International Institute for Sustainable Development
Institut international du développement durable
http://www.iisd.org

Land and Water Resource Management in Asia

Challenges for climate adaptation

Stephen Tyler and Liz Fajber

January 2009

Background Paper for the Asia Regional Meeting of the Dialogue on Climate Change Adaptation for Land and Water Management, January 19–21, 2009, Hanoi, Vietnam.

Land and Water Resource Management in Asia

Challenges for climate adaptation

Stephen Tyler and Liz Fajber

January 2009

Background Paper for the Asia Regional Meeting of the Dialogue on Climate Change Adaptation for Land and Water Management, January 19–21, 2009, Hanoi, Vietnam.

This paper is a product of work conducted independently by IISD with financial support from the Danish Ministry of Foreign Affairs.

Published by the International Institute for Sustainable Development

The International Institute for Sustainable Development contributes to sustainable development by advancing policy recommendations on international trade and investment, economic policy, climate change, measurement and assessment, and natural resources management. Through the Internet, we report on international negotiations and share knowledge gained through collaborative projects with global partners, resulting in more rigorous research, capacity building in developing countries and better dialogue between North and South.

IISD's vision is better living for all—sustainably; its mission is to champion innovation, enabling societies to live sustainably. IISD is registered as a charitable organization in Canada and has 501(c)(3) status in the United States. IISD receives core operating support from the Government of Canada, provided through the Canadian International Development Agency (CIDA), the International Development Research Centre (IDRC) and Environment Canada; and from the Province of Manitoba. The institute receives project funding from numerous governments inside and outside Canada, United Nations agencies, foundations and the private sector.

International Institute for Sustainable Development
161 Portage Avenue East, 6th Floor
Winnipeg, Manitoba
Canada R3B 0Y4
Tel: +1 (204) 958–7700
Fax: +1 (204) 958–7710
E-mail: info@iisd.ca
Web site: http://www.iisd.org/

Table of Contents

List of Acronyms

ADB	Asian Development Bank
CGIAR	Consultative Group for International Agricultural Research
CIAT	International Centre for Tropical Agriculture
COP	Conference of the Parties
DRR	Disaster Risk Reduction
FECOFUN	Federation of Community Forest Users, Nepal
FUG	Forest User Group
ICIMOD	International Centre for Integrated Mountain Development
IIRR	International Institute for Rural Reconstruction
IPCC	Intergovernmental Panel on Climate Change
IRRI	International Rice Research Institute
IWDM	Integrated Watershed Development and Management
IWMI	International Water Management Institute
IWRM	Integrated Water Resource Management
MO	Manila Observatory
MRC	Mekong River Commission
RECOFTC	Regional Community Forestry Training Centre
SEA	Southeast Asia
SIDS	Small Island Developing States
START	Global Change SysTem for Analysis, Research and Training
UNFCCC	United Nations Framework Convention on Climate Change

1. Introduction: Policy dialogue process

Throughout Asia, the need to adapt to the effects of climate change has become increasingly evident. The work of the Intergovernmental Panel on Climate Change (IPCC), research institutes, government and development organizations has also raised awareness of the challenges that this process poses, particularly for poor developing countries. This awareness has resulted in increased commitment to support for adaptation at the international level, linked to the United Nations Framework Convention on Climate Change (UNFCCC). Studies have identified the most vulnerable countries and regions; adaptive capacity has been assessed and improved; and national action programs have been initiated in many countries. As an example of the growing awareness of climate adaptation needs in Asia, the Socialist Republic of Vietnam announced at the 14th Conference of the Parties (COP-14) to the UNFCCC in December 2008 that it was launching a seven-year, US$135 million national program focusing on climate change adaptation.[1]

Despite these achievements, climate change adaptation has not been adequately integrated into planning and policy in key natural resource management sectors. To help address this situation, the Danish Ministry of Foreign Affairs is facilitating a strategic policy dialogue process with developing countries, relevant international organizations and experts involved in land and water management, as well as climate change. This "Dialogue on Climate Change Adaptation for Land and Water Management" aims to facilitate the exchange of information, experiences and lessons learned among experts in land and water management in Africa and Asia in order to:

- increase understanding of the implications of climate change for sustainable development;
- promote understanding of integrated land and water management response strategies, including local coping strategies, and the application of lessons learned in new contexts; and
- raise awareness of adaptation measures that address land and water management challenges.

The dialogue was initiated with a conference in Copenhagen in November 2008, and will continue with regional workshops in Sub-Saharan Africa and in Southeast Asia (SEA). It is anticipated that the findings and recommendations from this dialogue process will serve as inputs into the ongoing negotiations on the future of the international climate change regime expected to be concluded at COP-15 in Copenhagen (December 2009).

This paper was prepared as background to the workshop in SEA, held in Hanoi, Vietnam from January 19 to 21, 2009. The paper is intended to identify key development issues relating to land and water management in the less developed countries of the Himalayan and SEA regions, and how these are likely to be affected by long-term climate change. Because of the breadth and diversity of this region, it is not possible in this brief report to cover each country in detail. Instead, we focus on key issues of broad relevance and provide selected illustrations.

The paper links the issues of poverty reduction, land and water resource management, and climate adaptation in practice. Within SEA and the Himalayas, as elsewhere, land and water resource

[1] Vietnam News Service, December 12, 2008.

management issues are most pronounced in areas of marginal production systems, and directly connected to poverty reduction efforts. Climate change is likely to exacerbate existing challenges within these sectors in unexpected ways. The paper also reviews some of the many innovative efforts underway in the region to support land and water management and poverty reduction at multiple levels (local, national and regional). It highlights how climate change adaptation measures can complement and reinforce these innovations in land and resource management to reduce rural poverty in Asia. It concludes with the sharing of ideas regarding ways to strengthen the capacity of land and water managers to ensure their continued contribution to the sustainable development of their countries in a changing climate.

2. Land and Water Management: Linkages to poverty reduction and development challenges in SEA and the Himalayas

2.1 Current resource management and development challenges

Across SEA and the Himalayan region, the fate of the rural poor is closely tied to the land and water resources they rely on for food, water and economic security. While urban and industrial growth power the region's rapidly growing commercial economy, the rural poor remain dependent on the benefits provided by ecosystems. Land and water resources are the foundation for the agricultural production, fisheries and aquaculture that provide nutrition and income. These resources also support the production of livestock and forest products that provide food, fuel, fodder and building materials crucial for the livelihoods of impoverished families. At the same time, these ecosystems provide critical services to a wider rural and urban population, including surface and groundwater restoration, regulation of flooding and maintenance of biological diversity, among others.

These land and water resources are under increasing stress due to patterns of over-exploitation, conflicts over rights, and broader anthropogenic environmental change. As resources and ecosystems degrade, the livelihoods of the poor are further eroded. In environmentally fragile areas, such as upland and mountain regions characterized by steep slopes and poor soils, deforestation, overgrazing and intensified cultivation have led to soil erosion and fertility losses, increased flash floods, and decreased dry season water flow. These areas are home to many of the region's poor—particularly politically and socially marginalized ethnic minorities. Their limited asset base is further weakened by the impacts of extreme climatic events such as severe storms, floods, landslides and mud flows. Pastoral and agro-pastoral systems in marginal high-altitude zones are challenged by variable precipitation, increasing competition for grazing and policies that undermine collective pasture management.

The quality and quantity of regional water resources are under stress due to increasing variability and scarcity, compounded by pressure on ground and surface water resources to meet intensified agricultural outputs and industrial needs. For example, highly populated lowland regions of intensive agricultural production (as in parts of Nepal, for example, where up to four crops are produced per year on a single plot of land), rely on intensive inputs and water extraction with long-term impacts on groundwater quality and availability, and soil fertility. Degradation of wetlands, in part due to land conversion and variable water levels, is affecting regulation of flood plains, regulation of waste from increasing urban areas, fish-spawning habitat and rice production. As well, the construction of

large hydro dams to meet increasing demand for electricity is affecting seasonal inundation patterns both upstream and downstream, as well as water flow, fisheries habitat and agricultural production. As a result, the livelihoods of vast numbers of rural residents depending on those resources are at risk. Moreover, decades of investments in flood control, embankments and other control measures have not eliminated large-scale flooding. The sense of security provided by such investments has often proven false, with subsequent catastrophic failures of infrastructure, crops and livelihoods pushing families deeper into poverty.

