical to enable *end-to-end* cooperation among policy-makers, scientists, engineers, economists, water managers, decision-makers, local communities and other stakeholders. Indeed, climate change is a profound challenge, but it also presents us with an opportunity to re-think our strategies and to re-commit our societies to achieving well-

[4] WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, 2010. Progress on Sanitation and Drinking-Water: 2010 Update.

being for all in the Asia-Pacific region, making use of accumulated knowledge, developed capacity of the society as a whole and well-wrought and comprehensive approaches.

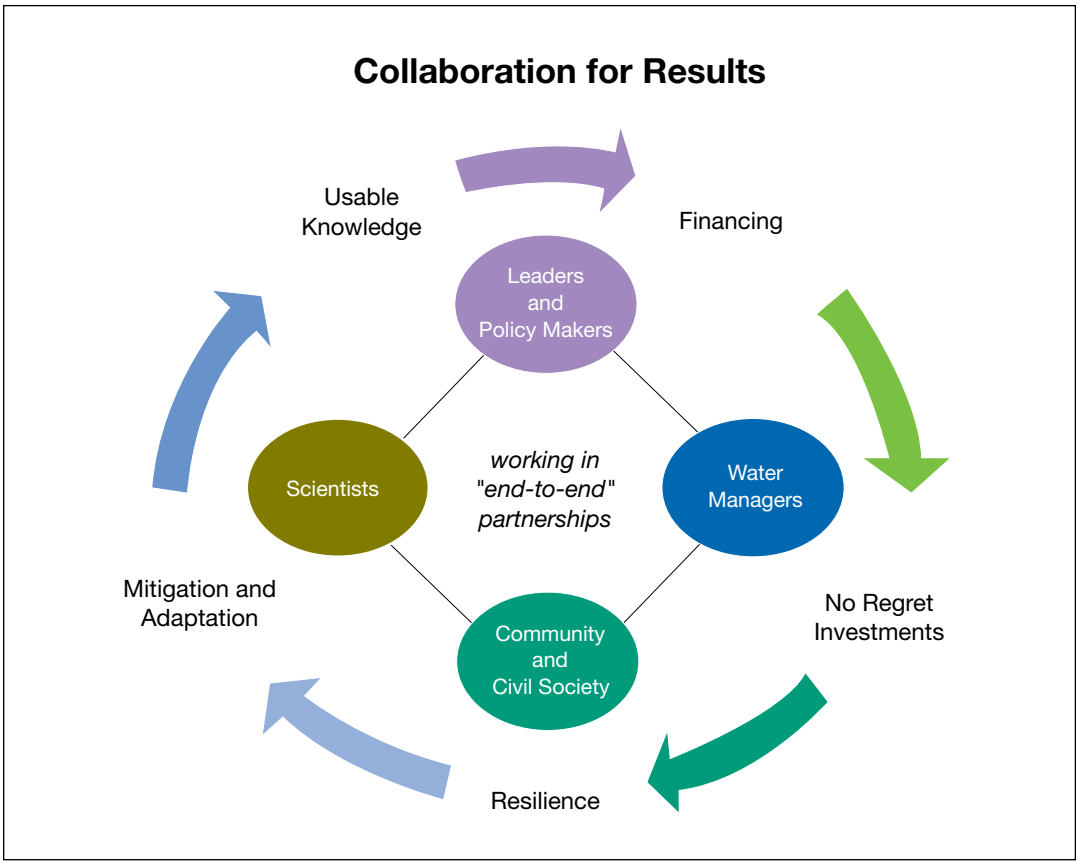
The guidance presented here takes the form of a set of general principles that collectively address the challenges of adaptation. They are based on the shared experience of the Asia-Pacific Water Forum (APWF) Steering Group on Water and Climate Change. The Steering Group was established by the Governing Council of the APWF in 2009 and tasked with three key result areas: (i) advising leaders on policies and practices; (ii) guiding knowledge networking in the region; and (iii) reporting progress annually to the leaders in the Asia-Pacific region with recommendations for action. The Steering Group comprises scientists, experts from international organizations, governments, civil society, and development funding agencies including World Bank, Asian Development Bank and the Japan International Cooperation Agency.

The principles and recommended actions in this framework document are targeted to government leaders, policy-makers and practitioners in the Asia-Pacific region. Follow-up actions by leaders in the region will be monitored and reported to the 2nd Asia-Pacific Water Summit, the Asia-Pacific Water Ministers Forum, dialogues under the Ministers for Water Security Initiative, and other regional conferences where leaders of government, civil society and the private sector meet. The principles should be taken together as they are complementary and are intended as integral parts of a holistic framework for action. Using this framework, the risks of a changing climate can be managed in a manner that reflects the unique climatic, environmental and socio-economic circumstances of each country in the region. Equally, the framework can be used to address the existing problems of climatic variability – including floods and droughts – through investments now.

