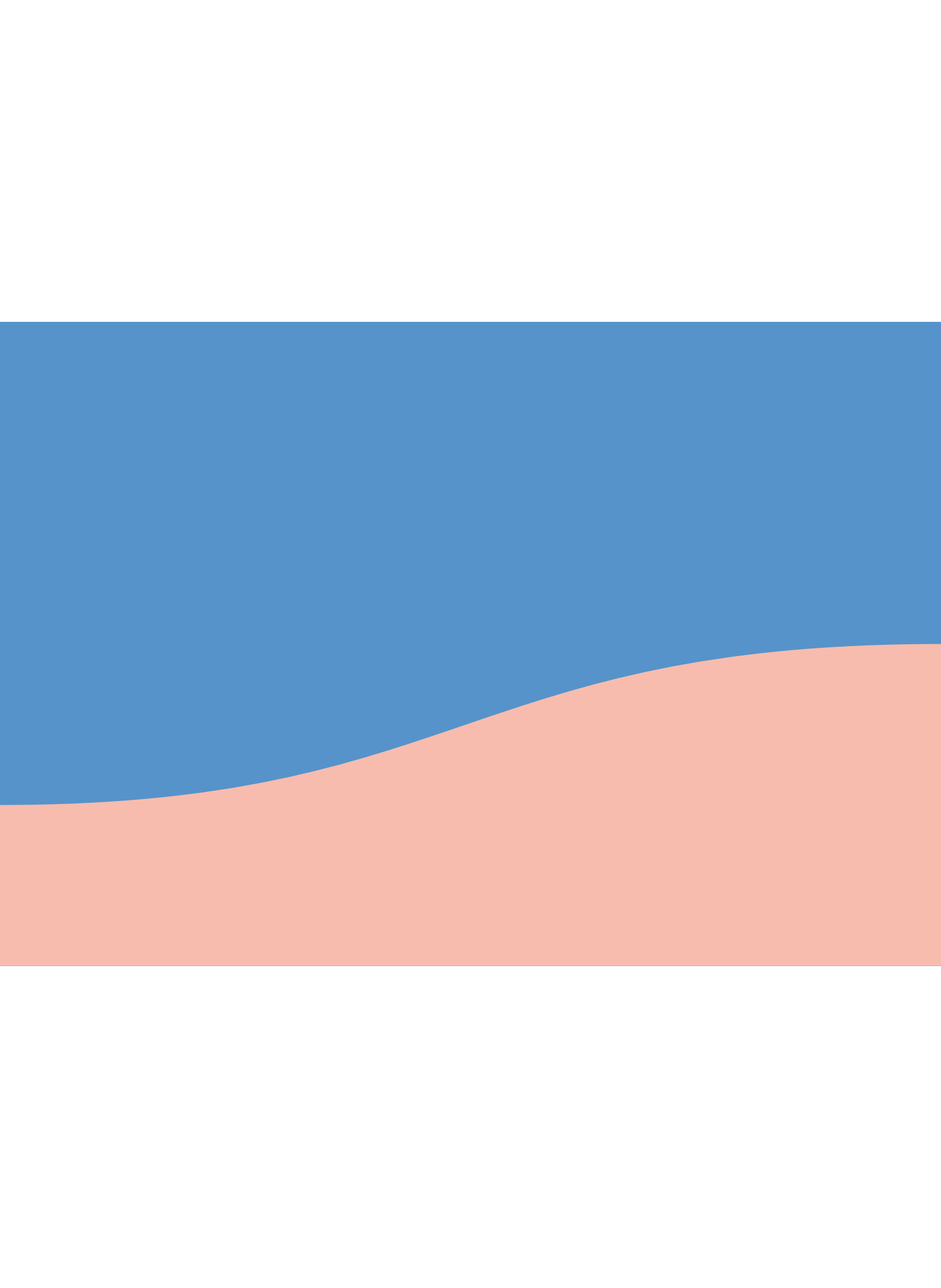


THE NAIROBI WORK PROGRAMME

ON IMPACTS, VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE

CLIMATE CHANGE AND FRESHWATER RESOURCES

A synthesis of adaptation actions undertaken by
Nairobi work programme partner organizations



UNFCCC

United Nations Framework Convention on Climate Change

THE NAIROBI WORK PROGRAMME
ON IMPACTS, VULNERABILITY
AND ADAPTATION TO CLIMATE CHANGE

CLIMATE CHANGE AND FRESHWATER RESOURCES:

A SYNTHESIS OF ADAPTATION
ACTIONS UNDERTAKEN BY
NAIROBI WORK PROGRAMME
PARTNER ORGANIZATIONS





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This publication is a synthesis of the voluntary contributions of 21 Nairobi work programme partners, demonstrating their commitment to achieving the objective of the Nairobi work programme. The UNFCCC secretariat would like to acknowledge GWP, the Stockholm International Water Institute (SIWI) and the International Water Management Institute (IWMI) for reviewing the final draft. The secretariat played a purely catalytic and facilitative role in developing this document, under the guidance of the Chair of the Subsidiary Body for Scientific and Technological Advice (SBSTA).

The list of contributing partner organizations is given in [TABLE I-1](#) of this document ([see page 14](#)).

¹ <<http://www.gwp.org>>.

I. ADAPTATION AND FRESHWATER RESOURCES

1.1. INTRODUCTION TO THE NAIROBI WORK PROGRAMME

The Nairobi work programme on impacts, vulnerability and adaptation to climate change (NWP) was adopted by the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) at its eleventh session, in 2005. Under the Subsidiary Body for Scientific and Technological Advice (SBSTA), the objective of the NWP is to assist all Parties, in particular developing countries, including the least developed countries (LDCs) and small island developing States (SIDS) to:

- Improve their understanding and assessment of impacts, vulnerability and adaptation to climate change; and
- Make informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account current and future climate change and variability.

The implementation of the work programme is structured around two broad themes: impacts and vulnerability; and adaptation planning, measures and actions.² Under these themes, the following nine action-oriented areas of work were identified:

- (1) Methods and tools;
- (2) Data and observations;
- (3) Climate modelling, scenarios and downscaling;
- (4) Climate-related risks and extreme events;
- (5) Socio-economic information;
- (6) Adaptation planning and practices;
- (7) Research;
- (8) Technologies for adaptation;
- (9) Economic diversification.

The NWP was designed to facilitate knowledge sharing and learning, and to catalyse actions in relation to adaptation to climate change by engaging a wide range of stakeholders. Since its launch, 209³ organizations, including intergovernmental organizations, non-governmental organizations (NGOs) and private sector entities, have formally engaged as partners in the implementation of the NWP. Among them, 59 partner

organizations have pledged to carry out 143 actions to address the needs and gaps identified under the work programme by Parties and other stakeholders.

The SBSTA mandates the organization of a series of knowledge-sharing events under the NWP and encourages the broad participation of all adaptation stakeholder groups, and the development and dissemination of a diverse range of knowledge products. In the course of its implementation, the NWP has provided a principal platform under the UNFCCC process for dialogue between Parties and organizations on the scientific, technological and socio-economic aspects of adaptation to climate change.

1.1.1. WATER-RELATED KNOWLEDGE PRODUCTS AND PLEDGES MADE BY NWP PARTNER ORGANIZATIONS

During the implementation of the NWP, a variety of knowledge products have been developed⁴ (including freshwater-related products), ranging from web-based platforms to printed publications, in order to:

- Disseminate actions undertaken by the NWP partner organizations and other organizations; and
- Promote understanding and assessment of climate change impacts, vulnerabilities and adaptation planning and practices.

Although not developed to exclusively target specific vulnerable sectors, knowledge products, such as the adaptation practices interface⁵ and the local coping strategies database,⁶ provide information on adaptation planning and practices on vulnerable sectors at various levels of implementation.

Several partner organizations have pledged actions to: undertake research and assessment; enhance technical and institutional capacities; promote awareness; and implement adaptive actions on the ground. These actions have contributed to the enhancement of understanding and assessment of vulnerabilities and adaptation practices in the water sector. To date, 66 of the 209 NWP partner organizations are engaged in actions related to water resources,⁷ and a total of 45 Action Pledges related to water resources have been made by partner organizations under the NWP. This represents about 30 % of the total action pledges.

1.2. PURPOSE AND SCOPE OF THE PUBLICATION

Although some of the knowledge products developed under the NWP address some aspects of water-related impacts and vulnerabilities and discuss the relevant adaptation planning and practices, there has been no specific focus on adaptation activities relating specifically to freshwater.

As part of the current implementation phase of the NWP, the SBSTA requested the secretariat, in consultation with Parties, to develop user-friendly outputs and make these widely accessible.⁸ In addition, participants at an informal meeting of representatives from Parties, organizations and experts noted that the information and knowledge products generated under the NWP are of a general nature and are not sector and location specific.⁹ Furthermore, it was noted that stakeholders are more likely to become engaged and motivated when provided with contextualized information and knowledge.

This is the third synthesis publication under the NWP, although it is the first to focus on a specific sector. This document provides a synthesis of actions undertaken by 21 NWP partner organizations, and highlights the results obtained and lessons learned on freshwater issues in particular.

The contributions of partner organizations showcase a rich mix of actions on freshwater resources, which have generated results on the ground, particularly in developing countries, and produced useful lessons demonstrating improved understanding and assessment of impacts, vulnerability and adaptation to climate change. These actions may prove useful for stakeholders in making informed decisions on practical adaptation actions and measures on water resources.

The scope of the information provided in this document is limited to concrete adaptation actions that address climate change impacts on freshwater resources.¹⁰ Only 3 per cent of total global water is available as freshwater. These freshwater resources – important for human livelihoods – are already being impacted and will be further impacted by climate change in the future. Given the intrinsic linkage between freshwater resources and other sectors and ecosystems, increased vulnerability in relation to freshwater resources will inevitably impact other sectors and ecosystems.

The publication consists of two parts:

Part I consists of three chapters. Chapter 2 presents a synthesis of the actions taken by NWP partner organizations under four thematic areas:

- Actions to improve the ability to understand impacts, vulnerability and adaptation to climate change in the water sector;
- Actions taken to enhance informed decisions on adaptation planning, measures and action;
- Actions to facilitate communication, dialogue and cooperation among different stakeholders, and enhance adaptive capacity through technical and institutional capacity building; and
- Practical adaptation actions and measures on the ground.

This is followed, in Chapter 3, by key messages and conclusions.

Part II presents a selection of case studies of actions reported by partner organizations under the four thematic areas identified above.

² Decision 2/CP.11, annex, paragraph 3.

³ As at 26 May 2011.

⁴ Information on knowledge resources and publications is available at <http://unfccc.int/5136.php>.

⁵ The adaptation practices interface is available at <http://unfccc.int/4555.php>.

⁶ The local coping strategies database is available at <http://maindb.unfccc.int/public/adaptation>.

⁷ As at 26 May 2011. The actions of some partners are classified under more than one category.

⁸ FCCC/SBSTA/2008/6, paragraph 34.

⁹ FCCC/SBSTA/2010/12, paragraph 40.

¹⁰ The scope of impacts on freshwater resources is based on the IPCC definition, i.e. climate change impacts on surface water, groundwater, including floods and droughts, erosion and sediment transport.

1.3. WATER RESOURCES UNDER THE CONVENTION

Adaptation activities relating to freshwater issues are included under the NWP, national communications, and national adaptation programmes of action (NAPAs) under the LDC work programme.

Commitments of Parties to the Convention (Article 4)¹¹ include the need to cooperate and implement adaptation actions to address the impacts of climate change, with a particular focus on the needs of developing countries. 'Article 4, paragraph 1(e)' of the Convention commits Parties to "develop appropriate and integrated plans for coastal zone management and water resources management for the protection and rehabilitation of areas affected by drought, desertification and floods".

The LDC work programme, established by the COP at its seventh session, includes the preparation and implementation of NAPAs under the Subsidiary Body for Implementation (SBI). It provides a process for LDCs to identify and prioritise actions to respond to their urgent and immediate needs with regard to adaptation to climate change. Based on the NAPAs submitted as of June 2011, of the 472 NAPA projects identified, 73 priority projects relate to water resources. This number, however, does not include the priority projects developed under other vulnerable sectors such as agriculture and biodiversity, which also have components that relate to water resource management.

All Parties to the Convention report on the steps they have taken to implement the Convention (pursuant to Article 4, paragraph 1 and Article 12). National communications reported by both Annex I Parties and non-Annex I Parties provide information on, among other things, vulnerability assessment, climate change impacts and adaptation measures, including those relating to water resources.¹²

Parties other than developed country Parties and other developed Parties included in Annex II to the Convention, particularly developing country Parties, are encouraged to undertake assessments of country-specific technology needs for both adaptation to and mitigation of climate change.¹³ The technology needs assessment reports indicate that water sector is the second most targeted for adaptation.¹⁴

At the sixteenth session of the Conference of the Parties (COP 16) in Cancun, 2010, Parties agreed to establish the Cancun Adaptation Framework,¹⁵ with the objective of enhancing action on adaptation, including through international cooperation and coherent consideration of matters relating to adaptation under the Convention.

The framework reiterates the importance of strengthening, consolidating and enhancing the sharing of relevant information, knowledge, experiences and good practices, at the local, national, regional and international levels, to take into account, where appropriate, traditional knowledge and practices to promote enhanced action on adaptation.

Paragraph 14(a) of the Cancun Agreement makes specific reference to water resources, freshwater, marine ecosystems and coastal zones when it refers to "Planning, prioritizing and implementing adaptation actions, including projects and programmes".¹⁶

1.4. WATER-RELATED IMPACTS AND VULNERABILITIES DUE TO CLIMATE CHANGE

The IPCC technical paper on climate change and water¹⁷ clearly indicates that freshwater resources are vulnerable and have the potential to be strongly impacted by climate change, with wide-ranging consequences for human societies and ecosystems based on observational records and climate projections. For example, increased intensity and variability of precipitation is projected to aggravate the risks for flooding and drought in many areas, which in turn is projected to affect water quality and exacerbate many forms of water pollution.

The impacts of climate change negatively affect livelihood security globally, and induce risks and vulnerabilities in sectors such as health, agriculture and food security, energy, transport, water supply and sanitation, industry, mining and other water-using and influencing sectors. Global environmental changes observed during the past decade can be attributed to anthropogenically enhanced climate change and are also related to water include: sea level rise; melting of snow and ice; changes in the frequency and/or intensity of extreme weather events; changes to ecosystems and biodiversity patterns. Changes due to climate change are expected to further aggravate water-related hazards and water scarcity, increasing the vulnerability of socio-ecological systems.

A synthesis of submitted NAPAs indicated that floods and droughts form some of the most frequently reported climate change vulnerabilities by LDCs.¹⁸ The enhanced severity and frequency of droughts and the unpredictable rainfall patterns as reported by LDCs are expected to lead to reduced crop yields, loss of income for farmers, and famine and malnutrition. Flood-related impacts include: loss of life; destruction of infrastructure; crop losses; sediment pollution; loss of soil fertility; landslides and erosion; and energy insecurity (e.g. disruption of hydropower systems).

In addition, Parties to the Convention also report on freshwater-related impacts and vulnerabilities in their national communications. In their fifth national communication¹⁹, Annex I Parties reported key climate change impacts of concern relating to the freshwater resources, including floods and water stress. In addition, some Parties have also expressed concerns about the retreat of glaciers and the thawing of permafrost. In the sixth synthesis of national communication from non-Annex I Parties²⁰, non-Annex I Parties presented problems with severe water supply problems caused by a rapid increase in population, growing demands from agriculture and industry, expanding urbanization, unabated pollution of water bodies and the effects of climatic variability and extreme events. In addition, some Parties also identified a change in the frequency and intensity of surface runoff and groundwater; soil erosion; drought; and pollution. Climate variability and change have been identified by Parties in their national communications to be responsible for the increase in the frequency and intensity of surface runoff, soil water erosion, drought, pollution and for the decrease in surface water/runoff and groundwater, with negative impacts on agricultural lands, grasslands and terrestrial and aquatic ecosystems. Given that more than 80 per cent of global agricultural land is rain-fed,²¹ the projected changes in water quality and quantity due to climate change are expected to have a significant impact on the agricultural sector, in terms of agricultural productivity and hence affecting food security. Other sectors that have been impacted and are predicted to be further impacted include:

- Human health (including in terms of increased mortality due to floods and drought and poor water quality);
- Infrastructure (in terms of the function and operation of existing water infrastructure, including hydropower generation, structural flood defences, drainage and irrigation systems);
- Fisheries (increased vulnerability and risk due to water pollution and changes in water resources); and
- Forest ecosystems (affecting productivity of forest ecosystems and a likely increased frequency of forest fires and insect outbreaks that have been found to be associated with the frequency of extreme events).

The impacts of climate change on freshwater resources affect the global population. At present, over one billion people already live in water-scarce areas.²² By 2025, almost two-thirds of the world's population is projected to experience some kind of water-related stress and, for one billion of them, the shortage will be severe and socially disruptive.²³

The effects of these changes will vary across and between regions, and between different generations, income groups and occupations²⁴ – and especially between women and men. For example, people living in poverty and in developing countries are more likely to be negatively impacted. The IPCC reports the increase in risk of child mortality in many regions of the globe due to the impact of climate change on freshwater resources. The negative impacts of climate change on freshwater resources, such as an increase in the frequency and intensity of floods and the subsequent deterioration of water quality, can increase the vulnerability of indigenous people, rural farmers, women and children, as a result of poverty, traditional roles, and their limited capacity to cope with water stress. Therefore, effective water management management is essential for livelihoods and economies to ensure that affected communities and ecosystems will be more resilient to the adverse impacts of climate change. Partner organizations have undertaken actions in relation to the vulnerability of the freshwater system and associated impacts on other sectors and on livelihoods is discussed in the next chapter.