In coastal areas, increasing urbanization, industrial expansion, intensification and competition of fisheries are leading to decline in the productivity and quality of marine environments. Poor families in coastal areas in Southeast and South Asia, particularly in the Philippines, Vietnam and Bangladesh, are exposed to increasingly intense cyclones, typhoons and other tropical storms. These storms have taken huge tolls on lives, damaged homes and fishing boats, and destroyed crops despite efforts to mitigate risk (UNDP, 2007). As a result, those with limited assets are often unable to recover from damages and sink deeper into poverty.

Across the region, economic growth has masked the widespread failures of resource management efforts in the face of these stresses. Management policies have often undermined the resource tenure and access rights of poor and marginalized groups, who have limited voice in governance and decision-making about the natural resources on which they depend. State policies have historically favoured large-scale commercial access to resources such as forests, fisheries or water, which has generated conflict and displaced traditional users. Tenure reforms have focused on private household tenures, rather than collective or community-based management systems that can be more effective for managing common pool resources (Tyler, 2006a; Ostrom, 1990). Sectoral resource management at the national level, with separate policy, regulatory and management regimes for forests, agriculture and water resources, are inconsistent with sustainable local practices that recognize the integral relationships between these resources for productive ecosystems. Women are particularly disadvantaged, as they often have much less access than men to productive resources (e.g., land, water); technologies (e.g., inputs, management practices); and services (e.g. agricultural extension, credit). This situation is of particular concern in many countries of SEA and the Himalayas that are experiencing high male urban migration, leaving rural women with additional agriculture and land management responsibilities but without the needed inputs, management services or tenure security.

It is impossible to discuss land and water management in the Southeast Asian and Himalayan region without considering urbanization. Over the next generation, the urban population of Nepal and Bangladesh is expected to triple, while that of Indonesia will increase by at least 80 million (Varis, 2005). In terms of livelihoods, mobility and resource pressures, the urban-rural distinction is blurring in densely populated Asian countries. Peri-urban zones of high population density and intensive agricultural and industrial production pose new management challenges and new demands on land and water resources. This urbanization/peri-urbanization has significant impacts not only on ecosystem provisioning services (such as supply of safe water and food), but also on the regulating services provided by flood plains and wetlands (as natural drainage systems are modified) and filtering (due to high concentration of pollutants). There is often little control over peri-urban development, as it frequently falls outside of municipal jurisdictions and is propelled by informal or

unorganized construction. As a result, vulnerable coastal sites, degraded wetlands or unstable slopes are often developed, increasing the climate risks to millions of the poor who cannot afford formal housing in serviced sites. Population growth, economic migration and displacement from degraded rural areas contribute to growing exposure of poor populations in these vulnerable sites.

For all these reasons, effective and equitable land and water management are critical to addressing poverty. The resource-based livelihoods of the rural poor, and the vulnerable living conditions of the urban poor, pose enormous development challenges throughout the region. The anticipated impacts of climate change will exacerbate most of these challenges and further imperil poverty reduction efforts.

2.2 Climate impacts in the Southeast Asian and Himalayan regions

As documented in the Fourth Assessment Report of the IPCC, a process of human-induced climatic change has begun and is already leading to more variable weather patterns and altered ecosystems (IPCC, 2007). SEA and the Himalayan region are already experiencing a broader range of climate variability than the norms of the climate record. This variability is expected to increase over the coming century, including altered rainfall patterns, temperature change, extreme weather events, and sea-level rise. The degree of change that will take place is unclear. While continually improving, climate models are most uncertain in the tropical belt in which most SEA and Himalayan countries fall. Climate modelling suggests fairly moderate temperature increases in the region but longer periods of warmer temperatures (Snidvongs, 2007). Temperature increases will be particularly important in the uplands regions and the Himalayas, but even in lowland areas, they are likely to result in greater heat stress on key crops, contributing to reduced global food grain production (Battisti and Naylor, 2009).

But the most severe impacts in the region are likely to come from changes in precipitation, snow and ice hydrology, and storm intensity and frequency, all of which are more difficult for models to accurately predict. Increasing rainfall in summer monsoon months is expected, along with a decline in winter rainfall, although the most notable pattern will be greater variability from the historical regularity of the monsoon pattern (Alam *et al.,* 2007). It is difficult to overemphasize the impacts of greater variability in a monsoon climate for areas where farmers have traditionally relied on highly predictable seasonal precipitation patterns. Poor rural people in the region are already puzzled by shifting seasonal climate patterns which weaken the value of their long base of experience and local knowledge, and expose them to new risks of food insecurity (Oxfam, 2008).

While flooding related to heavy rainfall and extreme storms has been historically familiar in the region, drought is now increasingly a problem. Parts of Indonesia, Vietnam, Laos and Nepal, among others, are now vulnerable to both severe flooding and drought, with direct implications for agricultural productivity and infrastructure requirements and stability. The intensity of tropical cyclonic systems is expected to increase, which would cause greater flooding and the loss of homes, assets and lives. Sea level rise remains uncertain: the most conservative estimates at 40 cm by the end of this century (Cruz *et al.,* 2007); other estimates suggest that it may be as high as 0.5 to 1 m by 2070 (Alam *et al.,* 2007). A rise in sea level of one metre would flood 5,000 sq km of the Red River Delta and most of the Mekong Delta (up to 20,000 sq km), inundate 17 per cent of Bangladesh and large

portions of the Small Island Developing States (SIDS).

Changes in temperature and rainfall patterns will directly affect agricultural production, particularly in rainfed upland areas. Yield of key cereal crops such as wheat (Fisher *et al.,* 2002), rice and soy are projected to become less reliable. The poor will be more exposed to disasters; higher intensity of rainfall events and tropical storms are likely to exacerbate flash floods and landslides in upland areas, with impacts on flow levels downstream. Variability in water flow regimes may also affect hydropower production, even as demand for electricity for urban air conditioning increases. Pest and disease patterns are also likely to change affecting the health of people, livestock and crops.

Changing rainfall patterns and an elevation increase in the winter snowline may contribute to further degradation of grazing lands in these areas, forcing pastoral communities to seek other livelihood opportunities. Increases in temperature and changing rainfall patterns will likely affect the regional hydrology of the Ganga and its major tributaries, introducing greater variability and extreme flow regimes downstream in Nepal, India and Bangladesh, and affecting the livelihoods of tens of millions of people. Glacial lakes are likely to breach and faster melting of glaciers may lead to increased flooding from large spring and summer flows in the short term, but overall decreased flow in the long term. These large (and occasionally violent) flows, combined with geologically unstable landscapes, will carry high sediment loads, magnifying flooding and siltation downstream.

Development challenges in coastal areas will be exacerbated with increases in frequency and intensity of tropical storms, higher sea levels and storm surges, and coastal and beach erosion leading to loss of livelihoods, property and infrastructure. Both artisanal and large-scale fisheries and marine aquaculture will be heavily affected, although seawater intrusion and declining river runoff may facilitate brackish water fisheries. Coastal populations may also have to deal with the spread of infectious bacterial diseases such as cholera due to warmer sea surface temperatures along coastlines (Pascual *et al.,* 2002). Flooding and storms may lead to loss of property, dislocation and spread of disease (Adger, 2003).