Laying the foundations for action

To lay the foundation for effective adaptation and mitigation efforts in the water sector, the Steering Group advises leaders in the Asia-Pacific region to support and adopt the following general principles and recommended actions in an integrated manner. Five Principles are articulated. Background information framing each Principle is presented, and two annotated actions are recommended.

Figure 2. Working with the 5 principles in *end-to-end* partnerships is necessary.



Principle 1 - Usable Knowledge

"We must support scientists and practitioners to work together and develop knowledge that leads to effective actions and increased public awareness."

Our shared understanding

The 4th Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC, 2007) has presented evidence for many climatic trends at global scale that will affect water security adversely, including (i) increases in high-intensity precipitation events; (ii) increases in drought-affected areas; (iii) increase in the intensity of tropical cyclones; and (iv) sea level rise.

The Asia-Pacific region is inherently vulnerable to climate-related hazards, including floods, landslides, mud flows, droughts, water scarcity and deteriorating water quality. Sea level rise is a particularly important issue in the Asia-Pacific region with its large deltas and coastal cities identified as "hotspots" in the AR4. Climate change is now a fundamental threat in this region.

What remains to be addressed?

There is still a "disconnect" between the knowledge generated by the scientific community and the specific needs of practitioners such as water managers in river basins and cities. There is a need to bridge this gap, to re-examine the basic planning methodology, and to reduce the gestation period from scientific finding to practical implementation. There is a specific need to customize projections of climate change to local conditions, particularly in developing countries. A more effective dialogue is required between scientists and communities of practitioners, both to improve the dissemination and communication of

scientific information as well as to learn from the experiences, knowledge and the needs of user communities.

Although there is strong evidence that climate change is occurring, there is still a gap between the generation of global projections and their effective use in adaptation strategies. The AR4 has clearly documented qualitative changes in extreme hydroclimatic events at global scale, but not quantitative changes at regional and river-basin scales. Due to the large uncertainty which is inherent in model projections of future climate and regional and local hydrology, model-based projection results cannot be used directly for infrastructure design adaptation.

What are the next steps?

Climate change knowledge must be formulated as a "public good," to be shared throughout the world. Under this consensus, we should establish a two-way flow of data, information and knowledge between scientific and socio-economic communities, and across different administrative levels, including village, district, state, national, and supra-national levels.

We should accelerate cooperative efforts by scientists and practitioners to improve the use of climate projections, and to quantify and reduce the uncertainty for sound decision-making, balanced planning and implementation.

We can apply the 5 principles simultaneously in the community, country, regional, and global arenas for action (Figure 3).

Action 1.1 Develop data infrastructure and networking for sharing data, information and knowledge to support decision-making and to raise public awareness

- Develop hard- and soft data infrastructure supporting inter-operability, data standards and methods of quality control and validation, and protocols for institutional collaboration.
- Increase the availability of historical observation data, to support the calibration and validation of model-generated climate projections, and to support local/regional impact assessments.

- Develop and share knowledge bases of local-level data, information and best practices for directed action.
- Encourage scientists to "translate" their findings into a language understandable by decision-makers, planners and other non-scientists; and encourage decision-makers and other non-specialists to increase their scientific literacy with respect to climate change.
- Promote the networking of educational institutes, especially the higher education sector, to share research and data related to climate change and its impacts.
- Facilitate regional demonstration activities in existing international frameworks, such as the Global Framework for Climate Services (GFCS) developed by the World Climate Conference-3, 2009 and the Asian Water Cycle Initiative (AWCI) by the Group on Earth Observations (GEO), 2005.

Action 1.2 Accelerate scientific efforts to improve the use of climate projections for countries, river basins and cities as well as to quantify and reduce the related uncertainty