¹¹ For the complete text of the Convention, see <http://unfccc.int/2853.php>.

¹² Information on national communications by Annex-I Parties is available at <http://unfccc.int/1095.php> and information on national communications by non-Annex I Parties is available at <http://unfccc.int/2716.php>.

¹³ Information on technology needs assessment reports by Parties and synthesis report is available at <http://unfccc.int/ttclear/jsp/TNA.jsp>.

¹⁴ FCCC/SBSTA/2009/INF.1.

¹⁵ FCCC/CP/2010/7/Add.1.

¹⁶ Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010, p. 5, available at <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf>.

¹⁷ BATES BC, KUNDZEWCZ ZW, WU S AND PALUTIKOF JP (EDS.). June 2008. *Climate Change and Water, Technical Paper VI*. Geneva: IPCC secretariat.

¹⁸ LEAST DEVELOPED COUNTRIES EXPERT GROUP, GEF AND ITS AGENCIES. 2009. *Least Developed Countries Step-by-step Guide for Implementing National Adaptation Programmes of Action*: LDC Expert Group.

¹⁹ For a complete description of the fifth national communications submitted by Annex I Parties, please visit <http://unfccc.int/4903.php>.

²⁰ For a sixth compilation and synthesis report of initial national communications from Non-Annex I Parties, please visit <http://unfccc.int/2709.php>.

²¹ FAO (UNITED NATIONS FOOD AND AGRICULTURE ORGANIZATION). 2003. Reported in BATES BC, KUNDZEWCZ ZW, WU S AND PALUTIKOF JP (EDS.). June 2008. *Climate Change and Water, Technical Paper VI*. Geneva: IPCC secretariat.

²² SMAKHITIN VU, REVENGA C, DOLL P. 2004. Taking into account environmental water requirements in global-scale water resources assessments. *Research Report of the Comprehensive Assessment Programme of Water Use in Agriculture*. No. 2. Colombo, Sri Lanka: International Water Management Institute.

²³ WEDO (WOMEN'S ENVIRONMENT AND DEVELOPMENT ORGANIZATION). 2003. *Untapped Connections: Gender, Water and Poverty*. WEDO. p. 61.

²⁴ WomenWatch: Article on Women, Gender Equality and Climate Change. Available at http://www.UN.org/womenwatch/feature/climate_change.

Table 1-1. Nairobi work programme partners and their contributions to this synthesis publication

Contributed by	Actions
ASSESSMENT AND RESEARCH	
Water Center for the Humid Tropics and the Caribbean (CATHALAC)	Assessing Potential Climate Change Impacts on Water Resources in Latin America and the Caribbean
International Water Management Institute (IWMI)	Groundwater as an Adaptation Measure
IWMI	Re-thinking Water Storage Options and Development Process under Climate Change
The Center for International Earth Science Information Network (CIESIN) of the Earth Institute at Columbia University, United Nations University (UNU) and CARE	Future Drying Trends in Mexico and Central America and Potential Migration
CIESIN and Earth Institute, Columbia University	Managing Climate Risk within a Haitian Watershed
Food and Agriculture Organization (FAO)	FAO-MOSAICC (MOdelling System for Agriculture Impacts of Climate Change)
FAO	Report on "Climate Change, Water and Food Security"
The International Centre for Integrated Mountain Development (ICIMOD)	Climate Change Impacts on the Water Resources of the Indus Basin: Capacity-building, Monitoring and Assessment for Adaptation
The International Institute for Sustainable Development (IISD)	Climate Risk Management Technical Assistance Support Project (CRM TASP)
The International Union for Conservation of Nature (IUCN)	Coping With Change: Watersheds, Seasonal Rivers and Livelihoods in the Indian Himalayas
IUCN	Water Management Adaptation in the River Santa Watershed: Capacity Development to Cope With Climate Change
IUCN	Local Water Governance: Catching Nile Water in a Systemic Way
Stockholm International Water Institute (SIWI)	The Euphrates and Tigris Regional Economic Benefit Sharing Study
SIWI, United Nations Development Programme (UNDP)	Mapping Financing Channels for Hydro-Climatic Adaptation
Women's Environment and Development Organization (WEDO)	Methodology to Link Climate, Water and Gender
Wetlands International	Impact of Changes in Water Availability due to Dams and Climate Change

	Countries/Regions covered	Key features and/or results to date	Reference in Part II
	Latin America and the Caribbean	– Among others, the first regional-scale assessment of the potential impacts of climate change on the water resources of Mesoamerica and the Dominican Republic completed and a training programme on the potential impacts of climate change in the globally strategic Panama Canal Watershed	Case study A-1
	Uzbekistan, India, Ghana	– Examples of how co-management of surface and groundwater offers attractive and innovative solutions to complex, politicized water allocation problems, local water availability improvement, and adaptation to increasing climate variability	Case study A-2
	Sub-Saharan Africa, Nepal, Mekong River Basin	– The impacts and benefits of various water storage options have been examined to feed into guidelines for long-term water storage development	Case study A-3
	Mexico, Central America	– Likely changes over Mexico and Central America have been mapped from an ensemble of model runs for runoff change up to 2080, and the relationship between likely runoff change and current runoff and rain-fed agriculture have been examined	Case study A-4
	Haiti	– The initial data collection has produced analyses in thematic areas of climate vulnerability and livelihoods across varying geographic scales	Case study A-5
	To be tested in Morocco	– An integrated system of models is being designed to carry out the stepwise impact assessment from climate scenarios downscaling to economic impact analysis at national level and will be tested in Morocco	
	Global	– Current knowledge of the anticipated impacts of climate change on water availability for agriculture is summarized, emphasizing the immediate implementation of 'no-regrets' strategies which make agricultural systems resilient to future impacts	
	Indus Basin (India, Pakistan, Afghanistan)	– Ongoing monitoring of snow, ice and water resources in the region through capacity-building and the establishment of appropriate hydrometeorological systems for monitoring	
	Dominican Republic	– A research plan has been developed, focusing on a vulnerable watershed, on the basis of a literature review and group consultation	Case study A-6
	India (Uttarakhand)	– Relevant stakeholders have been mapped and a database developed for Uttarakhand State and other governmental agencies, to be used for increasing the resilience of local populations	
	Peru, Latin America	– A water situation analysis of the Santa River Basin has been developed	
	Egypt	– A survey has been carried out to assess the effects of climate change on the cropping patterns, especially of small farmers	
	Euphrates-Tigris region	– The development of a hydro-economic tool used to estimate the efficiency of water use and the economic value of water in different uses	
	Global	– Initial analysis of nearly one hundred UNDP-funded projects tackling hydroclimatic adaptation	
	Global	– Initial results have demonstrated water vulnerability due to the effects of climate change; currently in the process of adapting an existing gender parity index to quantify the level of gender equality in each country and link the gender parity index to the climate impact on water availability or access	Case study A-7
	Inner Niger Delta region, Nigeria, Central Mali	– Overview of the economic value of the Inner Niger Delta and overview of the combined hydrological and economic impacts of climate change and dams	

Table I-1. **Nairobi work programme partners and their contributions to this synthesis publication** (continued)

Contributed by	Actions
POLICY SUPPORT	
Global Water Partnership (GWP)	Water Plans Build Climate Resilience (Partnership for Water and Development (PAWD) Programme)
GWP	Influencing policy and decision making to build water security and climate resilience
AMCOW GWP	Water, Climate and Development Programme (WCDP) in Africa
Wetlands International	Flood prediction tool: OPIDIN
Convention on Biological Diversity (CBD)	Recent Policy Agreement and Guidance on Water and Climate Change
FAO	FAO Report on "Climate change, water and food security"
Centro de Estudios en Cambio Climático Global, Instituto Torcuato Di Tella (CECG-ITDT)	Capacity Development for Policy Makers to Address Climate Change
Tearfund	Guide to build the capacity of national governments on integrated climate change adaptation into water policies and plans
IUCN	Water and Nature Initiative (WANI)
SIWI	SIWI initiatives on policy support

	Countries/Regions covered	Key features and/or results to date	Reference in Part II
	13 African countries	<ul style="list-style-type: none"> Plans have been developed and considerable progress has been made in reforming water management in all 13 countries involved in the programme; progress was made on the integration of water into national development plans and Poverty Reduction Strategy Papers, and raising the profile of water on the national agenda 	
	13 African countries, Asia, Latin America, Mediterranean	<ul style="list-style-type: none"> Supported various countries and regional economic development communities to develop water management and climate change plans and policies 	Case study B-1
	Eight African countries: Mozambique, Zimbabwe, Cameroon, Rwanda, Burundi, Ghana, Burkina Faso, Tunisia Four river basins (Limpopo, Kagera, Volta and Lake Chad)	<ul style="list-style-type: none"> In November 2010, during the third Africa Water Week, the extraordinary session of the African Ministers' Council on Water (AMCOW) adopted a decision recommending that the GWP and partners put the WCDP into operation In early 2010, GWP and AMCOW with support from Regional Economic Commissions (SADC, Economic Community of West African States (ECOWAS), and ECCAS) convened climate change dialogues in Africa, which identified actions relevant to advance water security and climate change adaptation in Africa, and the actions were used as a basis upon which to develop the WCDP 	
	Inner Niger Delta region, Nigeria	<ul style="list-style-type: none"> Among others, prediction of flooding using OPIDIN for improving farming systems and thus saving people's lives and property 	
	Global	<ul style="list-style-type: none"> Recognition of the interconnectedness of biological processes Identifies ecosystem-based adaptation as a key response to the impacts of climate change Attainment of consensus from Parties and governments pertaining to policy approaches and guidance principles 	Case study B-2
	Developing countries (but could also be applied at a global level)	<ul style="list-style-type: none"> Emphasizes the need for a closer alignment between water and agricultural policies Provides elements of information and guidance needed to assess and respond to the challenge that climate change is expected to impose on agricultural water management and food security 	
	Chile, Costa Rica, Dominican Republic, Honduras, Perú and Saint Lucia	<ul style="list-style-type: none"> Climate change planning is now being considered as part of the development agenda of many Latin American countries Institutional arrangements to address climate change are being strengthened or new ones developed (e.g. inter-ministerial committees) Enhancement of national technical capacity to assess costs of adaptation options in the water sector Costa Rica and the Dominican Republic have already finished their investment and financial flows assessments on their water sectors. For Chile, Honduras, Perú and Saint Lucia, the analysis is under way 	Case study B-3
	Developing countries	<ul style="list-style-type: none"> Providing practical, pragmatic, context-specific guidance for government officials and donor institutions 	
	Global	<ul style="list-style-type: none"> Development of the Pangani River Basin Management Project (PRBMP) Assessment of environmental flows and a scoping seminar for the Huasco River Basin in Chile 	
	Developing countries	<ul style="list-style-type: none"> Establishment of a platform for knowledge sharing and networking between the scientific, business, policy and civil society communities 	

Table I-1. Nairobi work programme partners and their contributions to this synthesis publication (continued)

Contributed by	Actions
UNDP United Nations Industrial Development Organization (UNIDO) UNICEF World Food Programme (WFP)	African Adaptation Programme
UNDP	Adaptation to Climate Change through Effective Water Governance
IUCN Eastern Africa Regional Office	Mainstreaming Climate Change and Adaptation into Integrated Water Resource Management in the Pangani River Basin
United Nations Economic Commission for Europe UNECE	Guidance on Water and Adaptation to Climate Change, developed under the Water Convention
IWMI	Regional/country assessments of climate change preparedness and/or vulnerability, including agricultural sector vulnerability – for policy support and investment planning
AWARENESS AND CAPACITY-BUILDING	
FAO, Global Environment Facility (GEF), and Bharathi Integrated Rural Development Agency (BIRDS)	Strategic Pilot on Adaptation to Climate Change (SPACC)
Tearfund	Community-Led Total Sanitation (CLTS)
Tearfund and World Health Organization (WHO)	Water Safety Plans (WSP)
World Meteorological Organization (WMO) and Cap-Net	Tutorial based on the existing training manual: "IWRM as a Tool for Adaptation to Climate Change"

Countries/Regions covered	Key features and/or results to date	Reference in Part II
Burkina Faso, Cameroon, Congo, Ethiopia, Gabon, Ghana, Kenya, Lesotho, Malawi, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Tanzania and Tunisia	<ul style="list-style-type: none"> – Identification of data needs to assess the implications of climate change on water availability in Kenya – Mapping the vulnerability of the Tunisian coastline to sea level rise – Implementation of a pilot project is creating a medium-scale irrigation system with hydropower generation which will feed into one community – Building capacity for the management of water resources, improvement of institutional arrangements, formation of partnerships and stakeholder engagement in the management of water resources 	Case study B-4
Ecuador	<ul style="list-style-type: none"> – A water law has been approved which provides a unique framework for effectively mainstreaming integrated water resource management (IWRM) – The National Development Plan has also assigned high priority to climate change issues and the Climate Change Unit has been transformed into a sub-secretariat. 	
Tanzania	<ul style="list-style-type: none"> – A climate study to attain scientifically robust climate predictions for the Pangani Basin has been completed – An integrated flow assessment has been completed to predict the implications of different water allocation scenarios; resulting in draft conclusions that include policy recommendations with implications on hydrology, river ecology, and socioeconomic situations of the Basin – Project also initiated demonstration actions to reduce vulnerability to climate change at three pilot communities in the Basin 	Case study B-5
Global	<ul style="list-style-type: none"> – Implementation of the guidance is promoted through a programme of pilot projects on adaptation to climate change in transboundary basins under the United Nations Economic Commission for Europe (UNECE) Water Convention and a platform for exchanging experience in this regard – Publication of the guidance in three languages (English, French, Russian) – Implementation of the guidance by countries and organizations beyond the UNECE region 	
South East Asia (greater Mekong Basin)	<ul style="list-style-type: none"> – Priority actions identified for government and communities to improve resilience of water sector and safeguard food production based on impact assessment studies. 	
India (Andhra Pradesh District)	<ul style="list-style-type: none"> – Farmers have acquired skills in managing climate risks through participation in climate change schools – Adaptation technologies and practices piloted and best practices have been identified – A package of best adaptation tools and practices has been documented and disseminated to support scaling-up 	
Afghanistan and southern Sudan	<ul style="list-style-type: none"> – Disaster Management Team in Afghanistan has seen particular success, with ten project communities having committed themselves to open defecation-free status in the first year of the CLTS programme – Guidelines drafted to assist Tearfund partners and DMT in robust programming of CLTS – Guidelines can be tailored to context specific scenarios 	Case study C-1
Sudan	<ul style="list-style-type: none"> – Committees in Aweil East County (southern Sudan) are noted to be looking after new water sources, and matters surrounding hygiene are discussed within the wider community 	
Global	<ul style="list-style-type: none"> – Planned to be finalized by June 2011 – Second version being prepared which is aimed at a more technical audience 	

Table I-1. Nairobi work programme partners and their contributions to this synthesis publication (continued)

Contributed by	Actions
World Wide Fund for Nature (WWF)	Ecoclubs Operate Weather Stations
IUCN	Awareness-raising in the context of the Pangani River Basin Management Project (PRBMP)
Environment and Development Action in the Third World (ENDA)	WRITESHOP Synthesis Report
SIWI	Global Water and Adaptation Action Alliance (GWAAA)
SIWI	Water and Climate Coalition (WCC)
WMO and GWP	Associated Programme on Flood Management (APFM)
Wetlands International, WWF-US, Conservation International, Cooperative Programme on Water and Climate Change, Wageningen University, the African Institute of Capacity Development, Oxfam America and IUCN	Ecosystem and Community-based Climate Change Adaptation Training Package
GWP	Knowledge product: Capacity Building and Awareness
UN Water and WMO	UN-Water Thematic Priority Area on Water and Climate Change (WCC-TPA)
ADAPTIVE ACTIONS ON THE GROUND	
ENDA	Impact of Climate Change and Variability on Water Resources in West-African Watersheds
FAO	Groundwater Management in India