Coastal deltaic areas are especially vulnerable to climate change impacts due to the combination of more variable upstream flows, as well as coastal storms and sea level rise. Low gradients and intensive agriculture in these areas reduce drainage and encourage saline intrusion. Change in hydrological flow and flooding will affect crop production, fisheries and human health. In the Mekong Delta in particular, basic infrastructure, food security and livelihoods will be dramatically affected. Vietnam would also lose much of the rice output from this most productive region of the country (UNDP, 2007).

How these projected changes in climatic conditions will manifest themselves at the local level cannot be clearly discerned. Inherent uncertainties continue to be associated with downscaling global models. Moreover, specific local impacts will depend not only on the magnitude of climate change experienced, but also on the responses of ecosystems that are already stressed by other factors such as anthropogenic degradation. The consequences for local communities will be further conditioned by the ability of these societies to adapt to increased variability and uncertainty. Adaptive capacity differs among individuals, social groups and countries and is influenced by a range of factors including economic and livelihood systems, access to infrastructure and services, social and gender

barriers, political institutions and personal attributes. The multiple dimensions of poverty may exacerbate vulnerability and weaken adaptive capacity. The poor often have limited access to information, technology and capital assets, hindering their ability to adapt or cope with climate impacts and related development challenges. Women, in many cases, are more vulnerable than men and may have less capacity to adapt to climate change and associated impacts, due to differing social practices, work responsibilities that may enhance their exposure and differential access to resources, information and services.

3. Land and Water Management at the Local Level

The additional stresses imposed by climate change will directly impact the poor who are most dependent on fragile ecosystem services for their livelihoods. To gain some insight into the likely impacts, and the types of adaptive responses needed to avert or overcome them, we will consider the range of current land and water management issues in the region and how local people, governments and regional organizations are already innovating in response. We start at the local level, where all adaptation takes effect.

3.1 Local level context

Farmers, fisherfolk, herders and other poor households face many practical challenges, some already induced by climate variability. Repeated severe drought and flooding, insecure land rights and declining productivity of agriculture and fisheries due to overexploitation, conflict and unsustainable production practices, particularly affect smallholder farmers and fisherfolk. To manage these impacts, families often are forced to sell assets such as land and livestock, and incur debt at exorbitant rates of interest, pushing them further into impoverishment. Those with some skills and social networks migrate to urban or peri-urban centres seeking alternative employment as low-paid, low-skilled labourers or elsewhere as agricultural labourers. In many areas, young men and women support their families as labour migrants, leaving in their home villages mainly the elderly and children, who have less capacity to work the land, fish or gather resources.

With only limited access to climate- and weather-related information, poor resource users are exposed to the greatest risks, yet have the least capacity to absorb losses. This pattern was demonstrated by the impact of Cyclone Nargis on the poor when it rampaged through the Irrawaddy Delta of Myanmar in May 2008. In contrast, farmers or commercial investors with greater material, financial and social assets are better placed to manage losses and secure access to productive resources, thereby increasing socio-economic disparities in many countries.

Improved approaches to land and water management are required to strengthen resilience of the resource base *and* the populations who rely on them. Increased resilience is needed to manage current development challenges as well as the future uncertainties and impacts of climate change. Such approaches are intricately connected with long-term strategies for sustainable development and poverty reduction.

3.2 Local adaptive responses

A number of innovative responses are already taking place at the local level to tackle the dual agendas of poverty alleviation and resource sustainability. These responses provide a base on which to enhance resilience to future impacts of climate change, and are in many cases already responding to climate variability. Positive local efforts include strengthening production systems, building economic assets, improving access to markets and information, diversifying to less climate-sensitive livelihoods, reducing disaster risks through local planning and preparation, and building foundations for all of these initiatives through more effective institutions of local governance and resource management. Each is discussed briefly below.

Improving production systems

Local approaches to land and water management have focused on improving production systems in order to increase productivity while reducing damage to land and water resources. Agricultural production systems are being strengthened through diversification of cultivars, improved soil-water management practices, identification and development of drought-tolerant, water-resistant and saline-tolerant varieties and management practices (such as early- or late-sowing varieties), as well as demand-responsive water management for agriculture such as drip irrigation. The mixed cropping of swidden systems provides some resilience to both environmental degradation and economic fluctuations, but requires improvements in soil fertility and erosion control, in part through agroforestry or fallow crops as in parts of Laos, Nepal and Indonesia. Innovations in fish-rice cultivation, inland fisheries and small-scale aquaculture are strengthening fisheries production systems, incomes and nutrition of small holders in many countries. Applied research programs, such as those led by the Consultative Group for International Agricultural Research (CGIAR) institutes most active in the region,[2] and others involving local research centres, have been crucial to developing and testing these new technologies.

Innovations in integrated water resource management, with approaches in both supply and demand management, have led to improvements in water resource sustainability. Improved management of irrigation channels and pond construction, combined with soil erosion control, have improved efficiency of water management systems. Rainwater harvesting efforts to recharge aquifers, particularly in parts of India, provide useful lessons for augmenting water supply in areas of increasing groundwater extraction and rainfall variability. Participatory water management institutions have increased productivity and incomes—as demonstrated by a project of IWMI and the Government of Cambodia that has enabled farmers to take over management of local irrigation systems that were previously degraded and poorly managed (IWMI, 2008). In contexts of decreasing water availability and severe degradation, there have also been innovations for fodder and pasture management in rangeland production systems, such as improved production of appropriate indigenous varieties for fodder and forage species (Zhaoli, 2008).

[2] Centre for International Forestry Research (CIFOR), International Rice Research Institute (IRRI), International Centre for Tropical Agriculture (CIAT), International Water Management Institute (IWMI), WorldFish Center.

Risk management and asset building

Poor farmers have limited tools with which to manage the higher risks associated with the impacts of greater climate variability on production systems. In order to cope with losses from declining productivity, climate extremes and economic shocks, many households and individuals may rely on selling liquefiable assets and borrowing from family, friends and frequently from exploitative money lenders. The debt load can plunge even middle-income farmers into poverty. Furthermore, marginal farmers and fishers can seldom risk experimenting with new, unproven technologies. One approach involves "hedging" production choices to manage these risks. In Cambodia, for example, farmers are responding to increasingly unpredictable rainfall by dividing their rice plots: on one half, using conventional wet-paddy rice techniques (resistant to heavy precipitation) and, on the other half, applying a system of rice intensification requiring much less water (Resurreccion *et al.*, 2008).

To address the growing need to manage climate change induced-risks, financial institutions such as credit, insurance, risk-spreading and other financial services need to be more accessible to the poor, and involve more gender-responsive strategies to reach women who are increasingly making production decisions. This may involve strengthening the accessibility and reach of formal lending institutions such as banks and co-operatives, or informal savings and micro-credit groups. While institutions such as women's self-help savings groups and micro-credit banks for the poor are common in Bangladesh and India, they are less common in countries in SEA. Innovative and accessible low-cost insurance products such as weather-indexed private crop insurance is now available to poor farmers in South Asia (Kelkar, 2006), and may have much wider application.

Markets

Improved access to markets can substantially increase returns to poor producers, reducing poverty and enabling more sustainable production. Value-added practices such as improved primary processing, drying, storage and sorting or grading will often increase economic returns to agriculture, livestock, fisheries and forestry activities. Improving linkages to markets through creating economies of scale by linking women and men producers through co-operatives and improving transport systems will also facilitate small producers to compete in markets and to strengthen economic assets. For example, in Nepal, the Medicinal and Aromatic Plants Program of Asia has supported women's co-operatives to improve drying, storage and grading techniques of high-value medicinal plants, and to improve their negotiating skills with buyers. Better access to market information for pricing and strengthening business plans and skills for both women and men has improved economic benefits and household assets. A stronger asset base provides greater protection and faster recovery from extreme climatic events or other calamities.

Access to information

Currently, the "last mile" of communication on key information relevant to poor resource users, such as marketing, product and input prices, weather and rainfall patterns, and of early storm or flood warning systems, seldom reach those most in need, particularly women. Climate and weather information needs to be accessible and locally relevant, and support given to local people to use this information. Information, education and campaign activities using accessible media such as community radio or local events are useful.