Improving projections

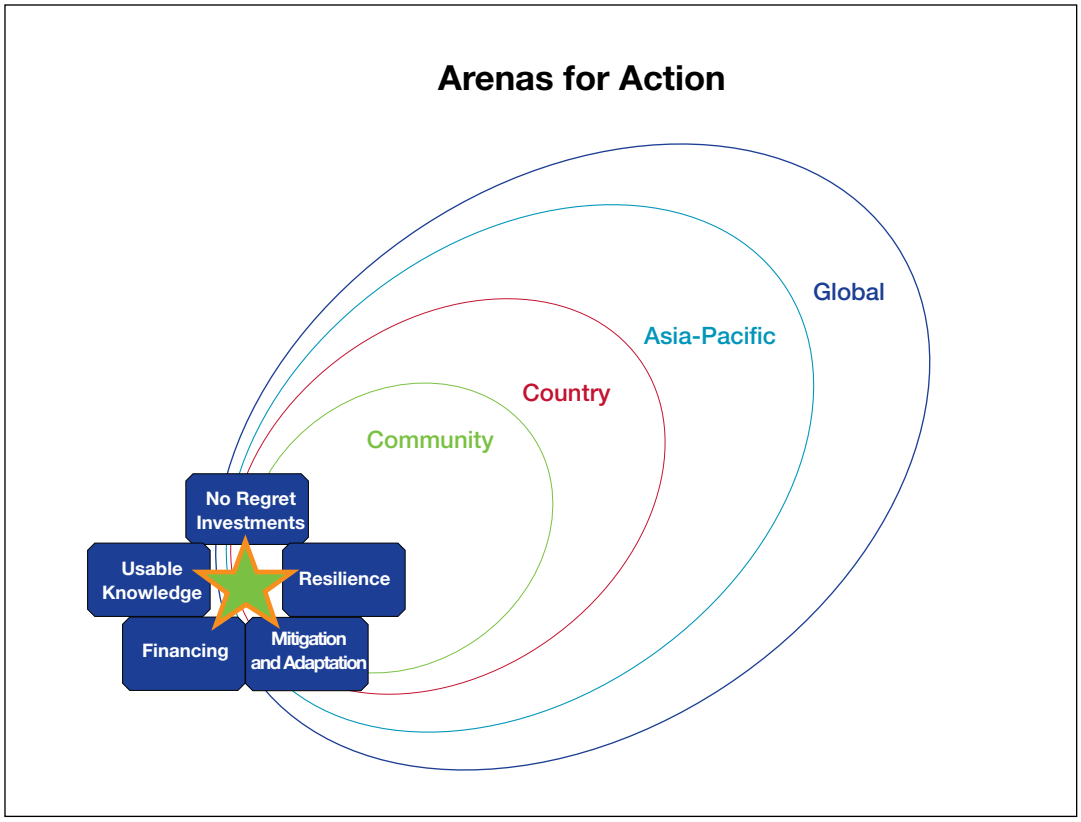
- Invest on improving use of climate projection capabilities, including impact model developments such as improved flood simulation models, GCM/RCM parameterizations and downscaling.
- Improve the resolution of GCMs, the representation of cloud microphysics and topography, and then the simulation capability of high-intensity precipitation events.
- Improve the coupling of atmospheric and land surface processes including their heterogeneity and bio-geochemical cycles.
- Improve hydrological models to address the large diversity of the natural and socio-economical conditions in the Asia-Pacific region.

Quantifying uncertainty

- Improve the collection, archiving and analysis of historical instrument records with particular emphasis on identifying and extending relatively complete, long-term hydrologic datasets for improving the performance of models at basin scale.
- Develop and improve the metrics used to evaluate the skill of GCMs (RCMs).
- Increase the use of analysis based on multi-model and multi-projection ensembles.

- Reduce uncertainty in the statistical inference of risks of hydrologic extremes – a specific challenge here is to develop robust alternatives to currently used frequency analysis methods based on the stationarity assumption.

Figure 3. Applying the 5 principles simultaneously in multiple arenas for action will lead to success.



Principle 2 – No Regret Investments

"We must identify and implement approaches that improve water security over a wide range of potential conditions, including current climate variability."

Start action today

We must build a society that can respond to continual, but uncertain changes. The sustainable development of water resources is unfinished business with respect to adapting to a changing climate, and to utilizing developing technologies for climate projection and adaptation.

An "adaptation deficit" already exists under contemporary climate conditions. In particular, extreme events – floods, droughts, and tropical storms – are not new, and many countries currently struggle to address such events, and to manage the resultant disasters. If we can improve our capacity to cope with these present problems, we shall be better equipped to deal with possible future increases in their severity and frequency.

Considering uncertainty, we should start now with "no-regrets", and "low-regrets" investments, which yield benefits at minimal or low cost even in the absence of climate change. We should take integrated approaches consisting of structural and non-structural measures. Flood management should encompass floodplain management, land use regulation, spatial planning, early warning, community-based activities, and risk financing, in addition to conventional structural measures. It is unrealistic to address increasing flood hazards under a changing climate by continually raising levee heights to confine floods inside river channels - people must learn to live with floods. Drought management should encompass monitoring networks, contingency planning, and community education in addition to relief activities. Policy responses to drought should focus on water-, food- and energy security.

The impacts and implications of climate change on the water cycle, water use, and water-related disasters will be complex, multidimensional and uncertain. It is necessary to assess comprehensively the likely changes in hazards and risks, covering political, socioeconomic as well as natural scientific aspects, for which there is high uncertainty. Outputs from global general circulation models (GCM) have the potential to provide a basis for adaptation planning, particularly when suitably downscaled and coupled with models of catchment hydrology.

Disaster risks reflect the magnitude and frequency of the hazard, the exposure and vulnerability of the population, and their adaptive capacity. The vulnerability of a society increases due to phenomena such as unplanned urbanization, which concentrates the population in cities and drives the poor to settle in riverbeds and on steep or unstable slopes. We should emphasize reducing the vulnerabilities of society and increasing their coping (adaptive) capacity, while mitigating existing hazards, such as through construction of levees to reduce flood inundation.

What remains to be addressed?