	Countries/Regions covered	Key features and/or results to date	Reference in Part II
	Rasuwa District, Nepal	<ul style="list-style-type: none"> – Awareness of local weather and water quality has increased – The establishment of the Climate Change Training Programme and the sharing of personal experiences of weather-related events has been encouraged – Construction of nursery, with the sale of plants expected to generate funds which will be put towards the long-term sustainability of the weather stations 	Case study C-2
	Tanzania	<ul style="list-style-type: none"> – Assisted in mentoring Tanzanian experts on environmental flow studies in different institutions, including the Ministry of Water and Irrigation, University of Dar es Salaam and PBWB – Exchange of experiences on issues of climate change and water governance; significantly enhanced the facilitation skills of partner organizations, basin and local government authority staff 	
	West Africa	<ul style="list-style-type: none"> – The report suggested that a standard approach be adopted, which facilitates the identification of the areas that need to be enhanced for each identified target group in terms of the adaptation measure envisaged 	
	Global	<ul style="list-style-type: none"> – Provided a vehicle for advocacy of water, climate change and adaptation, particularly in connection with the UNFCCC process 	
		<ul style="list-style-type: none"> – Identification of the multiple dimensions of the 'water-adaptation gap'; and the grouping of members with complementary skills and institutional reach needed to close these gaps 	
	Global	<ul style="list-style-type: none"> – Capacity building and the creation of a network on integrated flood management; development of pilot projects and support in the implementation of national strategies through pilot-scale demonstrations, and the involvement and support from the help desk support-based partners; compilation of guidance and advisory materials 	Case study C-3
	Asia, Latin America and Africa	<ul style="list-style-type: none"> – High-level policy-makers' dialogue held recognizing the importance of strategic environmental assessments and more strategic, integrated approaches in climate change adaptation planning – A communiqué has been issued, identifying and providing endorsement for the approaches of Wetlands International (and affiliated organizations) and the need to integrate functional ecosystems into climate change and disaster risk reduction planning 	Case study C-4
	Developing countries	<ul style="list-style-type: none"> – Enhancement of capacity and raising of awareness in China and South America – Implementation of an initiative to inspire regional cooperation on adaptation in Asia – Raising legislators' awareness on water and climate change in Latin American countries such as Honduras and Panama 	
	Global (28 members and 24 partners [organizations])	<ul style="list-style-type: none"> – Compilation of policy recommendation documentation – Formulation of a document pertaining to key messages on climate change and water 	Case study C-5
	Senegal/West Africa	<ul style="list-style-type: none"> – Legal and institutional measures implemented; physical structures installed; measures to protect and restore ecosystem together with various capacity building and awareness-raising actions 	Case study D-1
	India	<ul style="list-style-type: none"> – 6,533 farmers were trained to collect data that are important for understanding the local aquifers; participatory, capacity-building, and gender equity approach implemented 	Case study D-2

Table I-1. **Nairobi work programme partners and their contributions to this synthesis publication** (continued)

Contributed by	Actions
GWP	Building Resilience of the KaLanga Community in Swaziland
GWP	Water Plans Build Climate Resilience
ICIMOD	Local Responses to Too Much and Too Little Water in the Greater Himalayan Region
IUCN	Two pilot ecosystem and livelihood interventions in the Komadugu Yobe River of north-west Nigeria
Practical Action	Participation for dealing with water in Bangladesh
Practical Action	Participation for dealing with conflict over water in Sudan
SUS	Satkhira Unnayan Sangstha (SUS) adaptation initiatives to cope with salinity
Tearfund	Adapting Water Resources Management to Climate Change
GEF Small Grants Programme, UNDP	Community-Based Approach to Climate-resilient International Waters Management
UNDP	Community Water Initiative: Ensuring Water Security while Adapting to Climate Change
UNECE	Programme of pilot projects on adaptation to climate change in transboundary basins under the UNECE water convention
Wetlands International	Engaging Local Communities to keep the Delta Alive
WMO	Climate Change Adaptations in the Water Sector in Egypt
WWF	Putting an End to Water Woes
WWF	Conserving Traditional Water Springs

Countries/Regions covered	Key features and/or results to date	Reference in Part II
Swaziland (KaLanga)	<ul style="list-style-type: none"> Access to clean water for drinking and to support the livelihoods gained by over 9,600 people affected by polluted water in the KaLanga Community 	Case study D-3
13 African countries	<ul style="list-style-type: none"> Plans have been developed and considerable progress has been made in reforming water management in all 13 countries involved in the programme; progress was made on the integration of water into national development plans and PRSPs, and raising the profile of water on the national agenda 	
China, India, Nepal, Pakistan	<ul style="list-style-type: none"> A book documenting the results of this study has been published and a scoping study has been completed to form a strong basis for the next phase of the project 	
Nigeria	<ul style="list-style-type: none"> Two pilot ecosystem and livelihood interventions conducted for river restoration and weed control 	
Bangladesh	<ul style="list-style-type: none"> Youth volunteers established a disaster warning and response mechanism and a climate change awareness campaign; an early warning committee has been established; technologies identified by communities to improve their livelihoods 	Case study D-4
Sudan	<ul style="list-style-type: none"> Conflict between water-user communities in North Darfur resolved using a traditional system for conflict resolution and participatory consensus-building process 	Case study D-5
India	<ul style="list-style-type: none"> Five rainwater harvesting systems at Shyamnagar Upazila under Satkhira district to collect and preserve rainwater for supporting approximately 1150 children at five primary schools and the local community Rainwater storage strategy for agriculture; use of this water for irrigation purposes created opportunities to grow rice as well as to rear livestock 	
Niger, Brazil	<ul style="list-style-type: none"> Traditional strategies designed to cope with climate variability documented 	
Global (with focus on transboundary water bodies)	<ul style="list-style-type: none"> The communities' capacities have been enhanced to manage international waters resources sustainably, with increased community and ecosystem resilience to climate change; innovative community-based technologies, methodologies and approaches have been piloted, demonstrated and scaled up; regional networking of communities and NGOs around a shared body of water for effective management of international waters 	Case study D-6
Africa, South Asia, Central America	<ul style="list-style-type: none"> Innovative technology and local resources employed to develop water management systems that meet local needs and build capacities to cope with climate variability and change; increased the participation of the local community in their technical, management, and collaborative capacities; six international award-winning projects developed 	Case study D-7
Global	<ul style="list-style-type: none"> Two workshops held to exchange experiences between pilot projects; among other results, the riparian countries of the Rhine formed an expert group for climate change and applied a common multi-model methodology for the entire Rhine catchment in order to assess future climate change impacts 	Case study D-8
Inner Niger Delta, Mali	<ul style="list-style-type: none"> Local people learned and exchanged information on how to maintain the natural resource stocks of the Delta, and secure their own livelihoods and income-generation actions, for example, through micro-credit 	
Egypt	<ul style="list-style-type: none"> Cooperation among various stakeholders including ministries, governorates, water boards, universities/institutes, and local communities within the country has been enhanced to consider climate risks in water resources planning, management and operations and to develop adaptive measures and policy options 	Case study D-9
Nepal	<ul style="list-style-type: none"> Plastic water tanks have been constructed by six farmers from the Farmer School to help meet agricultural needs and hence support for commercial farming 	
Nepal	<ul style="list-style-type: none"> Water made available for drinking and irrigation 	



GLOBAL SALTWATER AND FRESHWATER ESTIMATES

FRESHWATER STORAGE

SALTWATER 97.5 %
(1,365 million km³)

FRESHWATER 2.5 %
(35 million km³)

30.8 %
groundwater, including
soil moisture, swamp water
and permafrost

0.3 %
lakes and rivers

68.9 %
glaciers and permanent
snow cover

Source: Igor A Shiklomanov,
State Hydrological Institute (St Petersburg)
and UNESCO (Paris) 1999. Adapted
from GWP "A world of salt: global saltwater
and freshwater estimates".

II. CLIMATE CHANGE AND FRESHWATER RESOURCES: A SYNTHESIS OF ACTIONS UNDER THE NAIROBI WORK PROGRAMME

This chapter presents a synthesis report of information on some of the work undertaken by NWP partners, including those completed through Action Pledges on a wide range of themes on the freshwater resources. The information is organized into four thematic sections relevant to the expected outcomes of NWP activities relating to freshwater resource management, namely:

- (1) Improving the understanding of impacts, vulnerability and adaptation to climate change on freshwater resources (Research and assessment) (pages 43–58);
- (2) Improving the ability to make informed decisions on adaptation planning, measures and action (Policy support) (pages 59–68);
- (3) Facilitating communication, dialogue and cooperation among different stakeholders, and enhancing adaptive capacity through technical and institutional capacity building (Raising awareness and capacity-building) (pages 69–76); and
- (4) Implementing practical adaptation actions and measures (Adaptive actions on the ground) (pages 77–92).

Each section includes a description of actions, best practices and lessons learned, and challenges and opportunities identified from implementing actions reported by NWP partner organizations. These actions are listed in [TABLE I-1 \(above\)](#). Some actions have been developed as [CASE STUDIES IN PART II](#) to provide examples of best practices. All relevant actions have been used to prepare the synthesis of information in this chapter.

2.1. ENHANCING THE ASSESSMENT AND UNDERSTANDING OF IMPACTS, VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE ON FRESHWATER RESOURCES (RESEARCH AND ASSESSMENT)

The activities carried out by partners included:

- Developing and applying modelling and monitoring tools to conduct vulnerability assessment of climate change impacts on freshwater resources;
- Conducting vulnerability assessment of the impact of climate change on freshwater resources at various scales, including regional, national and local, such as assessment of a river basin or a watershed; and
- Developing and implementing methods to understand the socio-economic impacts associated with impacts on freshwater resources.

Some partners also documented and disseminated the findings of these research and assessment activities, which means that there is some overlap with [SECTIONS 2.2., 2.3. and 2.4.](#) Some of the main activities and results are highlighted and described in more detail in [CASE STUDIES A-1 to A-7.](#)

2.1.1. RESULTS, GOOD PRACTICES AND LESSONS LEARNED

The activities reported by partners in this section were undertaken in Asia, Africa, Latin America and the Caribbean. They provide evidence of freshwater resource vulnerability due to climate change, and associated adverse impacts on livelihoods.

KEY FINDINGS

Freshwater resource vulnerabilities arise due to several factors, including:

- Scarcity of surface water, as well as unpredictability due to changing rainfall patterns including declining precipitation, increased risks of floods and drought, and melting of glacier ice;
- A decline in the quality of water from both natural and anthropogenic factors;
- Poor coordination and conflict between water user groups.

There are associated impacts on other sectors (such as agricultural productivity and food security, human health, biodiversity), socio-economic impacts, and increased risks to vulnerable groups.

Research and assessment actions by partner organizations have identified key issues and good practices, thus contributing to the overall understanding of the impacts of climate change on the availability and quality of the freshwater resources, impacts on livelihoods, and to better understanding of the economic value associated with freshwater resources.

Example: The United Nations Food and Agriculture Organization (FAO) report on “Climate Change, Water and Food Security” provides an assessment of the anticipated impacts of climate change on water availability for agriculture. The report emphasizes the need for closer alignment between water and agricultural policies and makes the case for immediate implementation of ‘no regrets’ strategies which have both positive development outcomes and make agricultural systems resilient to future impacts.²⁵

KEY FINDING

The engagement of national institutions in risk assessment actions has facilitated the use of project outcomes at policy level and helped institutions to develop targeted capacity building actions.

Example: The International Institute for Sustainable Development (IISD) has undertaken activities to enhance the capacity to manage climate change related risks on water resources in the Dominican Republic as part of the Climate Risk Management Technical Assistance Support Project (CRM TASP) [see CASE STUDY A-6]. The initial

stakeholder consultations and review works which focused on a vulnerable watershed and livelihoods of vulnerable populations have led to the development of a concrete research plan. Engagement of a national institution in various steps of implementation of its research initiative has helped IISD in delivering its capacity-building actions.

KEY FINDINGS

Quality monitoring, prediction and assessment tools, coupled with local knowledge have been found to be helpful in improving scientific information and the design of community-based adaptive action.

A range of initiatives have enabled the pairing of data analysis and data-driven decision tools with local needs and community knowledge.

Examples: Various initiatives have been reported by Wetlands International, FAO, ICIMOD, IWMI and SIWI. These organizations have developed and implemented models and tools to predict, monitor and assess impacts on the freshwater sector. The flood prediction tool developed by Wetlands International and its partners, for example, has helped in the improvement of farming systems by providing early warning of floods. The FAO-MOSAICC (Modelling System for Agricultural Impacts of Climate Change) tool, among other applications, can estimate the availability of water for irrigation schemes under various climate change scenarios. ICIMOD’s ongoing assessment work in the Indus Basin involves the monitoring of snow, ice and water resources through the use of hydrometeorological systems and capacity building programmes. IWMI carries out multiple research projects in many river basins (e.g. Ganga, Krishna, Indus, Volta, Blue Nile, Syr Darya), which aim to: increase the information base for water resources management under current and future climates; examine innovative adaptation technologies such as groundwater banking and managed aquifer recharge [see CASE STUDY A-2]; explore the prospects for planned versus ad hoc water storage development [see CASE STUDY A-3]; and evaluate the impacts of environmental water allocations on basin water resources development under increasing climate variability. SIWI, in its study on regional economic benefit sharing in the Euphrates and Tigris uses a hydro-economic model to estimate the efficiency of water use and the economic value of water for different uses at basin and sub-basin levels.

²⁵ The report is available at <http://www.fao.org/docrep/014/i2096e/i2096e.pdf>.

KEY FINDING

Building capacity in the local communities is an important factor which will ensure the continuity of the implementation of methods and tools on the ground.

Examples: The International Union for Conservation of Nature (IUCN) Water and Nature Initiative (WANI) has contributed to the knowledge base on risks and vulnerability of micro-watersheds in the Himalayas and a trans-Himalayan space. In addition, as an initial action on water management adaptation in the Santa River Basin in Peru, IUCN conducted a water situation analysis study in order to obtain inputs for future hydrological and water balance studies. CIESIN, in close cooperation with the Earth Institute, has undertaken initial activities (including establishing a climate monitoring system, carrying out land use and land degradation surveys, as well as a household survey) to understand and assess the risks of climate change on water and to improve risk communication and risk perception in Haiti [see CASE STUDY A-5]. These efforts have been undertaken with the broader goal of developing a long-term integrated water resources management strategy within the sub-watersheds of the Cote Sud region. One of the good practices integrated within the research and assessment initiatives reported by ICIMOD and CIESIN, is the capacity building of local community.

Initiatives reported by CIESIN, IISD, IUCN and WANI have used local consultations and surveys as a part of their assessment actions.

KEY FINDING

Research and assessment actions help in designing relevant adaptation actions on the ground and enhance the understanding of socio-economic impacts related to freshwater.

Examples: A number of partners have reported on initiatives involving the development and implementation of methods to understand the socio-economic impacts related to freshwater. An ongoing research initiative by the Women's Environment and Development Organization (WEDO) [see CASE STUDY A-7] in the Economic Community of West African States (ECOWAS) region will facilitate the

broader understanding of the effect of gender-differentiated impacts of climate change on water resources. Results from this work could serve as input to help make adaptation planning and practices more gender-responsive. CIESIN, in its collaborative effort with the United Nations University (UNU) and CARE has identified return migration and seasonal migration as local livelihood diversification strategies in Tlaxca and Chiapas states of Mexico, mostly related to unreliable harvests linked to changing rainfall patterns [see CASE STUDY A-4].

KEY FINDING

Improving existing infrastructure could provide better water management solutions.

Examples: Wetlands International and IWMI have assessed the impacts on water availability due to the construction of physical infrastructure. IWMI research has led to the realization that improving existing infrastructure (such as dams) could prove more cost-effective and lead to increased efficiency of water management when compared to the results of building new ones.

A number of lessons learned have emerged from the good practices and outcomes of these actions reported by the partner organizations on research and assessment. These include, among others, the need:

- For long term data to assess climate change events in a meaningful way;
- To create knowledge management and information systems that are maintained, updated and disseminated by national agencies, with the involvement of local communities and NGOs, and supported by international standards;
- To document and disseminate research and assessment outcomes with a view to informing policy makers;
- To undertake capacity-building of the local community to ensure the continuity of the application of methods and tools on the ground;
- To facilitate cooperation and collaboration among key partners at both the regional and the local scale- to ensure partners get first-hand and up-to-date information and take responsibility for implementation actions.

2.1.2. CHALLENGES AND APPROACHES

CHALLENGES

Lack of capacity among national agencies and lack of continuity, or instability, within the political system could pose a serious challenge in engaging national stakeholders and the integration of these lessons into national adaptation plans and strategies.

Lack of baseline data and historical data on water resources (e.g. water quality, river flow rates, precipitation data) limits the modelling of long-term climate risk and related factors.

Lack of adequate research on the relationship between freshwater systems and impacts on livelihoods.

Approaches: During the course of implementing research and assessment activities there have been numerous opportunities, especially relating to scaling up and replicating existing actions or activities. For example, the engagement of national stakeholders has been identified as an important means to ensure the mainstreaming of research outcomes into national adaptation plans and strategies. Also, the certainty of the research results could be improved with tested and improved monitoring and assessment methods and tools. The integration of spatial data and monitoring systems into local decision making processes remains a crucial step and a challenge in the design of high-impact research tools. Opportunities exist to compare results between research teams working on a watershed, a river basin or a transboundary watershed. This synergistic collaboration is a useful way to derive accurate scenarios of the vulnerability of the freshwater system and associated impacts.

Field research on livelihoods and freshwater systems is critical, and research methodologies need to take into account all relevant socio-economic factors and communities, including women, children, the socially excluded and rural farmers.

2.2. IMPROVING THE ABILITY TO MAKE INFORMED DECISIONS ON ADAPTATION PLANNING, MEASURES AND ACTION (POLICY SUPPORT)

Many activities carried out by NWP partners aim to facilitate the understanding of issues (climate change impacts and adaptation planning) among Parties and relevant decision makers in order to improve their ability to make informed decisions.

The IPCC states that “according to many experts, water and its availability and quality will be the main pressures on, and issues for, societies and the environment under climate change; therefore it is necessary to improve our understanding of the problems involved”. In line with this, adapting to climate change requires national development policies to be carefully drafted in order to respond to projected changes in water availability and to address inadequacies in information, investments and infrastructure for water storage, distribution and effective allocation.