There are some innovative pilots taking place in the region to address this need. For example, in Indonesia, Bogor Agricultural University is working with farmers to use climate forecasts through climate field schools (adopted from farmer field schools renowned in the region for supporting application of new agricultural practices). For example, when seasonal forecasts suggested a drier than normal crop season in 2006–2007, farmers stored a larger proportion of their first rice crop in anticipation of higher prices due to dry conditions for the second crop.[3]

In the Philippines, efforts are also underway to ensure two-way communication and information flow. The Manila Observatory (MO) has partnered with SMART, one of the country's mobile phone service providers, for a pilot project providing telemetric rain gauges and phones in disaster-prone areas such as in Mindoro province (Resurruccion *et al.,* 2008). Local farmers read the rain gauges and phone the information to the Observatory, while the MO can also use the phones to issue early warning of storms to the farmers. The farmers can also use the phones to access market information. Unfortunately these examples fail to address gendered differentiation in access to information and technologies.

Livelihood diversification and migration

Many poor rural households are already responding to environmental and economic challenges through diversification of livelihoods into non-climate- or less-climate-sensitive sectors. This may involve non-farm/fisheries work in their immediate locale, or, as mobility and communications links improve throughout the region, long-term or seasonal migration to urban centres within the region or beyond to East Asia or the Middle East. Few poor rural families rely solely on local resource production, and many have at least one family member sending remittances from migrant labour abroad. While in South Asia this has predominantly been men (although this is changing), in Southeast Asia, women constitute a large segment of migrants, partly due to fewer cultural constraints and emerging labour markets seeking cheap female labour. Remittance economies are crucial to the survival of rural families, and may also be used as investment in land and water management. For example, in Gujarat, India, remittance returns were used for to pay costs of maintaining small dams (Desakota Study Team, 2008). While migration may ultimately strengthen adaptive capacity for families at "home," it also exposes migrants to new social vulnerabilities.

Disaster risk reduction

There is increasing recognition that repeated exposure to extreme climatic events, such as floods, droughts or storms, is a key factor contributing to impoverishment and underdevelopment. Disaster relief mechanisms, while providing vital humanitarian aid in times of crisis, may inadvertently exacerbate vulnerability by weakening local leadership and response mechanisms. By incorporating disaster planning and preparation as a key part of local development planning, in collaboration with women and men at the community level, both capacities and infrastructure can be put in place to be better able to respond and recover from extreme events.

Disaster risk reduction (DRR) measures require better diagnosis of vulnerabilities, many of which are closely tied to climate risks. As such, the diagnostic, educational, organizational and substantive elements of DRR all provide foundations for climate adaptation. Successful DRR approaches in the

[3] R. Boer, personal communication.

region include Bangladesh, which has dramatically reduced loss of life from typhoons and floods over the past decade through an integrated community-level program of public awareness, typhoon shelter construction, better early warning systems, improved house design and extensive training, especially for women. In Vietnam, Committees for Flood and Storm Control are organized at local, district, provincial and national levels to promote better preparation, investment in boats and rescue equipment, training and public awareness-building, and to guide early warning, emergency and recovery efforts. These approaches have paid off in central Vietnam, where despite severe flooding and property damage in 2007, there was very limited loss of life compared with previous floods (Oxfam, 2008).

Strengthening institutions

Technical approaches to strengthening production systems are widely recognized as necessary but not sufficient to enhance resource sustainability and equity (Sayer and Campbell, 2004). Attention to more equitable tenure arrangements and access to productive resources is essential for sustainability and for poverty reduction (Tyler, 2006a). For common pool resources, such as forests, fisheries, pasture and water, it is widely recognized that neither public nor private resource tenure has been very effective (Acheson, 2006). Community-based resource management institutions (water, forests, rangelands, etc.) strive for more participatory and locally responsive planning, and aim to be inclusive of voices of poor and more marginal groups. For example, in Tam Giang lagoon, Vietnam, participatory planning with government officials and fisherfolk resolved conflicts over fisheries and waterways and improved governance of lagoon resources (Tuyen *et al.,* 2006). As well, innovative approaches to co-management have supported more equitable tenure arrangements, and addressed conflicts between different pastoral and sedentary groups. This has been accomplished in part through innovative and participatory institutional arrangements that enable different groups to voice their priorities and concerns, such as in a Himalayan region International Centre for Integrated Mountain Development (ICIMOD) rangeland program (Zhaoli, 2008).

One of the challenges in participatory community-based management is how to link local knowledge and perceptions with scientific assessments. These two domains of knowledge are not easily reconciled because of different fundamental assumptions and worldviews. However, promising approaches build on mutual exchange and shared learning. For example, the Challenge Program project on Companion Modelling for Resilient Water Management in the Mekong and in Bhutan facilitates discussion among stakeholders of different perceptions of existing water and socio-economic issues, generation and discussion of scenarios, and collaborative planning and co-ordination among users (IWMI, 2008).

Policies and program initiatives that foster the development of these local institutional arrangements for collective management and tenure, and build cross-scale linkages for learning between resource management institutions, local government, knowledge providers and senior governments are an important new trend discussed further below.

3.3 Enhancing resilience to impacts of future climate changes

The innovations described above demonstrate the foundations of adaptive responses on which to strengthen resilience to the challenges of environmental degradation, poverty and the future uncertainties and exacerbated conditions brought on by climatic change and variability. Climate impacts, environmental degradation and economic shocks require integrated strategies for land and water management, and sectoral responses need to move beyond responsive measures to building more resilient systems capable of self-corrective actions. This requires land and water management strategies that are able to flexibly respond to variability and to surprise. This may involve enhancing the ecological buffering role of components of the ecosystem, particularly wetland and riparian areas, groundwater and forests.

For surface and groundwater ecosystems, attention needs to be given not only to the quantity but also the quality of water supply and pollution control, particularly in peri-urban areas. Landscape management plans that employ "patchy" areas of semi-natural woods or grasslands may provide ecological buffers that reduce adverse hydrological and ecological effects of urbanization, and improve water-related ecosystem services (Desakota Study Team, 2008). Although integrated management of peri-urban areas in this fashion would affect only small geographic areas, it would reduce risks for very large populations of the urban poor.

Fisheries and aquaculture production systems can also build on current experience to improve climate resilience. Brackish water and estuarine systems may become more important in the future, so attention to ecological, technological and tenure/institutional lessons from aquaculture would be advisable. Investments in marginal production systems will be needed to enhance productivity in livestock operations and small-scale fisheries.

Extension services will need to improve reach to remote areas and provide needed information, inputs and technologies that respond to local priorities and specificities. Furthermore, extension services need to reach and respond to marginal groups and to both women and men, particularly in areas of high male migration where women have increasing responsibilities for agriculture and water management.

New resource co-management institutions that provide stronger roles for local institutions in governance for land and water management have demonstrated that they can be more responsive to local conditions and flexible enough to respond to uncertainty. However, they have also been criticized for exacerbating current social inequities, and for their limited management expertise and capacity, lack of budgetary support and for the confusion caused by new management organizations weakening existing local government bodies. Role clarity, accountability and broader access to information will be important to assure that these new resource management institutions can function effectively. This requires linkages with governance mechanisms, scientific resources and socio-economic networks at multiple scales.