Risk management, involving communities and various organizations, should be adopted as the main adaptation policy. How to assess risk under uncertain future conditions is currently an unresolved issue, and practical methods should be developed based on projections of extreme events.

While infrastructure is a vital element of adaptation measures, infrastructure planning methods must be fundamentally revised. As design of structural measures relies heavily on analysis of historical conditions (e.g., flood frequency analysis), climate change and uncertainty can undermine the performance of physical infrastructure, and high capital investment requirements create the risk of misallocation of capital if or when actual conditions fail to coincide with projections.

Committing to no-regret investments now, in synergy with the other 4 principles, will ensure that socio-economic benefits will keep accruing over time as adaptation takes hold (Figure 4).

What are the next steps?

We must start identifying, planning, and implementing adaptation actions on the ground; and improve adaptation planning methods. To implement the appropriate mix of structural and non-structural measures, multi-sectoral approaches are required.

Action 2.1 Plan for incremental adaptation actions in tandem with improving climate projections

Planning adaptation actions

- Mainstream adaptation in the national development planning cycle.
- Manage disaster risks with focus on society's vulnerabilities.
- Conduct comprehensive, credible assessment of basin-wide potential under current conditions for water resources development through watershed development, ground-water recharge, and local water systems.
- Incrementally develop and frequently adjust adaptation actions through use of enhanced instrumental records, updated projections, emerging technologies, and monitoring and evaluating of these actions.
- Limit, to the extent possible, the scope of critical decisions to a lead time of 20–30 years, over which uncertainty is both relatively low and, to an extent, quantifiable.
- Study and document the circumstances and existing coping strategies of communities and societies from which lessons can be learned and utilized for adaptation actions.

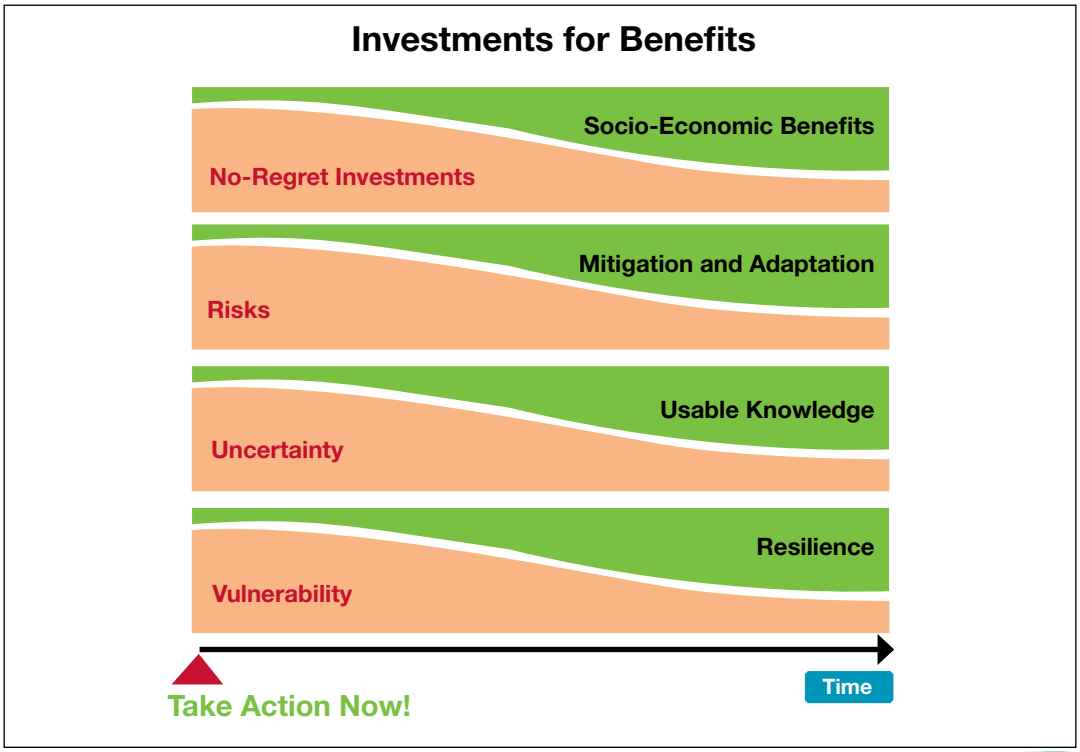
Improving planning methods of adaptation

- Establish risk assessment methods based on outputs of high-resolution GCMs and multi-model ensembles; and improve *downscaling methods.*
- Develop planning methods to identify robust infrastructure designs, which may be justified even if they are not "no-regret."

Action 2.2 Use an appropriate mix of structural and non-structural measures

- Expand beyond engineering-oriented approaches to those that integrate structural and non-structural measures in various sectors.
- Strengthen governing mechanisms involving a wide range of stakeholders at river basin level.
- Link flood risk management to the livelihoods of riparian communities - “living with floods”, and urban storm water management, including rainwater harvesting, use of wetlands, use of modular structures to treat waste water.
- Focus on urban water planning and management through measures including harnessing local sources and treatment and reuse of wastewater, as they reduce the dependence on external sources.
- Improve mechanisms for groundwater management in the context of integrated water resources management (IWRM), including sustaining existing recharge systems, creating new ones, and promoting legally enforced community groundwater regulation.