Two main actions for success have been identified: First, NWP partners have found that there are benefits to policy guidance documentation which facilitates the understanding (and implementation) of policy relating to climate issues in the context of water resources. Second, the importance of transboundary coordination is also evident. Building institutional capacity, training stakeholders on water management and increasing stakeholder engagement are some of the areas addressed within the regional level activities of some of the NWP partners.

Some activities are described in detail in [CASE STUDIES B-1 to B-5](#).

2.2.1. RESULTS, GOOD PRACTICES AND LESSONS LEARNED

KEY FINDING

Informed policy decisions can be made only with appropriate and context-specific data. Decision makers will have the ability to confidently design mechanisms that to encourage building of resilience to the impacts of climate change when they are provided with robust information.

Examples: The integrated water resource management initiative in the Pangani River Basin, supported by the United Nations Development Programme (UNDP) in partnership with the IUCN Eastern Africa Regional Office, provides a good example [see CASE STUDY B-5]. A climate study to obtain scientifically robust climate predictions for the Pangani Basin was conducted, and resulting data were incorporated into an integrated flow assessment. This assessment was then utilized to predict the implications of different water-allocation scenarios, derived from 15 development policy options relating to the environment and socio-economic status of the basin. This scenario analysis resulted in draft conclusions that include policy recommendations with implications for hydrology, river ecology and the socio-economic situation of the basin. The results of this study will additionally assist in ensuring that policy makers are better informed on future adaptation strategies and options for the basin.

KEY FINDINGS

Gaining a better understanding of current water resources is useful in defining actions to improve water security and adaptation. Critical elements for the development of a cross-sectoral adaptation intervention are:

- Providing a development context with a suitable entry point and national champions to drive the process forward;
- Creating a strategic road map integrated with development priorities, institutional arrangements and agreed roles and responsibilities for key players;
- Ensuring sustainability through institutional memory and stakeholder platforms; and
- Strengthening functions such as capacity development and knowledge management, and communication and advocacy.

Examples: GWP's Partnership for Water and Development (PAWD) project was implemented between 2005 and 2010, with the aim of enhancing Africa's water security through the development of water management strategies and plans. Several of the plans and strategies which were developed under the project outlined the need to build water infrastructure and to create hydrologic monitoring and observational networks as a means to build water security and climate resilience. Progress has been made in supporting the reform of water management in Benin, Cameroon, Cape Verde, Eritrea, Ethiopia, Kenya, Malawi, Mali, Mozambique, Senegal, Swaziland and Zambia. In

some cases, these efforts led to significant outcomes, such as national governments increasing their budgetary allocation to the water sector. In most countries, implementation of integrated water resource management plans is underway. CASE STUDY B-1 provides more information on GWP's work on supporting policy and decision making to build water security and climate resilience.

The International Water Management Institute (IWMI) research and vulnerability assessment work in the Greater Mekong subregion led to the identification of priority actions for governments and communities to improve resilience of the water sector and safeguard food production. The research work consists of reviewing the current status and trends in water management in the region and assessing likely impacts of climate change on water resources.

KEY FINDING

There is a need for increased cooperation among ministries to define priorities and facilitate the provision of information for the development of transboundary adaptation solutions.

Examples: Given the nature of many water sources, the risks and challenges arising due to climate change are not always limited to one nation. Solutions to the impacts of climate change on water resources therefore need to be coordinated across national boundaries. The United Nations Economic Commission for Europe (UNECE) Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE Water Convention) provides an important framework for transboundary cooperation in the context of climate change. It aims to protect transboundary waters (both surface and groundwater) by preventing, controlling and reducing transboundary impacts, and to promote cooperation.

Recognizing the urgency of this issue, the Meeting of the Parties to the UNECE Water Convention decided to develop *Guidance on Water and Adaptation to Climate Change*.²⁶ The Guidance on Water and Adaptation to Climate Change illustrates steps and adaptation measures that are needed to develop a climate-proof water strategy, especially in a transboundary setting. This guidance document aims to provide state-of-the-art climate change adaptation support for the existing challenges that countries face and, through its comprehensive and integrative character, add to the existing water management practices.

KEY FINDING

Strategic and methodological guidance documents are useful tools that can be utilized by decision makers to aid in the formulation of policy.

Examples: A methodological guidebook regarding investment and financial flows assessment for adaptation in the Water Sector²⁷ has been published through efforts of the initiative carried out by the Centro de Estudios en Cambio Climático Global, Instituto Torcuato Di Tella (CECG-ITDT) in collaboration with UNDP [see CASE STUDY B-3]. This methodology is designed to estimate the additional investment flows (investments in physical assets such as infrastructure) and financial flows (mainly programmatic measures) that are needed to implement adaptation measures (within a Latin American context) for a 2030 time horizon. The CECG-ITDT has been active in highlighting the necessity for climate change planning to be considered as part of the development agenda of many Latin American countries.

2.2.2. CHALLENGES AND APPROACHES

CHALLENGES

Data at the local level often does not exist. Challenges may hinder attempts to collect information needed for the purpose of supporting policy. Climate and hydrological data sharing is important.

The collection of robust data can be difficult, and budgets required to undertake data collection in a rigorous manner can be limiting. This can cause delays.

Although strategic and methodological guidebooks could be useful tools for implementation purposes, drafting such documentation requires a wide range of experts and may take a long period of time. Furthermore, once complete, regular updating of these guidebooks is needed to ensure they remain relevant.

Approaches: Given that data (and at times skills) may sometimes be lacking, dealing with scientific uncertainty when planning investments is inevitable. There is a need to move from the current paradigm that is focused strictly on event and response, which seems to create a disconnect between disaster-and-emergency responses and longer-term planning. In this regard, short-term interventions must fit into long-term development initiatives. SIWI, among other partners, recognizes the importance of work pertaining to disaster risk reduction, with a particular focus on water-induced disasters. SIWI emphasizes the need for disaster preparedness, which in itself contributes toward improving resilience.

There is a need for activities that produce robust climate data with respect to water. Such data would allow for more rigorous analysis which will provide an indication of priority needs. Combining this with appropriate guidance methodology documentation will ensure that 'no regrets' policies can be appraised and then implemented accordingly.

The existence of strong institutional capacity (and retention of institutional memory) presents a good opportunity to maintain the continuity of development initiatives (both in the start-up phase and in the long-run). An appropriate level of institutional capacity within a programme has the ability to overcome unforeseen circumstances that may arise.

CHALLENGES

Integrating climate change adaptation into freshwater management and broader national development can be difficult.

At the national level, leadership and coordination capacities on climate change issues among stakeholders can at times be fragmented.

²⁶ UNECE. 2009. *Guidance on Water and Adaptation to Climate Change*. Available at <http://www.unece.org/env/water/publications/documents/Guidance_water_climate.pdf>.

²⁷ See <<http://www.undpcc.org/documents/p/806.aspx>>.

Approaches: Development planners are challenged in designing policies that not only recognize the local nature of the impacts of climate change relevant to the water sector but also to take into account the interconnectedness of these impacts across sectors and at multiple scales. Synergies need to be facilitated among various cross-cutting adaptation projects, across sectors and at multiple scales. The overall political will for implementing adaptation policy and actions must be strengthened and the continuity of programmes on climate change adaptation must be ensured. Having said this, the human resources needed to handle adaptation projects may be scarce. Institutional capacity therefore needs to be nurtured to support policy making processes.

CBD's initiative [see CASE STUDY B-2] highlights how experiences from local initiatives can reveal approaches which incorporate cross-cutting adaptation measures. An extensive review of assessments regarding water, including in relation to climate change, in the context of policies and guidance provided by the CBD, was prepared for consideration of the fourteenth meeting of its Subsidiary Body on Scientific, Technical and Technological Advice. In a review of assessments on water in relation to climate change, ecosystem based adaptation approaches are identified as key responses for building resilience to the adverse impacts resulting from climate change. Examples of measures include restoring wetland functions to cope with flood management and risk; and restoring land cover (e.g. forests or vegetation cover in farmlands) to stabilize land and regulate water flows.

When they have proved to be successful, pilot demonstrations can be scaled up into broader-reaching policies. For example, under the Africa Adaptation Programme (AAP) (a programme initiated by UNDP) [CASE STUDY B-4], certain countries are experimenting with such an approach; in the Democratic Republic of São Tomé and Príncipe, a pilot project is creating a medium-scale irrigation system with hydropower generation which will feed into one community; and in Morocco, two field activities on integrated management of water resources were launched in two oasis communities.

CHALLENGES

Although climate change impacts may be localised, appropriate and cost-effective adaptation measures could be undertaken at the regional level. There is a need to align the goals of policy makers with the needs of those most vulnerable to the negative impacts of climate change on the water sector.

Approaches: The transboundary nature of water resources highlights the need to create regional synergies. It seems that few adaptation efforts are currently carried out at the transboundary level; however, transboundary cooperation can be a beneficial approach to reducing vulnerability. GWP's PAWD programme indicates that the opportunities for adaptation through shared river basins should be further explored and understanding should be enhanced.

At the national and regional level, water dialogues and forums are an effective means for communicating the climate change-related issues affecting the water agenda. Many NWP partners have facilitated the generation of consensus surrounding water within the context of climate change through dialogues and forums. These are useful platforms for discussing issues such as the need to recognize the critical role of water infrastructure in building resilience as well as the need to raise awareness on the opportunities available to access climate finance to support water management.

Moving from dialogue on the importance of water management for climate change adaptation to operationalization – whether at global, national or watershed level – will require closing the gap that exists between knowledge and practical applications on the ground. Reducing uncertainties and increasing the understanding of which policies and actions work in practice is required. In addition, global and national policy must be much better informed by experiences of what works on the ground.

2.3. FACILITATING COMMUNICATION, DIALOGUE AND COOPERATION AMONG DIFFERENT STAKEHOLDERS, AND ENHANCING ADAPTIVE CAPACITY THROUGH TECHNICAL AND INSTITUTIONAL CAPACITY BUILDING (RAISING AWARENESS AND CAPACITY BUILDING)

Institution building, with the aim of advocating the importance of the role of water within the climate debate, can be influential in awareness raising. Capacity building actions are targeted at both the institutional and individual level.

CASE STUDIES C-1 to C-5 provide descriptions of awareness and capacity building actions in more detail.

2.3.1. RESULTS, GOOD PRACTICES AND LESSONS LEARNED

KEY FINDINGS

The creation and dissemination of tools targeted at increasing the capacity of communities and policy makers in terms of climate change adaptation has been effective.

User-friendly products can be utilized at different levels depending on the users needs.

Examples: Wetlands International spearheaded the development of an Ecosystem- and Community-based Climate Change Adaptation Training Package which drew on its experiences of incorporating wetland management, resilient ecosystems, and the wider upstream and downstream socio-economic impacts of infrastructure development into national and regional planning policies and projects [see CASE STUDY C-4].

The World Meteorological Organization (WMO) is partnering with Cap-Net to develop a tutorial (both on-line and on CD-ROM) based on the existing training manual: *Integrated Water Resource Management as a Tool for Adaptation to Climate Change*.²⁸ The tutorial is aimed at decision makers who do not necessarily have the time to go through the manual in its entirety; yet it will provide the main messages of the manual. A second version, longer and more in-depth, is also being prepared for a more technical audience. This version could also serve as a basis for a self-learning module on water and climate change.

KEY FINDINGS

Institutional development and capacity support can produce ongoing benefits, as new skills and ideas get more entrenched.

New approaches, such as 'writeshops', can be beneficial.

Examples: The Strategic Pilot on Adaptation to Climate Change (SPACC) project, funded by the GEF and implemented by the FAO, has the development objective of enhancing the knowledge and capacity of communities on adaptation to climate variability and change in seven drought-prone districts of Andhra Pradesh, India. As a result of the project, farmers have acquired skills in managing climate risks through participation in climate change schools.

The PRBM project, the Climate Change and Development Project (CCDP) and the Global Water Initiative (GWI) in Tanzania have also been exchanging experiences on issues of climate change and water governance and this has significantly enhanced the facilitation skills of partner organizations, as well as basin and local government authority staff.

The 'writeshop', organized by Environnement et Développement du Tiers Monde (Environment and Development Action in the Third World) (ENDA) together with UNESCO, SEI and NCAP/ETC, held in Senegal in 2007, focused on adaptation measures for water management in response to climate variability and change in West Africa. A synthesis report on the 'writeshop'²⁹ provides an extensive discussion of issues such as: practical adaptation measures for river basins in West Africa; community-level adaptation approaches in the management of water resources; possible political and institutional measures to facilitate adaptive management at different levels in West Africa; and measures for increasing the capacity for integrating climate change adaptation measures into water resource management.

The associated programme on flood management, a joint initiative of the World Meteorological Organization (WMO) and GWP, provides access to knowledge and best practices, capacity building, exchange of cross-regional experiences and policy advice to assist national and regional flood management institutions [see CASE STUDY C-3].

²⁸ See <<http://www.cap-net.org/node/1628>>.

²⁹ The synthesis report is available at <http://www.nicap.net/no_cache/news-single-view/article/17/3/>.

KEY FINDINGS

Innovative approaches and flexibility can improve institutional arrangements, help form partnerships and engage stakeholders in the management of water resources.

Simple and localized initiatives, including community measurement of climate and hydrological variables, can have a profound impact on sharing knowledge, particularly using local education facilities.

Examples: The AAP has been active in this area. For example, part of Morocco's AAP capacity development plan has included the formation of partnerships with high schools and higher-level institutions, for research on topics such as infrastructure and water management. Also, to improve education on the management of water resources in Nigeria, the AAP has developed learning materials and packages on skills-based education in schools which address issues of school gardening as a core strategy for climate adaptation linked with water management.

In addition to being influential tools for capacity building, academic institutions are also an important source of information dissemination. For example, a course for 40 secondary school teachers on climate change, glacier retreat and integrated water resource management was organised by GWP Peru and partners in Cuzco, in September 2009 and helped raise awareness of water resource vulnerability, as well as illustrating how the adoption of integrated water resource management could lessen the risk of negative effects resulting from climate change. The course also presented teachers with information that could be incorporated into the school curriculum.

The World Wide Fund for Nature (WWF) has created the Eco-Club weather station initiative, which has established weather stations at local schools in the Rasuwa district in Nepal [CASE STUDY C-2]. Given the concentration of people at the schools, the weather stations have not only raised awareness in terms of the changing climate but have also heightened interest on climate issues. Another example is the launch, by Fiji's Department of Environment in partnership with the Land and Water Resources Management (LWRM), of an initiative in which a public bus, painted with images and messages to encourage water conservation and recycling, travels along the busiest route in the city of Lautoka as a means of raising awareness relating to the changing climate and its influence on water systems.

KEY FINDING

Creating dialogues for ongoing awareness-raising can help coordinate and sustain activities.

The Water Safety Plans (WSP) for Communities initiative undertaken by the World Health Organization (WHO) include 'water dialogues' which are instrumental in bringing together key stakeholders so as to further elevate water-related issues within the climate agenda. Certain NWP partners are dedicated to raising awareness of the role of water in the climate change process. For example, WCC³⁰ focuses on advocacy and international policy change, including under the UNFCCC, but it is also active in other fora, primarily UN-related, intergovernmental processes where water and climate issues are relevant. Similarly, the UN-Water Thematic Priority Area on Water and Climate Change is another example of strengthening the coordination of the UN System actions related to water and climate change [see CASE STUDY C-5].

Activities undertaken by WHO and Tearfund provide evidence that awareness-raising has the power to increase understanding and adoption of good practice at the community level. In the Aweil East County (Southern Sudan), WASH (Wash, sanitation and hygiene) committees are cleaning the area around their improved water sources on a regular basis, and responding to repair needs more quickly, and are discussing home water hygiene issues with their wider community.

2.3.2. CHALLENGES AND APPROACHES

CHALLENGES

There is a need to have a firm insight of the impacts of climate change on water as well as an effective means of communicating this knowledge.

Inadequate knowledge regarding climate information presents an obstacle to the appreciation of the scale of climatic impacts on water resources.

Approaches: A fuller understanding of the available tools helps trainers to engage with local communities at all levels, especially with decision makers, when discussing climate change adaptation. A challenge raised from the experiences of Wetlands International's Ecosystem and Community-based Climate Change Adaptation Training Package is that, in order for tools to achieve the required result, there is the need for a grounded understanding of tools by trainers. Without this grasp of understanding of the tools, the effectiveness of climate adaptation and capacity building will be diminished.

Many educational institutions in disadvantaged communities (who in many instances are highly vulnerable to the consequences of climate change impacts on water resources) do not yet include climate change impacts, risks and opportunities on their curricula. This is an issue which should be given attention. Research institutions and universities have a crucial role to play in educating people and raising awareness of climate impacts on freshwater systems. These institutions could be encouraged to establish research units and possible centres of excellence which can be tasked not only with building knowledge but also with the dissemination of information regarding climatic issues.

CHALLENGE

The rapidly changing information makes it difficult for all stakeholders to be informed and kept up to date with information.

Approaches: With regard to the importance of water-related impacts of climate change, there is a need to improve understanding and connections between scientists, policy makers and practitioners at both local and global scales to enable better and more rapid sharing of good practices on climate change adaptation. Where awareness is raised effectively, the creation and dissemination of thorough, user-friendly guidelines presents one method of ensuring that such awareness translates into robust programming whereby new processes are assimilated as norms, following the conclusion of a campaign.