Reinforcement of new local resource management institutions must pay special attention to social

differentiation and power relations, ensuring the promotion of more inclusive, representative, accountable and transparent decision-making processes on resource use and management. Of particular concern here are gender issues, which play a significant role across all aspects of adaptation and natural resource management. Despite widespread recognition of the importance of gender, and the high profile of gender as a development factor among donors and international organizations, it is often difficult for well-intentioned local organizations and practitioners to even identify, much less overcome, the disempowering effects of convention and social exclusion (Beck and Fajber, 2006). Women are generally the first and most seriously affected by resource degradation and disaster losses: they often have less education or access to information; they are the first to lose their share of scarce household food; they are obliged to travel farther to collect fuel or water and find fodder for livestock; they are less likely to have been taught how to swim to survive flooding; and they bear the burden of nursing family members weakened by water borne diseases. They have fewer livelihood options, and have to take over rural production tasks when their husbands leave to find employment. While they have proven to be capable managers and organizers of resource stewardship, and leaders in disaster risk reduction (Oxfam, 2008), it can be difficult to plan community processes that engage them effectively because they have so little time to spare. Women are on the front lines of climate impacts, and need to be central to adaptation strategies.

Local adaptation also requires integrated planning at the local level, across sectors and with attention to livelihoods as well as resource sustainability. Integrated management strategies that employ ecosystem and landscape approaches are one step towards this as they support frameworks and practices that recognize the interdependencies of land and water resources, and the need to consider these resources more holistically. However, for effective adaptation and resilience to climate impacts and uncertainties, attention must also be paid to strengthening social, economic and human capital alongside environmental security. This requires approaches that are not only focused on short-term responses, but also integrated in long-term development strategies. Given the increased exposure to extreme events that will take place—and is already occurring—it will be essential that adaptation efforts are linked closely to disaster risk reduction efforts and disaster management planning. This necessitates a movement away from "responsive" efforts to building adaptive and resilient approaches for local initiative linked to long-term development.

Box 1: Integrated Adaptation Planning in Vietnam

One example of integrated planning is the Community-Based Adaptation to Climate Change project implemented in Vietnam by the People's Committees of Thua Thien Hue province with CECI (Canadian Centre for International Studies and Cooperation), supported by the Canadian International Development Agency. This project strengthened local capacities to develop and implement adaptation plans through assessment of hazards, vulnerabilities and capacities, and participatory planning of initiatives across sectors including agriculture and aquaculture management, early warning, and disaster preparedness. The project aimed to integrate risk reduction and mitigation into local development planning, with attention paid to livelihood, environmental, social, personal and information security (Shaw, 2006).

The experience with land and water management suggests that local adaptive responses will need to employ integrated and holistic approaches across sectors, and with as much attention to livelihoods, social relations, governance and human capital as to ecosystem function. Building adaptive capacity means moving away from prescriptive management towards enabling strategies that help poor women and men to build their asset base, thereby enhancing resilience to environmental and

economic shocks. These approaches can be supported by local-level adaptation planning and practice that is inclusive, participatory and learning-oriented. Local adaptation approaches can reinforce new strategies for land and water management, but should link to national and regional decision-making, to ensure appropriate information, policy coordination, integrated planning and shared learning for effective adaptive management.

4. National Policy Context for Land and Water Management

The local-level development challenges discussed above have become increasingly evident to national policy-makers in the SEA and Himalayan region, who recognize the need for sustainable resource management to reduce poverty. Throughout the region, policy approaches have experimented with, and sometimes embraced, a range of tools to address the complexities of land and water management. Most of these reforms have involved a shift away from an analytical focus on resources *per se*, and increased attention to the constraints facing people who use and manage these resources. The success of these reforms and the challenges they have faced provide valuable guidance regarding actions that can be taken to increase resilience to ongoing and future climate change.

Governance arrangements are at the heart of many of the challenges in resource management. Integrated management is hampered by weak public access to information, decision processes that lack transparency or accountability, and few opportunities for public voices (particularly those of women) to be represented in management decision-making. Two dimensions of land and water management reform are increasingly recognized as essential: decentralized institutions for resource management and the integrated policy and planning frameworks to support them.

One broad area of innovation has been to decentralize resource management in the face of evident inadequacies at the state level. Decentralization has taken several forms: devolution of responsibility to lower administrative levels of government from state-level agencies; creation of new cross-sectoral agencies or multi-stakeholder planning agencies at a local or intermediate level; and recognition of new community-based institutions for local resource management. In addition to decentralization, governments have also made efforts to integrate land and water management, such as integrated river basin management or coastal zone management. These integrated approaches give increasing recognition to the need to engage and reconcile contradictory interests, including those of ecological protection and future generations, in resource planning and management. Changes to the way governments deal with natural disasters, through greater emphasis on disaster risk reduction, demonstrate elements of both approaches. Both decentralization and integrated management strategies, when effective, are likely to build adaptive capacity.

Decentralization

Throughout the region there are many examples of decentralization in land and water management. These efforts have been ongoing for almost two decades in various forms. One of the most common practices has been the devolution of irrigation system management to local water users (an administrative reform underway for at least two decades in the Philippines, Indonesia and South Asia, and more recently in Cambodia). The motivations for this policy have been mixed; while it was partly a recognition of the greater sensitivity of local management to context, conditions and needs,

it was also a response to fiscal realities and to mounting inefficiency in bloated public works bureaucracies at the national level. The challenges in devolution have to do mostly with maintaining a match between local authority, responsibility and fiscal and technical capacity. As with many other administrative decentralization efforts, it is common for responsibilities to be assigned to lower levels of government without matching authority and flexibility for planning, decision-making and revenue generation; and without access to supporting technical resources. This type of partial decentralization generally leads to resource deterioration and a loss of adaptive capacity.

Community-based resource management, or co-management between communities and governments, is another area of widespread policy reform in the region. In Bhutan, for example, field research experience demonstrated that watershed management policies that relied on traditional water rights were no longer appropriate as water demand and conflicts increased. They failed to provide incentives for upstream users to conserve and manage the resource, and lacked provisions for reasonable dispute resolution. National policies were modified to introduce better water management practices, and to enable community forestry practices (Duba and Ghimiray, 2006).

Community forestry has often been a controversial initiative throughout the region. In Nepal, thousands of community forests have been set up successfully, and after decades of decline, the forested area of the country has shown improvement in recent years (see Box 2). But community forestry initiatives have been plagued by lack of trust between state agencies and communities, each side accusing the other of sabotaging the provisions of new legislation by violating the intent of sustainable local management and livelihood development. Professional foresters concerned with protecting the resource base and gaining optimum commercial value for the resources may impose technical planning requirements on communities that are more onerous than those for commercial licensees with much greater technical resources. Often these disputes are mainly the result of poor communications: despite legislative mandates there are not good institutional forums to support collaborative management, multi-stakeholder planning, data sharing and dispute resolution. One approach in the Philippines achieved some success simply by providing a shared platform for communication and fact-sharing (O'Hara, 2006).

Box 2: Community Forestry in Nepal

Introduction of national legislation to enable community level forest tenure and provide for democratic local forest management institutions (Forest User Groups or FUGs) in the mid-1990s was accompanied by a significant transfer of decision-making and revenue to local communities. This has led to a transformation of the forestry sector and an enrichment of democratic processes in local governance. There are now over 14,000 FUGs from all 74 forest districts in the country, with membership totalling almost 35 per cent of the national population, and management rights for about 25 per cent of total forest area. The role of District Forest Officers in forest management has shifted from planning, initiating and regulating all activity, to training, facilitation and providing technical support to FUGs. Technical services such as capacity-building, planning, inventory and analysis are undertaken by a blossoming NGO community and by small-scale professional contractors. The Federation of Community Forest Users, Nepal (FECOFUN) has been formed to help local user groups share information and experience on forest management and product marketing, as well as to advocate for policy interests. The results have been a marked improvement in forest condition in most regions of the country, both in terms of density and age of managed stands. The adoption of a strong participatory governance model has been crucial to the growing political and economic engagement of local people. Practices of shared learning, capacity-building and sustainable forest management have been fostered by government, NGOs and FECOFUN (Kanel, 2006).