Figure 4. No-regret investments now will ensure socio-economic benefits later on.



Principle 3 - Resilience

"We must build societies' capacity to develop communities' resilience in the face of a changing climate."

Our shared understanding

The Asia-Pacific region is home to almost 60% of the worlds' population; and over 750 million of the global poor and vulnerable.[5]5 While climate change is a global phenomenon with regional political, economic and physical impacts and implications, resilience – like vulnerability – is local, and needs to be built locally, taking into consideration the regional geographical and economic diversities. However, it is often institutions at the national level that control resources and have the primary responsibility for allocating and prioritizing them. There is a need for improved governance systems and increased capacity coupled with the necessary policy reforms that allow local stakeholders to take steps to increase their resilience and sustainably manage their resources. It is also important to balance decision-making systems which engender an infrastructure building approach with natural, human systems which include environmental, societal, political and economic aspects in the solution.

What remains to be addressed?

While scientists continue their research, develop more accurate climate projections, and increase their understanding of the extent and consequences of climate challenges, rigorous policies, embodying sound strategies and pragmatic actions need to be devised to

[5] Asian Development Bank (2012): Basic Statistics 2012; and World Bank (2012) World Development Indicators.

strengthen the resilience of these most vulnerable people. Resources must be made available to implement such activities at the local level, to support mutually agreed-upon policies.

These policies, accompanying strategies and action plans need to be well articulated and shared with all stakeholders. What are they? Are there examples of effective measures that have already been implemented and can be shared across the region, reducing the time required to devise and pilot new action plans at local levels? How can newly available knowledge be made accessible rapidly?

In order to enhance resilience there is also a need to re-examine existing processes such as river basin management; to see how they can be more effectively implemented over a long planning horizon and in feasible increments such as re-packaging the long planning horizons into shorter periods, in smaller watersheds and with local communities.

What are the next steps?

Societal decision-making under conventional circumstances involves the allocation of scarce resources, guided by available technology and criteria of economic efficiency. Achieving societal consensus presents a challenge, since the decisions are likely to involve tradeoffs; e.g., reduced personal consumption in order to preserve ecological functions. These decisions will be complicated by the uncertainty of climate change. There is a need to build a robust local governance system and local capacities that can enable effective decision-making in a participatory manner. Building local resilience will require knowledge of downscaled climate change projections of the impact within the specific watershed and on the different sectors, as well as other relevant local information.

Action 3.1 Strengthen the adaptation capacities of water managers, communities, and of society as a whole

- Identify the gaps in the current governance structure and the adaptive capacity of communities, and develop systems for filling these gaps.
- Focus on capacity development programs and strengthening, including the localizing of climate projections and impact assessment. A local governance structure that will support the transfer of information to communities must be in place. These capacity development programs will require financing that can be sourced through or from national levels.

- Identify, utilize and adapt local methods, solutions and material, suited to local conditions. Some of these may already be available and in use while others may need to be identified.
- Build networks between local communities and experts to facilitate efficient sharing of information and best practices

Action 3.2 Improve community-based water risk management capacities

- Take up holistic and integrated land and water management planning as a comprehensive risk management strategy. The plan should be developed and implemented with a participatory approach involving all stakeholders. This includes adaptation planning and implementation encompassing communities at village/watershed level, through the sub-basin to river basin management organizations, to the national level.
- Study and understand institutional structures, their capacities and the skills needed for community-based risk management.
- Strengthen the capacity of academia, governmental institutions, communities and other stakeholders to collectively support community climate risk management efforts as communities typically face limitations in many areas, including budget, technology, and human resources.
- Share knowledge, experience and success stories on adaptation measures in water risk management emerging from community-based projects. A scaling up and disseminating of these practices should be established. Such best practices should include those that address sea level rise, flood mitigation, cropping calendars and agricultural practices, and related. Since these practices must ultimately be implemented at the local level, guidelines for tailoring them to particular local circumstances must be developed. A useful approach may be to produce simple booklets, instructional materials and directives, translated into local languages.
- Develop risk management approaches based on agricultural diversification. Many vulnerable local communities are involved in agricultural activities. Agricultural production is particularly sensitive to changes in hydro-climatic conditions, including temperature, water balance, and the occurrence of extreme events. Risk management approaches based on agricultural diversification can help build resilience to changes in these conditions, for example through development of drought and/or salinity resistant crops, altered cropping patterns and rotations, and so on.

Principle 4 – Mitigation and Adaptation

"We must adopt optimal combinations of measures."