CHALLENGE

It is difficult, within a project, to find the right balance between local awareness-raising and capacity building to undertake activities in local communities.

Approaches: In terms of achieving assimilation, caution and careful planning is needed to ensure objectives are realised. A hands-off approach may seem appropriate in order for the target group (i.e. community, villages, and so on) to freely adopt the insights and activities being raised and to ensure that these groups do not feel as though perspectives are being forcefully imposed upon them. However, a hands-off approach may introduce challenges. The Community-Led Total Sanitation (CLTS) project instituted by Tearfund [see CASE STUDY C-1] presents an example. Two particular physical concerns within the project involved: (i) the effects on water quality (particularly the potential contamination of groundwater); and (ii) the quality of structures, given that the process did not suggest a set design of sanitation solutions. Thus while awareness was heightened, concerns were raised surrounding whether or not this would translate into the initial goal of the process. This example highlights the link between awareness-raising and ensuring the appropriate capacity is established in the sites in which initiatives are conducted to ensure continuity and sustainability of initiatives.

CHALLENGE

Lack of funding can prevent effective awareness-raising.

Approaches: There are ample low- to no-cost approaches to enhance local consciousness on the adverse effects resulting from a changing climate. This is shown by the Eco-Club initiative which was implemented by the WWF in Nepal. The establishment of weather stations at local schools heightened awareness and promoted interest and participation in climate issues. This also spurred innovative ideas to contribute towards the sustainability of the weather station initiative. A nursery was established and the proceeds from this provide an additional source of funds which can be filtered back into the weather station initiative.

³⁰ See <<http://www.waterclimatecoalition.org>>.

2.4. IMPLEMENTING PRACTICAL ADAPTATION ACTIONS AND MEASURES ON THE GROUND (ADAPTIVE ACTIONS ON THE GROUND)

Many actions undertaken by NWP partners contribute to a knowledge base of best practices covering the implementation of practical actions on adaptation which could be potentially shared, replicated or scaled up.

Adaptation practices represent a diverse set of actions and activities in terms of location, nature and implementation approach.

The range of activities reported include practices to:

- Improve resilience of ecosystems (such as reforestation activities, and payment for ecosystem services);
- Change behaviour regarding the usage of water and addressing conflict situations;
- Build and restore physical infrastructure (such as dykes, anti-salt bridges, water storage technologies, traditional springs, and rain gauges);
- Diversify livelihood strategies (such as the use of micro-credit tools, technologies built using local resources);
- Revise laws and regulations (integration into national plans); and
- Collect, analyse and disseminate information on local coping strategies to reduce vulnerability due to climate change impacts on freshwater resources.

Although the effectiveness of any adaptation practice tends to depend on location and socio-economic situation, good adaptation practices have additional value because of their potential for being shared, replicated, improved and scaled up.

Some of the main actions and results are described in more detail in [CASE STUDIES D-1 to D-9](#).

2.4.1. RESULTS, GOOD PRACTICES AND LESSONS LEARNED

KEY FINDING

Restoring and building new infrastructure can improve the quality of water resources, and provide improved and predictable access to water resources, meeting household consumption and irrigation needs.

Examples: The Andhra Pradesh Farmer Managed Groundwater Systems (APFaMGS) initiative, led by FAO in collaboration with other partner organizations, involved training farmers to understand and measure local aquifers [see [CASE STUDY D-2](#)]. The subsequent behavioural change in water extraction, for example, helped to bring the water use in 500 communities in line with groundwater availability in the Andhra Pradesh. Satkhira Unnayan Sangstha (SUS) provided help with installing five rainwater harvesting systems benefited nearly 1150 children and the local community. Also, SUS's action on building an agricultural storage system has helped paddy farming and created other livelihood opportunities for farmers by ensuring the predictable availability of water during dry periods.

Restoration of the Polchet water source – a traditional water spring – including the construction of a water pipe in Ramche Nepal, with support of the Langtang National Park and the WWF's Buffer Zone Support Project, has provided adequate water supply for 160 people from 32 households.

KEY FINDINGS

Climatic variability and potential changes pose new challenges and dimensions to the management of international and transboundary water resources.

Strategic collaboration and partnership among multiple stakeholders, including national and local institutions, regional authorities and academia are crucial in addressing adaptation issues for transboundary waterbodies.

Examples: Good practices implemented by institutional and national collaboration and partnerships have yielded useful outcomes not just in ensuring effective implementation of adaptive actions on the ground, in particular addressing adaptive issues in transboundary water resources, but also avoiding duplication and fragmentation of efforts. These good practices are illustrated in several initiatives, including those from GWP [CASE STUDY D-3], UNECE and UNDP. Pilot projects on adaptation for dealing with the impacts of climate change, such as increased floods, water scarcity and drought in transboundary basins located in Member countries of the UNECE aim to demonstrate the benefits of and possible mechanisms for transboundary cooperation in adaptation planning and implementation [see [CASE STUDY D-8](#)]. UNDP

is also undertaking activities using a community-based approach to managing international waters [see CASE STUDY D-6]. A regional NGO forum was established involving civil society and community leaders to enhance collaboration in managing a transboundary water body in the South China sea.

ENDA, GWP and UNDP reported on their activities that are designed to influence water allocation and consumption. These activities engender the integration of climate-related risks into international and national water management policy.

KEY FINDING

The involvement of community leaders and members is essential for fostering local ownership, which will help to ensure the implementation and continuation of the project.

Examples: Almost all the reported initiatives were participatory, involving local communities (such as farmers, students, and so on) in data collection, the design and/or implementation phase. The APFaMGS initiative, for instance, engaged women farmer volunteers in data collection. ENDA's initiative on West African watersheds provides another example of the application of local surveys in the development of relevant options for community-based adaptation actions in the Senegal River Basin [see CASE STUDY D-1]. GWP's initiative on saving the Okpara dam in Benin involved establishing six local partnerships at the grassroots level, which continue to operate as a real platform for stakeholders to promote various water adaptive actions. The participation of local people in community water initiative projects initiated by UNDP [see CASE STUDY D-7] has also increased their level of technical management and collaborative capacities.

KEY FINDING

There is a need to recognize and document indigenous knowledge for coping with the impacts of climate change on the freshwater sector and to develop diversified livelihood strategies.

Examples: Some partner organizations such as Tearfund, ENDA, IWMI, UNDP and ICIMOD have identified and documented local coping strategies that could be replicated and scaled up (see BOX II-1). ICIMOD, for example, has published a book titled *"Local responses to too much and too little water in the greater Himalayan region"*³¹ which documents local responses to flood hazards and water stress in four countries.

A number of partners reported on activities that support the diversification of livelihoods as adaptation strategies. Practical Action, for example, worked closely with the local community in the Char lands in the northern Gaibandha district in Bangladesh in identifying technologies needed to diversify their livelihoods during flooding [see CASE STUDY D-4]. Eleven technologies were identified, some of which were manufactured using local materials.

KEY FINDING

A participatory consensus-building approach may help resolve conflict over water issues.

Examples: Practical Action also reported on activities it has undertaken relating to a participatory consensus-building approach. It undertook these activities with a view to assisting communities to deal with conflicts that arise due to water scarcity, especially in semi-arid and arid areas where these conflicts are more widespread. Practical Action adopted a traditional system of conflict resolution to address water conflicts, thus ensuring participatory use of water resources in Northern Darfur in Sudan [see CASE STUDY D-5].

³¹ See <<http://www.icimod.org/?opg=949&document=830>>.

KEY FINDING

Payments for environmental services can be used for water services.

Examples: In its Water and Nature Initiative (WANI) to build the resilience of Tacana watersheds of Guatemala and Mexico, IUCN adopted the concept of paying for ecosystem services with a view to preserving the watershed. The design of a payment scheme for a large farming area is currently under development. This would establish area-specific payments for environmental services and would serve as an important measure to mitigate risk to water resources and watershed services.

KEY FINDING

Communities can learn from each other.

Examples: Under UNDP's community water initiative [see CASE STUDY D-7], project members from the Zukpuri traditional area in Ghana have used their training to construct more than 30 wells for 16 communities in the Upper West Region, providing more than 26,000 people with access to safe supplies of water. Similarly, the technique of water storage for irrigation was replicated by the local community of Ramche village in Nepal after a field visit to Madanpokhara of Palpa district with cooperation of WWF's Langtang National Park and Buffer Zone Support Project.

Some of the useful lessons learned, based on the results of the implementation of above mentioned activities under adaptive actions on the ground, include:

- Adaptive measures need to be determined based on their cost-effectiveness in terms of short- or long-term benefits;
- Adaptive actions for any watershed, basin or transboundary water body need to be based on a concrete understanding of water resource potential and issues, and socio-economic dynamics;
- The involvement and capacity-building of community leaders, members and local institutions are essential for fostering local ownership and ensuring the implementation and continuation of the adaptive actions on the ground;

- Local communities are the most immediate observers of climate impacts and are therefore able to execute adaptive management activities and to monitor them locally;
- Use of adaptation strategies and technologies which are technically, locally and culturally appropriate are sustainable;
- Strategic and technical cooperation with multiple stakeholders is essential to ensure implementation of adaptation actions, particularly in the area of transboundary water management;
- The need for a robust and flexible institutional and legislative framework is critical for resolving water security challenges at a national or a regional scale.

2.4.2. CHALLENGES AND APPROACHES

The assessment of community-based activities that partner organizations have been implementing provides an indication of the outcomes of the efforts to address vulnerability of freshwater resources and the associated adverse impacts on livelihoods due to climatic change. However, since some of the activities are still in their early stages, it is too soon to see how these community-based actions will be sustained.

CHALLENGES

It is crucial to ensure the sustainability of ongoing initiatives so that local communities remain engaged and capable of implementing them.

Approaches to keep costs low should be identified, existing coping strategies documented and shared and results from community-based initiatives integrated into national planning.

Approaches: Although funding has not been clearly highlighted by many partners as a critical component of the design and implementation of community-based adaptation actions, lack of financial resources is a constraint, for example in restoring and building of new infrastructures, or for capacity-building programmes for local communities and local institutions. It is therefore important to:

- Properly document the financial implications of any community-based adaptation action in order to ensure that it is transferable and sustainable;
- Find ways to reduce costs by mobilizing local resources and adopting local materials and technologies;
- Find adaptation options ways to adapt that incur no or very minimal costs and enhance awareness of existing adaptation actions; and
- Increase awareness of the opportunities available for accessing climate finance for supporting adaptation practices.

A lack of capacity remains for identifying and accessing funding allocated for adaptation. It is therefore important to increase the visibility of low-cost and no-cost adaptation options, and to make the best use of available indigenous knowledge on reducing risks to water resources.

Documenting and disseminating indigenous and local knowledge on coping with stress on freshwater stock across the various regions of the world remains a challenge. These coping strategies, if identified, documented and disseminated, will provide tremendous potential for replication and scaling up elsewhere.

Although multiple-stakeholder consultations could be costly and often time-consuming, it is crucial that strategic and technical collaboration among stakeholders takes place.

It was noted that integrating findings from these community-based adaptive actions into national adaptation plans and broader national development is still a challenge due to inadequate capacity for integrating water security and climate change issues in national processes, and lack of information flow on best practices learned from the implementation of adaptation actions to policy makers.

One of the ways to address these challenges is to scale up and communicate ongoing community-based adaptation practices on freshwater resources.

Box II-1. Local strategies to cope with freshwater stress

ENDA, WWF and Tearfund have documented local coping strategies to adapt to the impacts of climate change on water resources, which are summarized below:

Reactive adaptation to rain shortages

- Rescheduling agricultural timetables (late sowing, short cycle crops, several repeated sowings, dry sowing);
- Simultaneous practice of rain-based and irrigated farming;
- Changing farming practices away from crops associated with rain-based farming and increasing the use of other farming practices (common among cattle rearers).

Measures designed to improve efficiency and effectiveness in water management for agricultural purposes

- Using compartments, filtering dykes and growing vetiver;
- Creating artificial ponds;
- Dividing plots up using rows of stones to minimize runoff after torrential rainfall to encourage water infiltration and percolation;
- Dividing fields into rectangular plots with mounds of earth through which a canal network can be organized using pipes;
- Adopting new transplanting techniques to make best use of water;
- Placing pumps in holes to reduce pumping height at well installations;
- Conserving traditional water sources;
- Increasing the number of deeper wells.

Short-term adaptation to flooding

- Corralling animals in family enclosures during high waters or flooding;
- Digging channels to drain stagnant water in the event of flooding;
- Digging ditches to collect flood and runoff water;
- Moving people to high ground in the event of flooding.

Measures used for the collection and storage of water for domestic use

- Water stored in small plastic bottles in own grounds;
- Collecting rainwater from roofs of houses.

Other spontaneous and reactive adaptations

- Use of alternative foodstuffs;
- Reduction of livestock during dry periods;
- Diversification and seeking of new occupations – fishing, raising cattle and so on;
- Traditional rationalization of fisheries;
- Moving to less dry areas; increasing migration;
- Change in stock size and herd composition;
- Changing roles of women and redistribution of household responsibilities;
- Fixation (nomads settling near water sources);
- Alternative food security measures and eating unconventional food items.

Further information

See http://www.nlcip.net/no_cache/news-single-view/article/17/3/.

See http://www.wwfnepal.org/media_information/publications/?200628/Climate-Change-Best-Practices.

See also <http://tilz.tearfund.org/Research/Water+and+Sanitation+reports/Separate+streams+Adapting+water+resources+management+to+climate+change.htm>.



III. KEY MESSAGES AND CONCLUSIONS

Although the activities documented in this publication provide only a snapshot of the total activities being undertaken worldwide to minimise the impacts of climate change on freshwater resources and adapt to future change, they show concrete outcomes, lessons learned and challenges.

The case studies demonstrate concrete results, including through:

- The development and implementation of impact assessment tools and models;
- Ongoing collaboration among stakeholders and institutions to protect transboundary water bodies;
- Capacity-building initiatives for communities and policy makers;
- The use of local resources, technologies and traditional knowledge to implement adaptation actions; and
- Observed improvements in human health due to improved quality of and predictable access to water resources.

Challenges have also been identified, especially in the designing and delivering of adequate adaptation planning and practices, as well as in the scaling up and dissemination of existing adaptation actions.

3.1. KEY MESSAGES

The following key messages derived from these activities could serve as inputs to adaptation planning and practices, and reduce the vulnerability of the freshwater system due to climatic change and associated impacts on livelihoods:

(1) *For purpose of conducting research and assessment, appropriate means and methods, which are coherent with local needs and community knowledge, are crucial for gathering appropriate and context-specific data on freshwater vulnerability and impacts due to climate change.* This will serve to address the current research gap and will be helpful for understanding climate change impacts on freshwater resources and associated impacts on other sectors and livelihoods, including its cross-sectoral dimension for an effective integrated water resource management. Appropriate and context specific data helps in making informed policy decision on freshwater management.

(2) *Involvement of influential and sector-relevant stakeholders – including national institutions – in developing initiatives related to water resources and climate change, provides added value.* For actions particularly relating to transboundary water resources, it is crucial to ensure that all stakeholders (including institutions) are involved in the formulation and implementation of adaptation measures. This coordination will be beneficial when defining the priorities and the support needed, as well as helping to avoid duplication and fragmentation of ongoing efforts. Proposed actions need to take into account the existing national development context so as to ensure that interventions focus on national priorities and are aligned with government frameworks.

- **Ownership:** Local authorities within communities should have involvement in the design, implementation and monitoring of programmes, as this introduces a form of familiarity for local community members.
- **Community involvement:** This can spur innovative designs and ideas. Local ‘climate champions’ or ‘climate advocates’ can be identified, which may assist in raising awareness.
- **Replicability:** Local knowledge and insights into small-scale demonstrations should initially be assessed. Proven successful practices may be recognized and possibly scaled up into broader-reaching actions and assist in policy formulation.
- **Inclusiveness:** Acknowledgment of minority groups and gender must be taken into account in the planning and implementing of adaptation projects.

(3) *Community-based adaptation actions and actions will not be sustainable if local communities are not engaged and are not technically and financially able to implement them.* This key message is derived from the implementation of adaptation actions specific to freshwater resources, but is also applicable to any other adaptation actions on the ground. This needs to be supplemented with capacity building of the local community, whenever there is a gap in the understanding of climate change impacts and adaptation actions. Building the capacity of the local community will ensure the continuity of implementation of methods and tools on the ground.