Integrated resource management

Integrated local management approaches, such as Integrated Water Resource Management (IWRM) and Integrated Watershed Development and Management (IWDM) have helped strengthen co-ordination across sectors and tackle land and water management challenges at multiple scales—from local communities to watersheds to basin levels. The IWDM program in particular has aimed to strengthen livelihoods through agricultural development. These programs also have strived for participation from multiple stakeholders, although some have been criticized for reinforcing social inequities and hierarchies.

The process of devising and then implementing new institutional arrangements takes many years, and relies on long-term vision, ongoing learning and adaptation, and consistency in policy direction (Kemper *et al.*, 2007). While integrated resource management brings a strong conceptual framework that links livelihoods with natural resource management, implementation of these programs has faced a number of challenges. Their origins in organizations that emphasized engineering and technical issues have meant that key social and institutional barriers are still hard to overcome in practice. For example, there continues to be a lack of integration across the sectors at an operational level and lack of attention to social and institutional innovations that may be more flexible than engineering solutions to respond to the uncertainty of climate impacts. Gender issues in land and

Box 3: Integrated Water Resource Management in Indonesia

Irrigation has long been essential to agricultural production in Indonesia, and post-colonial water management efforts focused on engineering works for flood management and irrigation improvement. In densely populated river basins, conflicts in water resource use have become more intractable in recent years: industrial and agricultural pollution have reduced water quality for other users; flooding problems persist; population growth imposes new demands; and agriculture is threatened by dry season water scarcity. In the 1990s the concepts of integrated water resource management and multi-sector planning were introduced and in major river basins, and new public corporations were created at the basin level to manage bulk water supply allocation, water quality and environmental controls, flood control and water resource infrastructure in all major tributaries. With decentralization reforms underway since 1998, the central and provincial governments are ceding more authority to district level administration in many areas. The adjustments continue in the water sector, with new management roles for different levels of administration. The central government still retains considerable power, exercising legislative authority and policy co-ordination in the water sector, providing technical advice and oversight of lower level administration, setting water tariffs and subsidizing capital costs for engineering works, providing strategic guidance to major basin planning and co-management of large irrigation systems. The provincial level issues licences and permits for water extraction under national authority, and is responsible for water resource management and development projects that encompass more than one district. A Provincial Water Resources Council provides multi-stakeholder input to operational policy and priorities. At the district level, a similar District Water Resources Council provides input to planning and management decisions. River basin management corporations interact with district and provincial authorities, but are directly accountable to the national Minister of Public Works. At the ground level, water user associations manage irrigation systems at a scale of 50–150 ha and form water user association federations to provide input to district-level planning. While there have been many efforts to decentralize planning and to engage multiple stakeholders, the lack of fiscal control at the local level limits management options, and weak linkages across different administrative levels hamper coordination.

water management are seldom adequately considered. Local knowledge and decision-making are generally sidelined in favour of technical analysis. The importance of open and accessible processes for communications, negotiation, shared information and learning across different administrative levels is often discounted. All of these factors limit the potential success of integrated management.

New institutional developments in integrated resource management can complement decentralization efforts if they recognize the diversity of management needs and institutional structures at different levels of public administration. So, for example, as Indonesia has reformed water resource management to become more consistent with its new decentralized governance structure, it has introduced multiple types of institutions at different levels (see Box 3). A key issue arising from experience with both decentralization and integrated resource management is to clarify what resource management functions are best decentralized (e.g., in the case of water, perhaps irrigation system management, erosion control, small scale storage or water harvesting), and what functions need to be integrated across different scales (seasonal allocation, basin level storage, flood management and wetlands).

Integrated management does not mean that conflicts are reduced, or that awkward trade-offs can be avoided in increasingly water-scarce regions. In Nepal, the inter-basin Melamchi Water Diversion project has diverted irrigation water used by farmers to supply urban uses in the Kathmandu valley, with complex and controversial challenges of fair compensation and participatory planning (Onta, 2005). Integrated management is not only a matter of planning for greater investment at a water basin, or even inter-basin level, but also of recognizing legitimate water rights and compensation for their loss.

4.1 Challenges

National policies to strengthen land and water management along with the development goal of poverty reduction, and to address climate change, must deal with several challenges. One of these is that governments have been unable to devise either public or private institutional mechanisms to consistently enable sustainable resource use (Acheson, 2006). This has led to experimentation with new forms of collective management of common pool resources, where private management is difficult and state management has often failed (Ostrom, 1990). Throughout the region, community-based management of forests, irrigation systems and fisheries is becoming widely recognized, and in the past decade a range of policy and legislative reforms has been introduced to secure limited collective rights of resource user groups and establish legal support for these innovations. These new user groups and institutional forms are generally poorly integrated into key land and water management planning and decision-making processes (Tyler, 2006).

Government policies that support regional economic integration and trade can also create challenges. The success of these strategies has led to increased commercial pressure on ecosystems that were once mainly used for local subsistence, such as the conversion of natural forests to plantations forests for industrial or food production. Examples include uplands production of coffee or rubber, lowland oil palm and coastal shrimp aquaculture. Some elements of these changes can be positive, by generating investment and export earnings from natural resources. But too often the traditional rights of poor people or ethnic minorities living in the affected forest regions are not sufficiently considered, and commercial development leads to their displacement and further

impoverishment. Where they attempt to benefit from investment in high-value commercial products (e.g., coffee, shrimp), the poor are often exposed to production and market risks that they are not well equipped to manage. Policies to support insurance schemes, fair compensation, recognition and reinforcement of rights, and social support measures could help with essential transitions, but are inconsistently applied around the region.

Governments are also struggling with the interaction of complex traditional systems of rights and management institutions for resources (e.g., water) that typically are ignored by contemporary legislative provisions. Legislation drawn up to mirror conditions in Europe or North America is inadequate to deal with the complex construction of resource rights, negotiations and trade-offs that have long guided access to resources such as water, fisheries or forests in the region. In these situations, the poor are often significantly disadvantaged; they do not understand their legal rights and cannot afford advisors, they have low status and are in a weak negotiating position. As a result, they are frequently disenfranchised. On the other hand, it is also true that traditional systems of social negotiation and management can also no longer cope with the magnitude of land and water development pressures (Onta, 2005). In a dynamic situation where markets, demographics and climate drivers are all impacting the use of ecosystems, resource management institutions need to become much more flexible, to enable local innovation and adaptation while providing supportive principles, guidelines and technical support; and financing long-term innovation and knowledge sharing.

The problems are compounded by the fragmentation of resource management responsibilities among multiple agencies and jurisdictions at different administrative levels. Not only are water, agriculture, forestry and other land-based resource uses typically administered by different agencies, but different aspects of their administration may involve local or provincial level jurisdictions in issues such as public health, commerce or licensing. Yet in practice, successful outcomes rely on closely linked planning and management interventions. For example, in Nepal, water management is closely tied to forests, yet the systems of resource rights, jurisdictions and administrative authority is very different and not well articulated (Varis, 2005).

In Vietnam, for water alone, it is estimated that earlier this decade there were at least 10 ministries, 15 central committees and general departments, and dozens of research institutes and expert advisory organizations all dealing with the water sector (Hansen and Phan, 2005). As in many other countries, the structure of decision-making in these various agencies is usually vertically integrated within a single agency, but poorly articulated between different agencies. In Vietnam, steps have since been taken to build shared knowledge and strengthen horizontal planning linkages between water management agencies, first by the Ministry of Agriculture and Rural Development and then by the consolidation of water management responsibilities in the new Ministry of Natural Resources and Environment (Hansen and Phan, 2005).

5. Regional Approaches to Land and Water Management

Overall, in both the Himalayas and Southeast Asia, government attention is focused primarily on regional economic integration and investments to support growth. These are double-edged swords for land and water management; they create new trading and value-added opportunities for farmers,

but place isolated resources under increased commercial pressures. The main response of regional organizations has been to invest in greater coordination at an official level, and greater knowledge generation and sharing in order to speed the land and water management innovations needed to respond to the challenges above.