Mitigation and adaptation must go hand-in-hand

Given the uncertainties of climate change, a diverse set of measures, encompassing both mitigation and adaptation, is needed to deal effectively with it. As the set of climatic, hydrologic, social, cultural, economic and political circumstances varies across regions, these measures will also need to be customized to the local conditions.

Water resources management provides opportunities for investments that deliver both mitigation and adaptation benefits. For example, multi-purpose water infrastructure can deliver clean hydropower (mitigation) as well as irrigation services and flood and drought protection (adaptation). Similarly, investments in watershed management can enhance carbon sequestration (mitigation), reduce floods and help manage soil moisture and groundwater recharge (adaptation.) Such measures can also be designed as pro-poor development, to create alternative livelihood opportunities (direct employment, timber and non-timber forest products, fisheries) and to build social capital (user groups and community consultation and representation committees), making them sound investments across a range of criteria.

Adaptation must be addressed in a broad development context

Adaptation, in particular, must be addressed in a broad development context, recognizing climate change as an added challenge to reducing poverty, hunger, disease and environmental degradation. Hence, adaptation should not be seen as something "new and separate"; it must be considered an integral part of sustainable development. Synergies between climate change adaptation and the achievement of the Millennium Development

Goals must be identified, and adaptation measures must be effectively integrated into the national economy and development and sector plans.

IWRM is a suitable approach to adaptation

Adaptation efforts must take account of the changes to the hydrologic cycle in river and lake basins (and their groundwater aquifers) in a holistic manner. IWRM is therefore a suitable approach to adaptation. IWRM is the adaptive management process by which economic, social and environmental benefits of water resources among a range of water uses and users are increased and balanced in river basins. Adaptation in cities will therefore take place in the broader context of the IWRM process in the basin in which the city is located.

Climate change and increased climate variability impact primarily through water and biological processes with implications for land use, including the coastal zone. Recognizing the fundamental importance of land and water linkages for livelihoods, food security, shelter, ecosystem services and economic growth, efficient and coordinated management of land and water resources is essential for building resilience to the impacts of climate change.

The importance of the IWRM approach to adaptation was recognized by the IPCC in the Third Assessment, where it is stated that ”it can be expected that the paradigm of IWRM will be increasingly followed around the world... which will move water, as a resource and a habitat, into the centre of policy making. This is likely to decrease the vulnerability of freshwater systems to climate change.”

Managing water in an increasingly uncertain world, due to climate and other drivers of change, calls for risk management approaches. IWRM concepts, approaches and guidelines need to be further developed to address risks at all levels, from the community through the basin and national to the regional levels.

Climate change impacts all sectors of society, mainly through the land and water system, and calls for both horizontal and vertical integration of management approaches. The use of water by different sectors (agriculture, energy, domestic, industry etc.), and the way in which these uses affect each other, require cross-sectoral IWRM approaches, not least to address adaptation (horizontal integration). Similarly, in the river basin context, IWRM bridges from the community/watershed level through the basin, across boundaries within and between countries (vertical integration). Although “land and water integration”

is inherent in the IWRM concept, the importance of this linkage needs to be stressed in adaptation planning.

Action 4.1 Promote IWRM in river basins as the appropriate process for planning and investments

- Recognize the river basin as the logical framework within which hydrologic and environmental processes are quantified, and hence as the fundamental geographical setting for IWRM and adaptation planning. River basins may be defined at many levels, from local watersheds to transboundary basins extending over several countries or states (e.g. Mekong, Indus). IWRM should extend to the entire river basin, as one integrated unit, in order to achieve optimal operation policies.
- Ensure cross-sectoral dialogue on adaptation planning at both national and river basin levels, including government and relevant stakeholder groups
- Promote adaptation dialogue and consensus building by coordinating across different geographical zones, including upstream and downstream zones, inundation and non-flooding areas, areas of groundwater recharge and use, and urbanized and agricultural areas; and across different priorities including flood control, water utilization, and environmental conservation. This requires an understanding of the respective adaptation needs of each zone.
- Strengthen institutions for land and water management for effective adaptation and mitigation actions, building on the principles of participation of civil society, gender equality, subsidiarity and decentralisation.
- Develop different approaches for effective adaptation for land and water within a comprehensive, integrated framework, where bottom-up meets top-down—from community based adaptation in the villages to the basin, national and regional/transboundary levels.
- Develop a comprehensive information base for effective IWRM, including information on important hydrologic, hydraulic and environmental processes (e.g. river discharge, snow- and ice-melt rates, groundwater levels, infiltration, evapotranspiration, sediment-, nutrient- and heavy metal loads etc.). Improved hydro-climate system modeling capabilities are required in order to provide this information, and to link river basin planning and management processes to climate projections.
- Ensure that IWRM policies and plans reflect both historical records and future (projected) hydro-climatic conditions.