(4) *There are opportunities for low-cost to no-cost adaptation actions which can have significant impact on the ground and reduce vulnerability to freshwater resources and livelihoods. As lack of availability and access to adequate funding could limit certain adaptation actions, it is important to find ways to reduce adaptation costs by mobilizing local resources, traditional knowledge and adopting local materials and technologies. Local coping strategies should be identified, documented and disseminated to vulnerable groups. Innovative approaches and flexibility can reduce costs by improving institutional arrangements, forming partnerships and engaging stakeholders in management of water resources.*

(5) *Given the considerable disconnect between the efforts being undertaken by scientists, policy makers and practitioners and fragmentation in actions, finding effective ways of disseminating information has become extremely urgent and important to ensure alignment and constructive flow of information between various stakeholders. User-friendly knowledge products, policy dialogues, forums and localized initiatives could serve to enable better and more rapid sharing of good practices on climate change adaptation. Practical experiences and lessons learned from development actions provide an opportunity for the compilation of guidebooks and guideline methodologies which may assist in the project design and implementation process, provided that they are up-to-date. This form of policy support documentation would be especially helpful in countries with low institutional capacity. Universities and other academic institutions provide another means of bolstering capacity and raising awareness, both of which would be complementary to the development of a strong base for the support of decision making processes. Forums provide a space for the encouragement of coordination and capacity building. There is a need to strengthen water resources management and climate adaptation as a part of development planning at basin, national and regional levels. Therefore there is a need to build the capacity of institutions and stakeholders to integrate water and climate change actions into development planning and strengthen water infrastructure.*

3.2. CONCLUSIONS

As reflected by all the adaptation actions discussed in this document, *considering good adaptation actions for freshwater resources is central to building resilience to climate change and also responding effectively to its impacts.* Challenges and opportunities remain to improve actions on all four areas: assessment and research, adaptive actions on the ground, raising awareness and capacity building, and policy support. There is also a need to enhance synergy and information flow across different levels of adaptation actions.

Reducing the vulnerability of freshwater resources and improving livelihoods requires various actions and actors across different levels, as evident from these ongoing adaptation actions. The NWP has the potential to facilitate the implementation of adaptation actions in relation to freshwater system in a future climate regime, through:

- Engaging stakeholders and encouraging them to share results, challenges and opportunities to enhance the implementation of adaptation actions;
- Motivating stakeholders to explore opportunities to collaborate with each other to scale up and replicate existing adaptation actions;
- Supporting freshwater work in a cross-sectoral dimension; and
- Facilitating the development of user-friendly knowledge products to help disseminate best practices on adaptation in relation to freshwater resources, including local coping strategies.



THE NAIROBI WORK PROGRAMME
CLIMATE CHANGE AND FRESHWATER RESOURCES

A. CASE STUDIES ON RESEARCH AND ASSESSMENT



CASE STUDY A-1.

ASSESSING POTENTIAL CLIMATE CHANGE IMPACTS ON WATER RESOURCES IN LATIN AMERICA AND THE CARIBBEAN

WATER CENTER FOR THE HUMID TROPICS AND THE CARIBBEAN (CATHALAC)

A research gap exists in terms of comprehensive exploration of the actual implications of the scenario data, to serve as inputs to adaptation planning. In support of the development of such adaptation plans and policies CATHALAC and its partners the United States Agency for International Development (USAID) and the National Aeronautics and Space Administration (NASA) have, in the recent years, undertaken various actions such as this to fill this research gap, and have made particular headway in understanding the potential impacts of climate change on biological diversity, forest carbon and water resources.

CATHALAC and its partners have recently completed the first regional-scale assessment of the potential impacts of climate change on the water resources of Mesoamerica and the Dominican Republic. This is a follow up of an earlier assessment of the potential impacts of climate change on regional biodiversity, in the context of the Regional Visualization and Monitoring System (SERVIR, in Spanish).

The study was conducted in parallel with another assessment of potential impacts on forest carbon stocks, but focused primarily on potential changes in both water availability and water quality (the former using surface water runoff as an indicator; the latter using sediment loading as an indicator).

RESULTS

The study indicated a reduction in the availability of surface water in future in seven priority transboundary watersheds where the analysis was carried out. The Coco, Lempa, Motagua, San Juan, Sixaola, Usumacinta, and Yaque del Sur Rivers were chosen as priority watersheds. The analysis indicated that, in general, regardless of the climate change scenarios, there is a trend for lower surface water runoff through the 2080s, indicating a likely reduction in the availability of surface water.

The study helped to promote an understanding of the potential impacts of climate change on the water resources of Mesoamerica and the Caribbean. This is important, especially as recent publications, including the *2010 Atlas of Latin America and the Caribbean and the Latin America and the Caribbean: Environment Outlook* developed jointly by UNEP and CATHALAC, have noted the vulnerability of the region's water resources.

However, this study did not draw any compelling conclusions on the potential impact of climate change on water quality, even although deforestation across the region is expected to further contribute to overall declines in water quality.

FURTHER INFORMATION

CATHALAC: <<http://www.cathalac.org>>.

CASE STUDY A-2.

GROUNDWATER AS AN ADAPTATION MEASURE

INTERNATIONAL WATER MANAGEMENT INSTITUTE (IWMI)

Groundwater depletion is a serious concern, and managed recharge of aquifers is needed in some regions. However, groundwater extraction becomes an opportunity because it creates storage capacity. In a warming climate, one of the best places to store water is underground, where it is shielded from high rates of evaporation and accessible to large numbers of small farmers when and where they need it.

India is the world's largest user of groundwater. In regions such as North Gujarat and the large coastal aquifers of Tamil Nadu, Saurashtra and Rajasthan, over-extraction has led to the collapse of agricultural economies. This was followed by a host of government and NGO intervention strategies focused on conservation, water imports and 'alternative livelihoods' strategies; none of which have replaced the benefits conferred by groundwater.

In Ghana, shallow groundwater is widely used for irrigation. Such irrigation has increased dramatically over the last 10 years, and it offers a potential for improved livelihoods for local farmers. This is an important source of water in conditions of increasing rainfall variability. The question is how to develop this precious resource sustainably.

Kyrgyzstan's decision to operate their dams for winter hydropower generation led to modifications to the existing water management and allocation arrangements in 1991. The outcome was increased winter river flows and lower water availability downstream in the summer where water is needed for irrigation. As noted in its report, 'Groundwater Development in Fergana Valley', the suggestion from IWMI has been that, where the summer shortages are felt and where groundwater is underexploited, this is a practical, 'second best' solution, because a negotiated political resolution for a more equitable water sharing regime is not expected soon.

IWMI and the Hydrogeological and Engineering Geology Research Institute (GIDROINGEO) in Tashkent, Uzbekistan, conducted a study to assess the feasibility of banking excess surface flows in aquifers in winter and increasing groundwater use for irrigation purposes in summer. The study covered the Fergana Valley, incorporating 18 aquifers, based on geographic information systems (GIS) analysis of the water balance in 1995 and 2001.

RESULTS

- This array of studies demonstrates the need to examine various groundwater supply options in different parts of the world – in the context of improving water access and availability to offset increasing climate variability;
- A range of technical options are available for groundwater recharge. Technology aside, a managed recharge strategy strongly implies a shift to conjunctive management of surface and groundwater;
- Groundwater offers a number of unique benefits, including potentially wider, more reliable and equitable access to water for the poor;
- Groundwater storage – whether it is underused or overexploited – creates an opportunity for adaptation to and mitigation of climate change effects and offers attractive and innovative solutions to complex water allocation problems.

LESSONS LEARNED

- Co-management of surface and groundwater offers attractive and innovative solutions to complex, politicized water allocation problems, and to local water supply problems;
- Groundwater itself is underexploited in many parts of the world and holds considerable promise in the face of a changing climate;

- Investment in relatively inexpensive engineering would be needed to enhance and stabilize groundwater aquifers that offer water supply close to points of use;
- Climate and other drivers of change raise questions about the continued reliance on surface water resources, prompting countries to fundamentally rethink groundwater management strategies.

FURTHER INFORMATION

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CASE STUDY A-3.

RE-THINKING WATER STORAGE OPTIONS AND DEVELOPMENT PROCESS UNDER CLIMATE CHANGE

INTERNATIONAL WATER MANAGEMENT INSTITUTE (IWMI)

For many millions of smallholder farmers, reliable access to water is the difference between plenty and famine. A classic response is to store water behind dams or in tanks or ponds when it is abundant and where it can be conserved for times of shortage. Water storage spurs economic growth and helps alleviate poverty by making water available when and where it is needed. Today, many developing countries, even those with abundant water, have insufficient water storage capacity. When most people think about water storage, the first thing that comes to mind is large dams. More than 45,000 large dams (over 15 metres high) have been built throughout the world. The majority of these are in North America, China and Europe. About 40 per cent are used solely or partially for irrigation.

IWMI conducted a study on methods of storing water. Some effective methods for storing water are also relatively simple and cheap, bearing in mind that in some regions, such as Ethiopia, even simple ponds and tanks are beyond the financial means of the poorest. Ponds and tanks built by individual households or communities can store water collected from micro-catchments and rooftops. Individual ponds and tanks may be small in volume, but in some places this water is vital to supplement domestic water supplies and the needs of household gardens, rain-fed crops and livestock. Thousands of small community dams have been constructed in northern Ghana and Burkina Faso for just such purposes.

A surprising amount of water is stored in the soil. Soil moisture conservation techniques such as bunding, terracing and mulching keep moisture in the soil for longer than under natural conditions and so increase the water available for crops. These and similar inexpensive measures play a vital role in supporting crop production in arid and semi-arid environments.

RESULTS

How should one choose from the range of available storage types, and how to plan storage development in a sustainable way? These are the questions that researchers at IWMI deal with through research projects in Sub-Saharan Africa and the Mekong Basin, Nepal. The data for future climate scenarios were downscaled to finer resolution at individual basins. These data serve as input to hydrological and water resources planning models in Koshi Basin (Nepal), Volta Basin (Ghana and Burkina Faso), Blue Nile Basin (Ethiopia), Mekong Basin (covering several countries in South-East Asia). Various storage options and combinations, and scenarios for storage development have been simulated, and impacts and benefits have been examined, to feed into guidelines for basin-wide long-term water storage development.

LESSONS LEARNED

- In adapting to climate change, careful attention must be given to the full continuum of physical water storage from groundwater, through soil moisture, small tanks and ponds to small and large reservoirs;
- Water storage should be just one component of a multi-faceted approach to adapting agriculture to climate change;
- Appropriate water storage for agriculture can contribute to both poverty alleviation and climate change adaptation.

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CASE STUDY A-4.

FUTURE DRYING TRENDS MEXICO AND CENTRAL AMERICA AND POTENTIAL MIGRATION

THE CENTER FOR INTERNATIONAL EARTH SCIENCE INFORMATION NETWORK (CIESIN) OF THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY, UNITED NATIONS UNIVERSITY (UNU) AND CARE

A collaborative effort between the Center for International Earth Science Information Network (CIESIN) of the Earth Institute at Columbia University, the United Nations University (UNU) and CARE, sought to estimate potential migration from areas that may be affected adversely by climate change, based on maps by CIESIN and a study by UNU and partners (de Sherbinin *et al.*, 2011, Warner *et al.*, 2009). Change in precipitation levels is a major expected climate impact, which may result in water insecurity in certain regions. Mexico and Central America could be particularly negatively impacted by reduced runoff, which integrates rainfall and evapotranspiration along with soil moisture recharge.

As a part of this collaborative effort, the likely changes in Mexico and Central America from an ensemble of model runs for runoff change up to 2080 were mapped (Nohara *et al.*, 2006), and the relationship between likely runoff change and current runoff and rain-fed agriculture were examined. This mapping analysis was combined with field work in Tlaxcala and Chiapas states in Mexico, in which a researcher from the European Commission's Environmental Change and Forced Migration Scenarios (EACH-FOR) research project interviewed experts, migrants and non-migrants about patterns of migration in relation to environmental stress. The EACH-FOR Mexico case study was conducted by Stefan Alscher of Bielefeld University. Studies were conducted in the hurricane-prone Chiapas state of Southern Mexico and in Tlaxcala state, a highly desertified state in Central Mexico. Both areas are considered very vulnerable to the effects of climate change, particularly in combination with deforestation, erosion, and underlying poverty and social vulnerability.

RESULTS

The findings of the study suggest the likelihood that the region will see a persistent decline in precipitation over the course of this century. **FIGURE A-1** shows that runoff in the region is predicted to decline by at least 5 per cent and possibly more than 70 per cent, with declines getting progressively worse in the semi-arid and arid north. Given the region's mountainous topography, extensive irrigation is only practicable in the coastal and northern plains that are dominated by middle-sized and large landowners. Most smallholder farmers, particularly in the centre and south, will remain heavily dependent on rain-fed agriculture.

The indirect link between climatic change and migration was noted frequently in fieldwork, mostly related to unreliable harvests linked to changing rainfall patterns. In dry land areas such as Tlaxcala, which depends on rain-fed agriculture, the majority of interviewees complained of shifting rainfall periods, which increases uncertainty and causes a decline in crop yields and incomes. The area of Tlaxcala is projected to have a 10–20 per cent decline in runoff in association with climate change. 'Return migration' and seasonal migration as livelihood diversification strategies have been documented in this area. The opportunity for some people to migrate seasonally, send remittances, and return home is an example of migration as an adaptation strategy to deteriorating environmental conditions.

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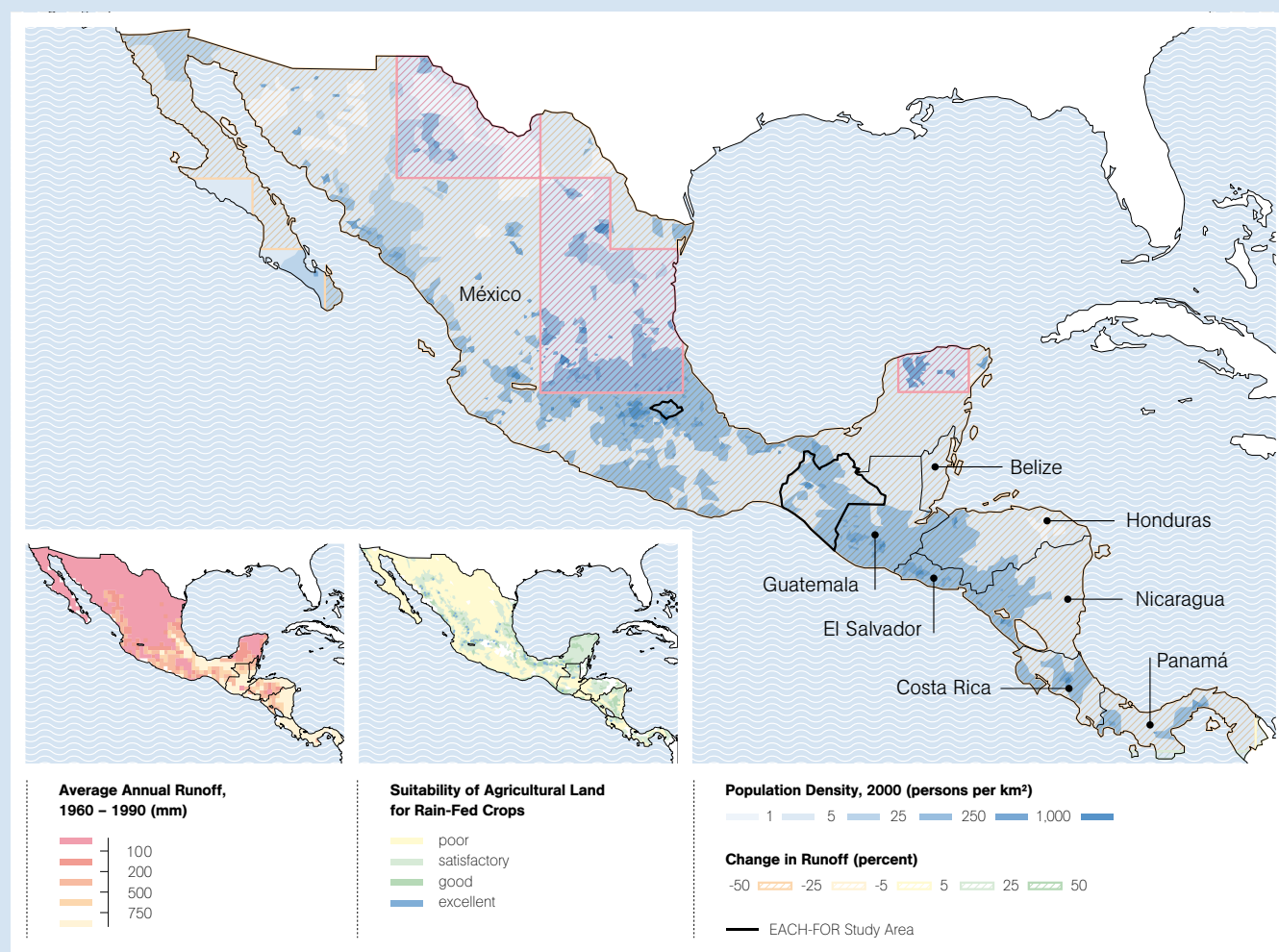
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Figure A-1. Map of Mexico and Central America Depicting Projected Changes in Rainfall.



Sources: CIESIN, UNU and CARE.

CASE STUDY A-5.

MANAGING CLIMATE RISK WITHIN A HAITIAN WATERSHED

CIESIN AND EARTH INSTITUTE, COLUMBIA UNIVERSITY

The Haiti Regeneration Initiative (HRI) aims to bring about lasting positive change to Haiti's environment and the livelihoods of its population over the next 20 years and beyond. The Earth Institute and CIESIN at Columbia University have joined the partnership to provide a rigorous technical and research-based programme to help catalyse the ambitious, innovative solutions to the country's large-scale, chronic problems of environmental degradation and poverty, in order to kick-start a virtuous circle of recovery and growth. The long-term goal is to develop and implement a long-term integrated water resource management programme within the sub-watersheds of the Cote Sud region [FIGURE A-2]. A review of past projects makes it clear that sustainable development in Haiti must tackle a minimum core of interconnected issues simultaneously: disaster risk reduction, agricultural productivity, energy options, health care, education and poverty.