The most prominent regional effort at resource management is the Mekong River Commission (MRC), comprising a joint mechanism for collaborative planning and monitoring of the Lower Mekong River to support sustainable and equitable use of the basin's resources. It was set up under a 1995 agreement among Thailand, Laos, Cambodia and Vietnam, and the upper Mekong countries of Myanmar and China are involved as dialogue partners. The MRC has supported a wide range of planning studies covering scientific, technical and social dimensions of resource development in the basin, with an emphasis on building sustainable use. The main challenge the MRC faces is that the fundamental interests of different member countries in using the basin's water resources conflict (Campbell, 2005). The MRC also is challenged to balance its resource development and planning mandate with the need to manage impacts. This is particularly difficult for an organization that has no real political accountability to the people most affected by resource development projects.

A number of regional scientific and interdisciplinary organizations and networks are engaged in regional research and development projects on land and water management. Many of these foster collaborative studies, capacity development, and knowledge sharing across the region on land and water management issues. Key players include the CGIAR centres (IRRI, IWMI, CIAT, WorldFish Centre and CIFOR) as well as the Asian Institute of Technology and ICIMOD. In addition to these research-oriented organizations, there are a wide range of service organizations that mostly focus on building capacity for resource management, either for government or non-government actors, with the support of international donors. Examples include the Regional Community Forestry Training Centre (RECOFTC), the International Institute for Rural Reconstruction (IIRR) and the Asian Disaster Preparedness Centre. The Asian Development Bank (ADB) has supported technical collaboration, capacity development and policy coordination in the land and water management sector at a regional scale in support of regional economic development.

Most of these regional knowledge-generating and capacity-building organizations are increasingly involved in climate change and adaptation studies that build on resource management. These initiatives link key actors across the region to discuss experiences, lessons and joint analysis, thereby building regional collaboration and exchange (but with little emphasis on integrated planning or decision-making across national boundaries). In addition to the organizations mentioned in the previous paragraph, regional organizations with a specific climate focus include the Global Change SysTem for Analysis, Research and Training (START), the Asia-Pacific Network for Global Change Research and the Stockholm Environment Institute. The United Nations Development Programme and United Nations Environment Programme also sponsor regional collaboration for climate adaptation.

As examples of initiatives that have potential for promoting regional learning and policy linkages on climate adaptation we refer specifically here to:

- SEA-START, together with national and regional partners, has supported some of the initial

scientific research on climate change impacts and adaptation strategies in the Philippines, Indonesia, Vietnam, Thailand and Cambodia. These projects had strong emphasis on agriculture-, water- and forest-related impacts and adaptation strategies.

- The MRC has recently implemented the Climate Change Adaptation Initiative, which was launched with a regional climate change forum held in Bangkok in December 2008. This preparatory phase is laying the foundation for a longer project (2009–2012) that will include a basin-wide integrated assessment on impact and assessment planning. This project and regional forum are meant to provide a platform for learning and dialogue across the member countries of the MRC, to draw on experiences and lessons from adaptation efforts at multiple scales.
- The ADB has initiated a program (2007–2011), with support from the Japanese and U.K. governments, to improve mainstreaming of adaptation issues in investment planning; develop national capacities for adaptation; and co-ordinate and strengthen international responses for adaptation. The project has strong emphasis on implications for infrastructure, but is also aiming to strengthen a framework for regional and sub-regional co-operation and linking relevant line ministry actors across the region.

These initiatives offer opportunities for strengthening regional collaboration and learning; they are also fairly limited in number and scope. Key factors hindering their success, particularly among those of inter-governmental organizations are political interests and national sensitivities of sharing information on water resources and management (e.g., among countries in South Asia and the Mekong River Basin). Some of the scientific organizations and institutions with more arms-length political concerns may be able to by-pass some of these challenges. Opportunities exist to strengthen science/civil society/policy networks across the region to promote learning and collaboration that may influence activities and strengthen capacities at national scales. However, effective regional collaboration requires accountability and transparency among countries and actors.

6. Conclusions

Climate impacts will exacerbate most of the land and water management issues in the region. Increased variability is already observable and is expected to grow. There is high uncertainty about the localized effects of climate change, so it is impossible to predict and plan for specific conditions. This means that even if changes are broadly understood, they are likely to have unexpected consequences and surprises. Responding to this situation requires building adaptive capacity, both among individual actors and decision-makers, but also in institutional networks that link them. Measures to boost adaptive capacity parallel innovative approaches to land and water management in the region.

Problems of land and water management are well recognized, and closely linked to poverty reduction in less developed countries of Himalayan region and Southeast Asia. While there is an obvious need for more integrated planning and coordinated resource management responses, these problems cannot be resolved by prescriptive management measures because local conditions, especially in marginal areas, are highly variable. The implication is that solutions must put a premium not only on better integrated planning, but on more engagement of local-level public and private

decision-makers, improved knowledge by all actors of options and innovative technologies, and better application of this knowledge by resource users, both women and men. These factors require enabling conditions and tools to support smallholders, knowledge providers and decision-makers to strengthen collaboration across scales of action, from local to regional.

Innovations in these domains are being fostered at multiple levels in the region:

- At the local level, these include improved and integrated production systems, better access to information for poor resource users (particularly women), secure individual and collective tenure, investment in value-added and market access for high-value products.
- At the national level, policy reforms include decentralization and devolution to foster increased stakeholder involvement in planning and new institutions of resource management at the local level, while redefining the role of public resource agencies. While these may be challenged by strongly entrenched sectoral agencies and the structure of state budgets, there is still scope to overcome such resistance. International agencies can support win-win opportunities for state agencies to achieve effective outcomes through better collaboration and integration, as in the case of DRR.
- Regional land and water management efforts have been hampered by conflicting national strategic interests, but stronger platforms for shared knowledge, learning and innovation in resource management and climate adaptation have been built through research and capacity-building networks. These have the potential to be expanded to ensure better cross-scale linkages from the local to regional levels.

The absence of effective mechanisms to link between these different levels is a continuing challenge in the region. It is particularly important for effective governance and decision-making to ensure that new institutional structures and intermediate level organizations are suitably accountable both upwards to decision-makers and downwards to resource users and stakeholders. Building professional and fiscal capacity at the local level will help improve implementation capability for land and water management and support climate adaptation.

As awareness in the region grows regarding the threats posed by climate change to water management, disaster management and food supply, it becomes more critical to address the local, regional and national concerns identified above. The land and water management context, together with the development imperatives of the large and impoverished rural population in the region suggest the need for an emphasis on better mechanisms to generate knowledge, co-ordinate planning, reinforce economic incentives for sustainable resource use, anticipate and respond to unexpected conditions, and to share relevant information in formats accessible to users across all scales of decision-making. This will require not only capacity development, research and information management, but also innovative institutional development at multiple levels. Mechanisms to support interaction between local resource users, managers, researchers and policy makers are important to speed the adoption of innovations, the effectiveness of management and the removal of barriers to adaptation (Armitage *et al.*, 2008).

Such measures will recognize and build on local knowledge through fostering diverse solutions to common problems in various landscape and socio-political contexts. They will provide institutional

platforms for negotiation and shared learning. Some solutions are better worked out locally, while others require higher order integrated planning and even policy reforms. Flexible and decentralized implementation of policies, with strong adaptive management feedback through monitoring and research, helps to build learning-oriented decision-making at all levels.

7. Discussion Questions

As land and water managers prepare for climate change, answers to the following questions could be helpful in facilitating the design and implementation of measures that simultaneously support the achievement of current sustainable development objectives and adaptation to climate change:

- What are some specific examples of land and water management reforms that would contribute to resilience to climate change in your countries?
- How can measures to improve climate change resilience also improve poor peoples' capacity to cope with short-term climate variability?
- What gender-specific strategies are needed to ensure that women have access to adaptation measures suited to land and water management?
- How can integrated resource management approaches better address livelihoods and adaptation issues?
- What are the synergies between poverty reduction practices and climate adaptation, and how can these be realized?
- How would adaptation fit into integrated approaches to land and water management, both in terms of organizational arrangements and roles for planning, policy and program implementation?
- What are the critical climate adaptation needs relating to land and water management at different scales? How can good practices be identified and communicated?