Examples of Climate Change Adaptation Actions as part of the IWRM Process In River Basins

- Develop flood and eco-sensitive zoning plans
- Strengthen water (use) rights systems for water scarce and drought prone areas
- Develop accurate and transparent water accounting and monitoring systems
- Increase focus on water demand management, including the "3R" approach: Reuse, Recycling and Recharge
- Increase storage capacity, including surface (constructing new dam storage, upgrading existing facilities), groundwater recharge (rainwater harvesting), while maintaining and utilizing the natural storage capacity of ecosystems to the maximum possible extent
- Increase use of new and emerging technologies in water scarce and drought prone areas, e.g. membrane filtration
- Focus on watershed management as a resilience building approach to adaptation
- Introduce economic instruments such as Payment for Environmental Services (PES) in order to maintain healthy ecosystems that contribute to climate change resilience

Action 4.2 Promote synergies in the planning and implementation of adaptation and mitigation measures

- Pursue low-energy water development and low-water-consumption energy development (measured e.g. through energy footprints for water, and water footprints for energy). Energy production (primarily cooling of thermoelectric generation) accounts for the majority of water abstractions in the US and Europe (35–50% of all abstractions), thus making energy production very vulnerable to increased variability and to changes in the hydrological regime, including changes in water temperature.
- Examine the water-energy synergy in the context of multi-purpose water infrastructure, which provides e.g., hydropower generation, flood control, irrigation and/or domestic water supply.
- Promote land and water management activities which at the same time contribute to adaptation through watershed management, and to mitigation (CO_2 removal) through carbon sequestration ("re-carbonizing the landscape" as the World Bank expresses it).
- Co-ordinate mitigation and adaptation efforts by sharing knowledge between the human and natural systems, including water, energy, health, agriculture, and ecosystems, and by promoting inter-operability of knowledge and management systems for success-

ful joint implementation. This will require coordination between different agencies and institutions, and a convergence of mitigation and adaptation programs and activities.

- Document and disseminate effective ("best") mitigation and adaptation practices already developed and utilized within the region. Many of these examples will be locally generated, and many of these will be cost-effective as community-level practitioners are skilled in using locally available resources and innovations.

Principle 5 – Financing

"We must increase dedicated climate financing substantially."

The costs of inaction

"There are risks and costs to a program of action. But they are far less than the long-range risks and costs of comfortable inaction." -John F. Kennedy

The likely costs of adaptation to climate change are high: the World Bank (2009) recently estimated the costs of climate change adaptation in developing countries at between $75 Billion and $100 Billion per year by 2050, assuming a world that is 2°C warmer. Estimates from other recent studies by the UNFCCC, UNDP and others are broadly consistent. ADB has estimated the adaptation costs in developing Asia and the Pacific at $28 Billion per year. These are large numbers, but the costs of inaction are higher still. ADB (2009) calculated that without effective adaptation, climate change could result in reductions of close to 7% in GDP in Southeast Asia, and the Stern Report (2006) has produced comparable estimates (5%) of global GDP impacts.

Resources currently available for adaptation fall far short of these needs. Although post-CoP15 pledges to the Green Climate Fund over the 2010-2012 period approach $ 30 billion, these funds must target both mitigation and adaptation globally, and not all funds pledged have yet been deposited. Further, estimates of adaptation requirements often fail to account for the "adaptation deficit": the additional resources required to achieve an acceptable level of water security under current climate variability.

Challenges in assessing and financing climate change adaptation

Estimates of adaptation funding needs cover an order of magnitude, and must be viewed as uncertain at best. In addition, the politics of adaptation finance are often contentious: developing countries argue that since they have contributed little to the emissions responsible for anthropogenic warming, they should not have to bear the costs of adaptation. They expect developed countries to provide grant financing as a matter of climate justice. On the donor side, it is not always clear if contributions to climate investment funds represent "new" resources, or if they are simply a re-labelling of previously committed development assistance. There are also relatively few good estimates of the specific needs and/or impacts by sector and by region.

There is also a mismatch in scales between the global and regional estimates cited above, and the more detailed, targeted estimates that will be required to guide national and local adaptation investment planning and policy-making. Our capacity to provide economic assessment of specific adaptation options is also currently constrained by deep uncertainty around the future conditions under which investments will be expected to perform. Uncertainty is not limited to climate and water systems, but extends, for example, to availability and prices of other key resources (including energy); and range of technology choices.

Currently, climate adaptation finance embodies a "top-down", perspective emphasizing internationally negotiated agreements, protocols and funding vehicles. By contrast, "adaptation is local," and effective strategies for adaptation finance cannot be formulated without the explicit input and participation of the communities most likely to be affected adversely by climate change. The right balance must be struck between centralised and decentralised solutions.

What are the next steps?

Two broad priorities stand out: first, the need to improve our understanding of the likely costs of climate change impacts in the water sector and in closely linked sectors including agriculture, energy and health; and the costs and benefits of specific adaptation options at a level of detail that supports effective planning and implementation. Without this informa-

tion, we risk a serious misallocation of adaptation resources. Second, we must mobilize to secure the necessary funding, and we must ensure that it is utilized efficiently, transparently and democratically.