RESULTS

The initial data collection has integrated research questions from several disciplines and produced analyses in thematic areas of climate vulnerability and livelihoods across varying geographic scales. A team of researchers from the HRI partnership, including researchers from Columbia University, experts from the United Nations Environment Programme, researchers from the American University of the Caribbean, Les Cayes, the Organization for the Rehabilitation of the Environment (ORE) and Catholic Relief Service practitioners initiated field data collection in April 2010.

Inter-departmental cooperation between key spatial research centres led to studies following three major areas, to update the data sets and create the tools required for hazard mapping used for the prioritization and sequencing of disaster risk reduction infrastructure investments:

- **A climate monitoring system:** HRI has installed four rain gauges at strategic points across the watershed, including one climate monitoring station in Port-à-Piment village to make the data from all four collection points available for both the watershed and the international communities interested in climate conditions in the south-western region. The station in Port-à-Piment collects and reports hourly data on wind speed and direction, relative humidity, ground and air temperature, solar radiation, precipitation, and soil moisture. It is operated with solar panels and sends all the data via satellite to a server in real time figures. The information gives rise to climate prediction models as part of local early warning systems.
- **A land use and land degradation survey:** HRI has conducted a preliminary land-use and land degradation survey. The Land Degradation Surveillance Framework is a comprehensive field survey of terrain, vegetation and soil conditions. It is designed to provide a spatially explicit layout for landscape characteristics and soil data. Soil samples were collected in April/May 2010 and are currently being analysed. Field observations included data on per cent and type of vegetation cover, infiltration rates, and visible erosion and slope, among others. Further, a preliminary land-use and land cover map has been produced using remote sensing tools. These tools will help with long-term planning for ecosystem restoration of the watershed and natural systems for reducing disaster risks.
- **Communication, risk perception, environmental awareness, and behaviour:** 2010 research included rapid interviews with key respondents as well as focus groups to understand social dynamics behind disaster preparedness and the structure of community organizations. The initiative's objective is to improve risk communication and risk perception to support better decision-making in the watershed. A household survey enquiring about behavioural choices related to risk perception and effective communication will be conducted at the same time of the socio-economic survey. The results from this study will inform the overall communication strategy of the initiative.

FURTHER INFORMATION

Center for International Earth Science Information

Network: <<http://www.ciesin.org>>.

Port-à-Piment climate monitoring station:

<<http://www.haitiregeneration.org>>.

Figure A-2. Map of the Cote Sud Initiative intervention area. Department Sud, South West, Haiti.



Sources: CIESIN.

CASE STUDY A-6.

CLIMATE RISK MANAGEMENT TECHNICAL ASSISTANCE SUPPORT PROJECT; DOMINICAN REPUBLIC COUNTRY STUDY: CLIMATE RISK MANAGEMENT IN THE WATER SECTOR

INTERNATIONAL INSTITUTE FOR SUSTAINABLE DEVELOPMENT (IISD)

IISD is implementing the Climate Risk Management Technical Assistance Support Project (CRM TASP) in seven countries. Funded by UNDP, this initiative aims to enhance the capacity to manage risks related to climate variability and climate change. The project's research actions concentrate on one priority sector in each country. In the Dominican Republic, the focus is on water resources. Climate risk management aims to provide stakeholders with relevant decision-support information and tools to face the challenges brought about by increased climate risks, thereby improving the likelihood of development programmes achieving their goals. Climate risk management integrates traditional approaches of climate change adaptation and disaster risk reduction.

In order to support coherent and sustainable climate risk management, UNDP has commissioned three implementing organizations to conduct climate risk assessments in selected high-risk countries. IISD is responsible for studies in seven countries, including the Dominican Republic. (The six other countries with which IISD is engaged are Honduras, Nicaragua, Peru, Kenya, Niger and Uganda.)

In each country, IISD implements the CRM TASP through the following six steps:

- (1) Stakeholder dialogue;
- (2) Literature review on the state-of-the-art of climate risk management;
- (3) National inception workshop (presentation of literature review; decision on focus of the country study);
- (4) Focused risk assessment (primary research);
- (5) Participatory scenario development workshop(s) (identification and prioritization of climate risk management options); and
- (6) Reporting and dissemination.

In the Dominican Republic, the project is currently on step four. Based on a broad literature review on state-of-the-art climate risk management and group discussions held at a national inception workshop in September 2010, it was decided to concentrate the primary research phase on one vulnerable watershed. Participants at the inception workshop felt that water resources represent a crucial link between many climate hazards and their impacts on the livelihoods of vulnerable populations. Within the geographical limits of one watershed, risks relating to floods, droughts and other climatic changes can be assessed more specifically; concrete risk management options can be devised; and policy recommendations can be drawn to create an enabling environment for effective risk reduction at the national level can be drawn.

In collaboration with the UNDP country office and the National Institute for Hydraulic Resources (INDRHI), the government's water agency, IISD has developed a research plan involving the elements of research, application of models and tools, analysis of climate change impacts, community consultations, workshop and policy analysis. Research will be conducted by INDRHI, IISD, SEI, local NGOs and consultants. The results will be summarized in a final project report. National capacities are strengthened through better risk information as well as through training and advice in tools such as CRiSTAL, PSD, WEAP and DSSAT.

RESULTS

Project actions have so far comprised stakeholder consultations, the initial literature review, which will be published shortly, and the definition of a detailed work plan for the main research phase. More specific results of the risk assessments in the water sector and risk management options are expected for late 2011.

LESSONS LEARNED

Achieving a high level of participation by national institutions, especially government agencies, in risk assessment actions can be more time-consuming but it is worth the effort, as studies can be much better orientated towards important research gaps, capacities can be strengthened where there is a need, and there is likely to be better uptake of results.

FURTHER INFORMATION

International Institute for Sustainable Development:
<<http://www.iisd.org>>.

CASE STUDY A-7.

METHODOLOGY TO LINK CLIMATE, WATER AND GENDER

WOMEN'S ENVIRONMENT AND DEVELOPMENT ORGANIZATION (WEDO)

The Women's Environment and Development Organization (WEDO) is developing and testing a methodology to link climate change, water and gender in order to address the lack of scientific evidence linking the existing disproportionate gendered burden of water collection and management with the expected impacts of climate change. WEDO will analyze the links to provide a basis for the inclusion of a gender component in projects related to climate change adaptation/mitigation and water resources. The objective of this study is to understand the effect of the gender-differentiated impact of climate change on the water resources sector and to use the results to inform and influence adaptation programmes and projects to be more gender-responsive – contributing to both gender equality and poverty eradication. The methodology has been developed, in part, with funding from United Nations Population Fund (UNFPA).

This particular initiative is focused on the Economic Community of West African States (ECOWAS) region, which includes 15 countries: Benin, Burkina Faso, Cape Verde, Cote D'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. In the ECOWAS region about 67 percent of the population use an improved source of drinking water and 60 percent of households are within 15 minutes of a drinking water source. More than 50 percent of the population is without access to improved water services in Niger, Sierra Leone and Mauritania (FIGURE A-3). Only five countries in the region are on track to meet Millennium Development Goal 7 Target 3 on drinking water: "Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation". Data from The World's Women 2010 report shows that in sub-Saharan Africa 63 percent of women in rural areas are responsible for water collection compared with 11 percent of men; in urban areas 29 percent of women are responsible for water collection compared with 10 percent of men. In countries with less of a gender gap, the proportion of men and women collecting water is more equal.

WEDO's initial methodology is based on fairly limited data available through the World Bank database and the UNDP climate country profile. Data sources were chosen because of their coherence in collection. However, there is a need to set up and make available new data sources in order to

improve the results of the methodology. Time-use data on water resource use and management are necessary, as are sex-disaggregated data on social indicators such as the representation in decision-making spheres (e.g. business, education and government), access to information (e.g. media available, literacy rates, educational attainment and freedom to access), and access to resources (e.g. land ownership rights, labour force participation and salary).

RESULTS

The results of the research first demonstrate that, in the long term, climate change negatively impacts water availability through changes in temperature and precipitation. Increased temperature and low levels of precipitation have negative effects on the availability of water resources, thus decreasing water availability.

A second stage will help to clarify the linkages and illustrate the potential negative effects of climate change on gender equality. This will be done by adapting an existing gender parity index to quantify the level of gender equality in each country and link the gender parity index to the climate impact on water availability or access.

FURTHER INFORMATION

Women's Environment and Development Organization (WEDO): <http://www.wedo.org>.

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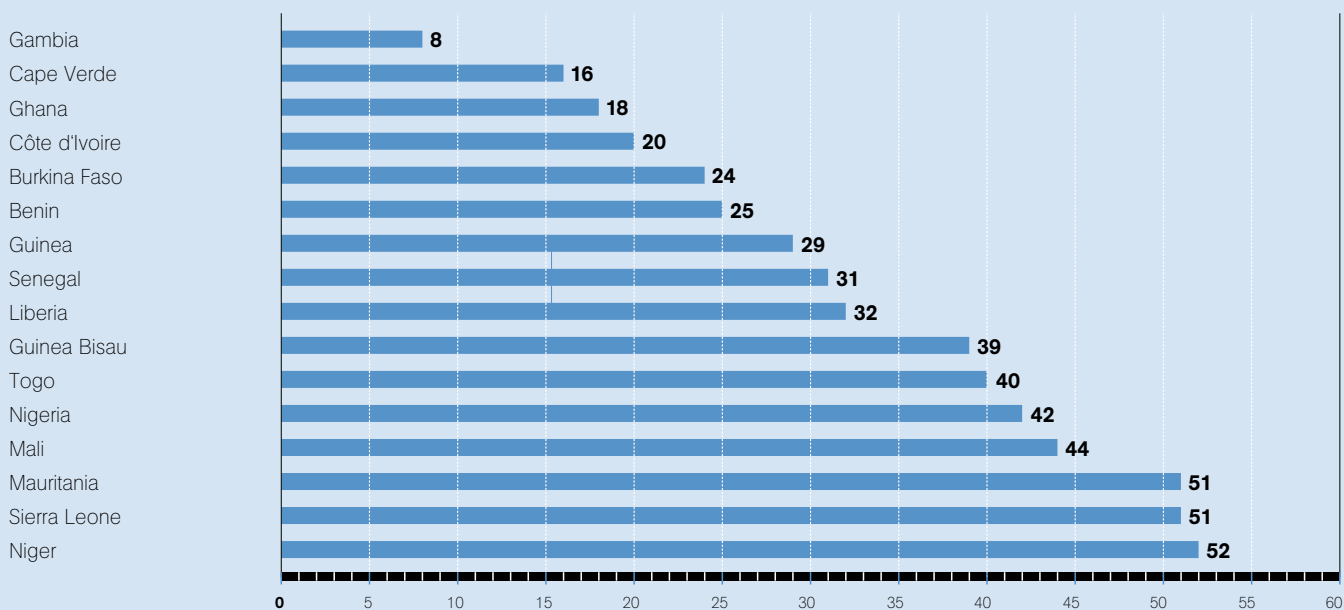
Image A-1.

Children collecting water from a well, Kara, Northern Togo.



Sources: JVE, 2008.

Figure A-3. Percentage of western African population without access to improved water services.



Sources: WEDO, based on data from the *Human Development Report 2010*, UNDP.





THE NAIROBI WORK PROGRAMME
CLIMATE CHANGE AND FRESHWATER RESOURCES

B. CASE STUDIES ON POLICY SUPPORT

CASE STUDY B-1.

INFLUENCE POLICY AND DECISION MAKING TO BUILD WATER SECURITY AND CLIMATE RESILIENCE

GLOBAL WATER PARTNERSHIP (GWP)

Through its global network of more than 2400 partners, present in 157 countries, GWP supports countries in developing appropriate, context-specific and relevant policies, governance frameworks and institutional arrangements essential for building water security and enhancing climate resilience. Many developing countries have overlapping mandates and policies for managing water, which has led to duplication of resources, and institutional gaps for building long-term climate resilience. This is also compounded by weak institutional, governance and coordination arrangements at the national level.

Since 2005, GWP has supported various countries and regional economic development communities in the development of robust and flexible policies and plans that take into account the uncertainty inherent in projected climate change impacts at multiple levels and scales.

RESULTS

- Thirteen African countries have developed new water management plans and strategies;
- Southern African Development Community (SADC) regional dialogues have led to the development of climate change adaptation strategy;
- In Asia, a regional framework has been agreed for managing floods in the Ganges-Brahmaputra Basin;
- In Latin America, El Salvador's National Climate Change Plan and Policy included inputs from GWP;
- In the Mediterranean, the Regional Strategy for Water recognizes links between water and climate change;
- In Central Asia and the Caucasus, stakeholders agreed to improve water efficiency and water quality as immediate actions to adapt to climate change.

LESSONS LEARNED

- Investment in water resource management is a 'no regrets' adaptation strategy. It delivers important benefits to vulnerable populations today, while strengthening resilience to longer-term climate risks;
- Integrating water security into development plans and decision making processes enhances climate resilience;
- Finance and economic development ministries play a key role in cross-sectoral coordination;
- Economic arguments are needed to convince policy and decision makers on the benefits of adaptation;
- Recognising the relationship between climate change, water and development helps to build essential links between water and climate change strategies relevant for low-carbon development trajectories;
- Placing a regional perspective on adaptation has multiple benefits and allows stakeholders from countries sharing a river basin to take part and identify win-win opportunities for adaptation;
- The transboundary basin approach and integrated water management approach are essential for analyzing development trajectories considering various climate change scenarios.

FURTHER INFORMATION

Global Water Partnership: <http://www.gwp.org>.

CASE STUDY B-2.

RECENT POLICY AGREEMENT AND GUIDANCE ON WATER AND CLIMATE CHANGE

CONVENTION ON BIOLOGICAL DIVERSITY (CBD)

An extensive review of water, including in relation to climate change, in the context of policies and guidance provided by the Convention on Biological Diversity (CBD), was prepared for consideration of the fourteenth meeting of the SBSTTA. The science underpinning this process was derived from reviews of published assessments, including the conclusions of the IPCC regarding water, the report of the Second Ad Hoc Technical Expert Group (AHTEG) on biodiversity and climate change and national level experience.

RESULTS

- The findings of the IPCC Technical Paper on Climate Change and Water and the second AHTEG on biodiversity and climate change have recognized, in particular, that the relationship between climate change and freshwater resources is a matter of primary concern because climate change will severely impact water quality and availability;
- Water forges strong links between the interests of the multi-lateral environment agreements, including regarding climate change, desertification and wetlands, which are also critical for migratory species;
- An expanded monitoring and indicators framework has helped deliver greater awareness of the scope and relevance of the strategic plan in relation to water and climate change.

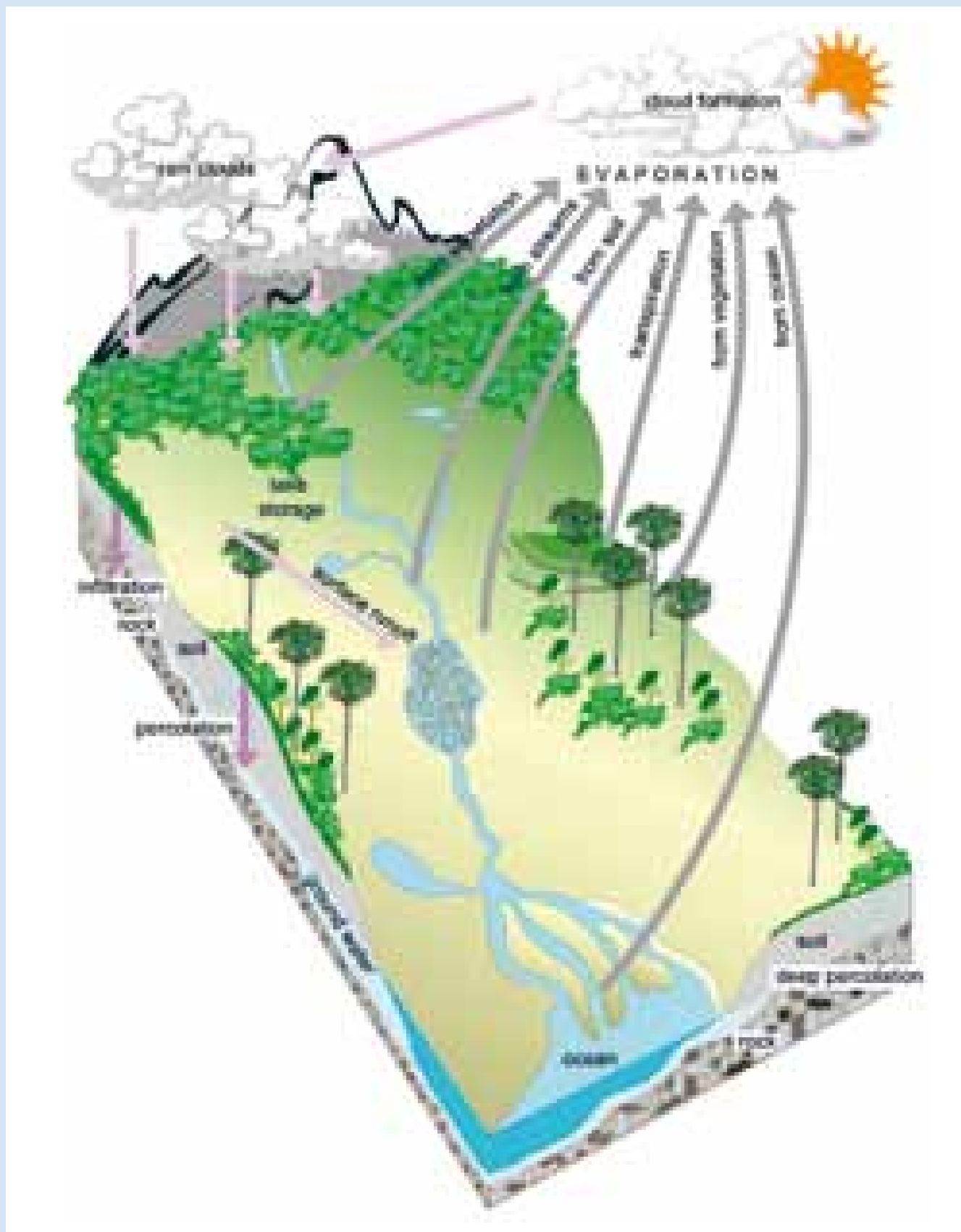
LESSONS LEARNED

- The carbon cycle and the water cycle (FIGURE B-5) are important large-scale bio-geological processes for life on Earth, which are broadly linked;
- Ecosystem-based adaptation approaches are key responses; examples include restoring wetland functions manage with flood risks and restoring land cover (e.g. forests or vegetation cover in farmlands) and soil functions to stabilize land and restore its water retention functions.