References

Acheson, J. M. 2006. Institutional Failure in Resource Management. *Ann Rev Anthropol.* 35: 117-34.

Alam, M., A. Rahman, M. Rashid, G. Rabbani, P. Bhandary, S. Bhadwal, M. Lal, and M.Soejachmoen, 2007. Impacts, vulnerability and adaptation to climate change in Asia; Background Paper. Produced for the UNFCCC Asia Regional Workshop on Climate Change Adaptation, Beijing China 11-13 April 2007.

Armitage, D., M. Marschke, et al. 2008. Adaptive co-management and the paradox of learning. *Global Environmental Change*, 18(1), 86-98

Battisti, D. S. and R. L. Naylor. 2009. Historical Warnings of Food Insecurity with Unprecedented Heat, *Science* 323: 5911, pp. 240-244.

Beck, T. and L. Fajber. 2006. Exclusive, moi? Natural resource management, poverty, inequality and gender in Asia, in S. Tyler (ed), *Communities, Livelihoods and Natural Resources: Action Research and Policy Change in Asia*. Warwickshire: ITDG and Ottawa: IDRC. Chapter 15, pp. 298-320.

Campbell, I. C. 2005. Integrated Water Resources Management for the Mekong River Basin, in A. Biswas et al. (eds) *Integrated Water Resources Management in South and South-East Asia.* New Delhi and Oxford, Oxford University Press, pp. 250-266.

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

Desakota Study Team, 2008. Re-Imagining the Rural-Urban Continuum: understanding the role ecosystem services play in the livelihoods of the poor in desakota regions undergoing rapid change. Kathmandu: ISET International and ISET Nepal.

Duba, S. and M. Ghimiray. 2006. Walking the extra mile: from field learning to natural resource management research and policy in Bhutan, in S. Tyler (ed.), *Communities, Livelihoods and Natural Resources: Action Research and Policy Change in Asia*. Warwickshire: ITDG and Ottawa: IDRC. Chapter 10, pp. 191-208.

Fischer, G., M. Shah and H. vanVelthuizen, 2002. Climate change and agricultural vulnerability. Preprints, *World Summit on Sustainable Development*, Johannesburg, 160 pp.

Hansen, J. M. and D. H. Phan. 2005. Integrated Water Resources management in Vietnam: Present Status and Future Challenges, in A. Biswas et al. (eds.) *Integrated Water Resources Management in South and South-East Asia.* New Delhi and Oxford, Oxford University Press, pp. 219-249.

Intergovernmental Panel on Climate Change, 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp. www.ipcc.ch/ipccreports/ar4-syr.htm Accessed 9 Jan 2009.

International Water Management Institute, 2008. IWMI Research in Southeast Asia. www.iwmi.cgiar.org/Publications/Other/PDF/IWMI_South_East_Asia_Brochure.pdf Accessed 2 Jan 2009.

Kanel, K., R. 2006. Current Status of Community Forestry in Nepal. Paper prepared for the Regional Community Forestry Training Centre for Asia-Pacific. Bangkok, Dept of Forests, Kathmandu**:** www.forestrynepal.org/current-status-of-community-forest-in-nepal.

Kelkar, Ulka. 2006. Adaptive Policy Case Study: Weather-indexed insurance for agriculture in India, in D. Swanson and U. Kelkar (eds.) *Designing Policy in a World of Uncertainty, Change and Surprise*, Winnipeg, IISD. www.iisd.org/climate/vulnerability/policy_insights.asp Accessed 9 Jan 2009.

Kemper, K. E., Blomquist, W. & Dinar, A. (2007). *Integrated river basin management through decentralization*. Berlin Heidelberg: Springer Verlag.

Moench, M. and The Risk to Resilience Study Team. (2008). *Understanding the Costs and Benefits of Disaster Risk Reduction under Changing Climatic Conditions*, From Risk to Resilience Working Paper No. 9, eds. Moench, M., Caspari, E. & A. Pokhrel, ISET, ISET-Nepal and ProVention, Kathmandu, Nepal, 38 pp.

O'Hara, P. 2006. Shaping the key to fit the lock: Participatory action research and community forestry in the Philippines, in S. Tyler, ed. *Communities, Livelihoods and Natural Resources: Action Research and Policy Change in Asia*. Warwickshire: ITDG and Ottawa: IDRC. Pp. 253-273.

Onta, I. R. 2005. Status of Integrated Water Resources management in Nepal: an Overview, in A. Biswas et al. (eds) *Integrated Water Resources Management in South and South-East Asia.* New Delhi and Oxford, Oxford University Press, pp. 148-177.

Ostrom, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge, UK; Cambridge University Press.

Oxfam. 2008. *Viet Nam: Climate Change, Adaptation and Poor People.* Hanoi and Oxford: Oxfam. 56 pp. www.oxfam.org.uk/resources/policy/climate_change/downloads/vietnam_cc_adaptation_poverty.pdf Accessed 9 Jan 2009.

Pascual, M., M.J. Bouma and A.P. Dobson, 2002. Cholera and climate: revisiting the quantitative evidence. *Microbes Infect.* **4**, 237-245.

Resurreccion, B., E. Sajor and E. Fajber, 2008. Climate adaptation in Asia: Knowledge Gaps and Research Issues in Southeast Asia. Kathmandu: ISET International and ISET Nepal.

Sayer, J. and Campbell, B. 2004. *The Science of Sustainable Development: Local Livelihoods and the Global Environment*. Cambridge: Cambridge University Press.

Shaw, Rajib. 2006. Community-based Climate Change Adaptation in Vietnam: Inter-linkages of Environment, Disaster and Human Security. In *Multiple Dimensions of Global Environmental Changes*, edited by S. Sonak. Bangkok: TERI.

Snidvongs, Anond. 2007. Vulnerability to Climate Change Related Water Resource Changes and Extreme Hydrological Events in Southeast Asia. In *Assessments of Impacts and Adaptation to Climate Change: Final Report of the AIACC Project*, edited by J. K. a. C. S. Neil Leary. Washington DC, USA and Trieste, Italy: International START Secretariat and the Academy of Sciences for the Developing World.

Takeya, K. M. Miura and R. Matsumaru. 2005. Integrated Water Resources Management in Indonesia, in A. Biswas et al. (eds.) *Integrated Water Resources Management in South and South-East Asia.* New Delhi and Oxford, Oxford University Press, pp. 206-218.

Tuyen T.V. *et al.* 2006. Participatory local planning for resource governance in the Tam Giang lagoon, Vietnam. In S. Tyler, ed. *Communities, Livelihoods and Natural Resources: Action Research and Policy Change in Asia*. Warwickshire: ITDG and Ottawa: IDRC. p.57-84.

Tyler, S. (ed). 2006a. *Communities, Livelihoods and Natural Resources: Action Research and Policy Change in Asia*. Warwickshire: ITDG and Ottawa: IDRC.

UNDP, 2007b. *Human Development Report 2007/2008*. Fighting Climate Change: Human Solidarity in a Divided World. New York: UNDP.

Varis, Olli. 2005. Externalities of Integrated Water Resource Management in South and Southeast Asia, in A. Biswas et al. (eds.) *Integrated Water Resources Management in South and South-East Asia.* New Delhi and Oxford, Oxford University Press, pp. 1-38.

Zhao-li, Yan, 2008. Co-management of rangeland resources in HinduKush Himalayan Region: Involving Farmers in the Policy Process. www.future-agricultures.org/farmerfirst/files/T1a_Zhaoli.pdf Accessed 2 Jan 08.