Action 5.1 Conduct economic impact assessments for various adaptation options

- Improve assessment methods to reflect the fundamental uncertainty in climate and hydrologic projections, and to allow the evaluation/identification of *robust* solutions that are effective across a range of scenarios, as distinct from "optimal" solutions developed under a specific set of assumptions.
- Develop economic impact assessments of proposed climate disaster risk-reducing measures, reflecting the often enormous costs of disaster relief financing and the long-term negative impacts on economic growth of such disasters where resilience is low.[6]
- In developing, presenting and utilizing economic impact assessments, emphasize studies that examine *current, quantifiable* risks (e.g., flood and drought), where you can *demonstrate* benefits from investments. If economic impact assessment focuses exclusively on future, hypothetical risks associated with climate change, the cascade of uncertainty (in both climatic and non-climatic factors including prices and technology) can call into question the soundness of conclusions, and lessons drawn. Identify, document and share good contemporary studies that provide guidance with respect to future conditions.
- Apply economic assessments comprehensively in the context of IWRM processes in river basins and cities, encompassing the life cycles of infrastructure, emphasizing adaptation for water security in the long term, and recognizing the public goods generated by many water sector investments.
- Use the concept of a "triple bottom line" to optimize economic performance, social equity and environmental sustainability in a balanced manner and thereby increase water security through the process of IWRM.

[6] The IPCC AR4 projects more frequent heavy precipitation events, an increase in the area affected by drought, and more intense tropical cyclones (typhoons and hurricanes) associated with global warming. Post-disaster relief expenditures are often large relative to investments in climate disaster risk reduction.

Action 5.2 Mobilize significant investments today (e.g., 1% of GDP) to prevent greater damages later (e.g., 5%) as advised by the Stern report

- Establish national and sub-national "road maps" to guide financing priorities and strategies, prioritizing the interests of the most vulnerable, and recognizing and supporting climate change adaptation as an important dimension of the IWRM process.
- International/multi-lateral funding must be focused on the creation of public goods. For example, develop funding arrangements that enable adaptation on a basin-wide scale, across boundaries within and between countries.
- Ensure that new (e.g., Green Climate Fund) funding streams for adaptation are channeled through existing institutions that have proven to be effective; and directed sufficiently toward the water sector. As countries increasingly seek direct access to multilateral climate funds through National Implementing Entities (NIE), care should be taken to ensure that funding for water sector adaptation activities is channeled to effective agencies at central, river basin and local levels.
- Maintain flexibility by avoiding financing arrangements for special purposes and narrow interests; and align adaptation financing with disaster risk reduction and overall development objectives.
- Demonstrate the commonality of purpose between building climate resilience and overall development activities, so that the (much larger) funding streams currently available in national development budgets can be made available for climate change adaptation.
- Inform, support and assist decision-makers and other parties in developing countries in preparing applications for grants, loans and technical assistance to gain access to the increasing funding opportunities anticipated post COP15.
- Provide financial and technical support for R&D of promising (but unproven) mitigation and adaptation technologies early in the development cycle (*note: we currently tend to finance proven technologies*) –and be prepared to take some risks in their application.
- Promote investment in existing infrastructure (including knowledge infrastructure) that generates benefits today as well as potential additional benefits under climate change. For example, encourage international funding for collaborative climate research.
- Identify opportunities for Public-Private Partnerships (PPP) to leverage private investments and innovations, particularly when it makes advanced technologies or practices available in developing economies and offers opportunities for leapfrogging. When utilizing PPPs to address climate adaptation, ensure that there is transparency, public oversight and participation in the allocation and administration of funds.

- Partner with the private sector *locally* to facilitate the financing of adaptation-oriented infrastructure and services, particularly where local firms have limited access to capital.
- Provide start-up financing and technical assistance to introduce and to increase the coverage of disaster insurance pools (household, agricultural, other).
- Finance long-term capacity building for adaptation as part of IWRM processes in river basins and cities, including education and water governance institutions.

"To address this issue, we commit to support urgent actions to mainstream adaptation into broader development strategies and encourage developing countries themselves to integrate adaptation into their development policies. The early start of activities under the UNFCCC Adaptation Fund should make an important contribution in this respect. We call on the multilateral development banks and other development agencies to support countries in this endeavor." - Leaders Declaration, 2008 G8 Hokkaido-Tokyo Summit

Steering Group on Water and Climate Change

The Steering Group on Water and Climate Change was established by the Governing Council of the Asia-Pacific Water Forum in June 2009 and tasked with three key result areas: (i) advising leaders on policies and practices; (ii) guiding knowledge networking in the region; and (iii) reporting progress annually to the leaders in the Asia-Pacific region with recommendations for action. The Steering Group comprises scientists, experts from international organizations, governments, civil society, and development funding agencies including World Bank, Asian Development Bank and the Japan International Cooperation Agency.

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