FURTHER INFORMATION

Convention on Biological Diversity: <http://www.cbd.int/>.

Figure B-5. The simplified water cycle.



Sources: The River Awareness Kit, Mekong River Commission.

CASE STUDY B-3.

CAPACITY DEVELOPMENT FOR POLICY MAKERS TO ADDRESS CLIMATE CHANGE

CENTRO DE ESTUDIOS EN CAMBIO CLIMÁTICO GLOBAL, INSTITUTO TORCUATO DI TELLA (CECG-ITDT)

The “Centro de Estudios en Cambio Climático Global, Instituto Torcuato Di Tella” (CECG-ITDT) is a research centre focused on global climate change, adaptation and mitigation, including the economics of climate change. ITDT is currently the Regional Centre of Excellence providing methodological training and technical education to Latin American and Caribbean countries in the framework of the UNDP global project “Capacity Development for Policy Makers to Address Climate Change”. The main objective of this project is to assess the investment and financial flows (I&FF) needed to address climate change in key sectors in developing countries, in order to be able to implement relevant adaptation and mitigation policies and measures.

RESULTS

- A Methodological Guidebook regarding I&FF assessment for adaptation in the Water Sector has been published;
- I&FF assessments have been completed in Costa Rica and The Dominican Republic;
- I&FF assessments are under way in other four countries (Chile, Honduras, Peru and St. Lucia).

LESSONS LEARNED

Some good practices have been identified, especially those resulting from an increased cooperation among ministries to define priorities and facilitate the provision of information. Three other achievements are highlighted:

- (1) Climate change planning is now being considered as part of the development agenda of many Latin American countries;
- (2) Institutional arrangements to address climate change are being strengthened or new ones are being developed (e.g. inter-ministerial committees);
- (3) National technical capacity to assess costs of adaptation options in the Water Sector has been enhanced.

FURTHER INFORMATION

<<http://www.undpcc.org/documents/p/806.aspx>>.

CASE STUDY B-4.

AFRICA ADAPTATION PROGRAMME

UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

The Africa Adaptation Programme (AAP) was launched in 2008 by UNDP, in partnership with United Nations Industrial Development Organization (UNIDO), UNICEF and the World Food Programme (WFP), with funding of US \$92 million from the government of Japan. The AAP is a strategic initiative to foster more informed climate change adaptation decision making and more effective implementation of those decisions in each of the 20 participating African Countries.

The first outcome of the AAP focuses on introducing dynamic, long-term planning mechanisms to manage the inherent uncertainties of climate change. AAP countries are carrying out a number of actions which relate to assessing and identifying vulnerability to water-related climate impacts. Additionally, the AAP supports adaptation practices, which reduce countries' vulnerability to water-related climate impacts such as water-borne illnesses, water shortages and reduced water quality, and thus build resilience to such shocks. Furthermore, the AAP is addressing obstacles to the management of water resources, which arise due to gaps in both infrastructure and governance.

RESULTS

- Assessments are underway to understand the risks and vulnerabilities of climate change on the water sector. For example, in Kenya, the AAP has identified the data needed to assess the implications of climate change on water availability;
- Several small-scale demonstrations have been implemented, which if proved to be successful, can be scaled up into broader-reaching policies: in the Democratic Republic of São Tomé and Príncipe, a pilot project is creating a medium-scale irrigation system with hydropower generation which will feed into one community;

- Institutional arrangements are improved: the formation of partnerships and stakeholder engagement in the management of water resources is encouraged within participating countries in order to bolster capacity building. In this regard, Morocco's AAP capacity development plan has formed partnerships with high schools and higher-level institutions such as the French Central Meteorological Office;
- Stakeholders are trained and educated on water management: the 'Use of Climate Model Scenarios for Water Resources Management' workshop is one example where 20 scientists from 10 countries in eastern and southern Africa received training on the utilization of regional climate modelling to assess the impacts of climate change on water resources.

LESSONS LEARNED

- Improved access to accurate climate data and information is crucial for ensuring that climate change adaptation projects reflect country-specific challenges;
- Comprehensive development strategies need to take gender into account when planning and implementing adaptation projects;
- Social inclusion must also be taken into account, especially that of vulnerable/marginalized communities and youth.

FURTHER INFORMATION

<http://www.undp-adaptation.org/africaprogramme/>.

CASE STUDY B-5.

MAINSTREAMING CLIMATE CHANGE AND ADAPTATION INTO INTEGRATED WATER RESOURCE MANAGEMENT: PANGANI RIVER BASIN

THE INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN)

The Pangani Basin Water Board (PBWB) is mainstreaming climate change into integrated water resource management in the Pangani River Basin to support the equitable provision of freshwater for the environment and for livelihoods for current and future generations. This initiative is part of the Pangani River Basin Management Project which is generating technical information and developing participatory forums to strengthen Integrated Water Resources Management (IWRM) in the Pangani River Basin. This includes mainstreaming climate change, to support the equitable provision and wise governance of freshwater for livelihoods and environment. The Pangani Basin Water Board (PBWB) is implementing the project with technical assistance from the International Union for Conservation of Nature (IUCN), Netherlands Development Organization (SNV) and the local NGO PAMOJA. The project is financially supported by the IUCN Water & Nature Initiative, the Government of Tanzania, the EU-ACP Water Facility, and the Global Environment Facility through UNDP.

The project promotes an increased understanding of the environmental, economic and social implications of different river flow scenarios under a range of climate change scenarios. This includes establishing a sustainable local system for collecting and analysing river flow assessment information over time. Community participation in adapting to climate change impacts through integrated water resource management has been strengthened through the establishment of sub-catchment and basin-level water user associations to integrate community, district, and regional-level concerns into basin-level planning. The objective of the project is to empower water users and managers in the Pangani Basin to manage and allocate water resources with consideration for climate change, environment and other technical information, through consultative processes and the sound framework of IWRM.

The Project has supported the PBWB in using the principles of IWRM, specifically in providing technical information to support the allocation of river flows; in strengthening water managers and water users to participate in IWRM activities; and subsequently in developing an IWRM plan. The Project has been structured into four main technical project components:

- Increasing understanding of environmental, economic and social implications of different river flow scenarios under expected climatic conditions and increasing capacity to collect and analyze such flow assessment information;
- Strengthening and empowering water users to participate in IWRM and climate change adaptation processes through dialogue and decentralised water governance;
- Promoting understanding of the water sector's vulnerability to climate change and generating lessons from pilot actions in adaptation;
- Coordination role of Basin Water Office with other sectors and stakeholders in the development of an IWRM plan.

RESULTS

- A climate study was completed to attain scientifically robust climate predictions for the Pangani Basin, and data from this study was incorporated into an integrated flow assessment;
- The integrated flow assessment was utilized to predict the implications of different water allocation scenarios, derived from 15 development policy options, on the environmental and socio-economic status of the basin;
- Climate change vulnerability assessments were conducted in the Basin to determine communities vulnerability to climate impacts and identify adaptation actions;
- Adaptation actions have been implemented to increase community adaptive capacity, including provision of alternative water sources, training and support for alternative income generating activities and strengthening of grassroots water governance institutions to manage water resources;

- Groundwater assessment was completed and will be used as part of a larger integrated water resource management and development (IWRM&D) plan for the Basin;
- Information from the integrated flow assessment will be used as a part of IWRM&D plan;
- Information from the project is being used to guide development of policy guidelines for formation of water user associations.

LESSONS LEARNED

The initiative is currently under evaluation to measure the impact of the interventions to date.

FURTHER INFORMATION

All technical reports from the flow assessment study are available at <http://www.iucn.org/water> and <http://www.panganibasin.com/>.





THE NAIROBI WORK PROGRAMME
CLIMATE CHANGE AND FRESHWATER RESOURCES

C. CASE STUDIES ON RAISING AWARENESS AND CAPACITY BUILDING

CASE STUDY C-1.

COMMUNITY-LED TOTAL SANITATION IN AFGHANISTAN AND SOUTHERN SUDAN

TEARFUND

Community-Led Total Sanitation (CLTS) has become a widely popular demand-led approach to improving access to safe sanitation, through raising awareness of the harm caused by open defecation. The goal of CLTS is to enable communities to decide and achieve their own sanitation solutions once they have become committed to improving their collective sanitation practices. Within Tearfund, all Disaster Management Team (DMT) country programmes are implementing CLTS to some extent, or are planning to implement the process.

RESULTS

- Tearfund's DMT Afghanistan has been particularly successful, with ten project communities having committed themselves to open defecation-free status in the first year of programming CLTS;
- Community members have come up with innovative designs and ideas, usually based on extensive use of local materials;
- Communities have been empowered to analyse and address their own priority issues without being dependent on external services;
- Guidelines have been drafted to assist Tearfund partners and DMTs in robust programming of CLTS, particularly in addressing the issues of environmentally and physically safe sanitation systems, and the issue of achieving safe sanitation systems equitably throughout a community following a CLTS campaign.

LESSONS LEARNED

- In the pre-triggering phase, the facilitating team should consider the risks of contamination of surface or groundwater sources according to prevailing geology, topography, drainage, and potential locations of latrines.³²
- If contamination of water supplies is deemed a risk, then the team should conduct the simple risk assessment procedure outlines in the Tearfund guidelines;
- In the post-triggering phase, the facilitating team should hold a community activity to consider locally available materials and building techniques.

FURTHER INFORMATION

Tearfund: <<http://www.tearfund.org>>.

³² Triggering is the process by which a collective sense of shock and disgust among community members regarding open defecation brings them to the point of agreeing and declaring that, as a community, open defecation will no longer be practised or tolerated.

CASE STUDY C-2.

ECO-CLUBS OPERATE WEATHER STATIONS

WORLD WIDE FUND FOR NATURE (WWF)

In 2008, the Langtang National Park and Buffer Zone Support Project established weather stations in Neelkantha Secondary School in Dhaibung, Bageswori Secondary School in Bhorely, and Shree Setibhumi Secondary School in Ramche of Rasuwa District in Nepal. Previous assessments showed that people lacked knowledge and information on climate change at the local level. The weather stations were installed with the aim of increasing the level of understanding of the hydrometeorological sector and to disseminate information on climate change in the local community. The Eco-Club associated with each school is responsible for operating the weather station by ensuring maximum student participation.

RESULTS

- Local weather conditions are monitored, recorded and stored;
- A mechanism is in place which ensures that local people are able to be well informed about maximum and minimum temperatures as well as humidity;
- The weather station helped students to enhance their technical and scientific knowledge;
- The entire community is involved;
- A nursery has been established, which will provide an additional funding stream for the weather stations, contributing to the sustainability of the programme.

LESSONS LEARNED

- Community participation has distinct benefit on raising awareness;
- The programme has created a platform for community members to share their personal experiences in terms of changed climate extremes.

FURTHER INFORMATION

WWF Nepal: <<http://www.wwfnepal.org/>>
and further information available at
<http://www.wwfnepal.org/media_information/publications/?200628/Climate-Change-Best-Practices>.

CASE STUDY C-3.

THE ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

WORLD METEOROLOGICAL ORGANIZATION (WMO) AND GLOBAL WATER PARTNERSHIP (GWP)

The Associated Programme on Flood Management (APFM) is a joint initiative of the World Meteorological Organization (WMO) and the Global Water Partnership (GWP). It promotes the concept of integrated flood management (IFM) with the aim of encouraging efficient use of floodplains and minimizing losses of life from flooding.

The APFM programme aims to combine the principles of integrated water resource management and flood management practices. It is designed to assist national and regional flood management institutions by providing access to synthesized knowledge and best practices, capacity building, advice on flood management, policy and strategy, and exchange of cross-regional experiences. To achieve this, the APFM created a Help Desk on IFM, a policy series on flood management, tools for integrated flood management³³, and capacity-building materials in flood management for trainers, teachers, students and children.

RESULTS

Since the launch of the Help Desk in June 2009, 50 requests from 33 countries have so far been received and dealt with in various ways depending on the level of the request. The Help Desk is supported by approximately 20 partner organizations including governments, academia and international bodies. Partners provide specific expertise in particular areas including the Asian Disaster Preparedness Centre, UNESCO-IHE, DHI, the Dundee Centre on Water Law and Policy, and many others.

A communication strategy has been drafted to provide guidance on how to contact the help desk, for what reason and what may be expected – and to increase visibility of the help desk at country and community level. The Help Desk provides a user friendly interface to get support on IFM and access to available materials.

A number of case studies based on the experiences of organizations active in flood management are in the process of being collected from various regions of the world. The main objectives in collecting these case studies are to:

- Identify the extent to which flood management has been carried out;
- Understand shortcomings in current flood management practices worldwide;
- Extract lessons learned and good practices in flood management; and
- Catalogue the policy changes and identification of institutional changes required to support integrated flood management.

The success of the programme has inspired the development of a related programme on integrated drought management. The aim of that programme is to alleviate poverty in drought-affected regions of the world through an integrated approach to drought management, cutting across sectoral, disciplinary and institutional jurisdictions. The programme intends to provide policy and management guidance through the globally coordinated generation of scientific information, sharing knowledge and best practices for drought risk management.

LESSONS LEARNED

- An extreme 'bottom-up' approach risks fragmentation rather than integration. It is important to analyze the strengths of both top-down and bottom-up approaches in determining the appropriate mix;
- A wide range of individuals, actions and agencies are involved in the successful implementation of disaster management strategies. They involve individuals, families and communities along with a cross-section of civil society such as research institutions, governments and voluntary organizations;
- A holistic approach to emergency planning and management is preferable to a hazard-specific approach, and integrated flood management should be part of a wider risk management system;

- Integration and institutional synergy are necessary to bring all the sectoral views and interests to the decision making process;
- Integrated flood management should encourage the participation of users, planners and policymakers at all levels. The approach should be open, transparent, inclusive and communicative; should require the decentralization of decision-making; and should include public consultation and the involvement of stakeholders in planning and implementation.

FURTHER INFORMATION

Integrated Flood Management Concept Paper.
Available at <http://apfm.info/pdf/concept_paper_e.pdf>.

³³ See <<http://www.floodmanagement.info/>>.

Image C-2.

Regional training of trainers' workshop: Integrated Approach to flash floods and flood risk management in the Hindu Kush-Himalayan Region. Kathmandu, Nepal. October-November 2010.



Sources: WMO.

CASE STUDY C-4.

ECOSYSTEM AND COMMUNITY-BASED CLIMATE CHANGE ADAPTATION TRAINING PACKAGE

WETLANDS INTERNATIONAL

Wetlands International has spearheaded the development of an Ecosystem and Community-based Climate Change Adaptation Training Package based on its experiences and the lessons learned in the Inner Niger Delta. A core component of the training package drew on the experiences of incorporating wetland management, resilient ecosystems and the wider upstream and downstream socio-economic impacts of infrastructure development into national and regional planning policies and projects. Contributing partners included WWF-US, Conservation International, Co-operative Programme on Water and Climate Change, Wageningen University, the African Institute of Capacity Development; and a host of other contributing organisations such as Oxfam America and IUCN were also involved in the development. The working draft was developed in 2010.

RESULTS

- An abridged version of the course has been developed and provided to high-level policy makers drawn from across the African continent;

- The high-level policy makers dialogue recognized the importance of strategic environmental assessments and more strategic, integrated approaches in climate change adaptation planning;
- A high-level communiqué has been issued, identifying and providing endorsement for the approaches of Wetlands International and partners and the need to integrate functional ecosystems into climate change and disaster risk reduction planning.

LESSONS LEARNED

- Full understanding of tools is pivotal to helping the current pool of trainers engage their own local communities at all levels, especially decision makers, on climate change adaptation;
- There is a need to dispel any misunderstanding surrounding the role of strategic environmental impact assessments and assumptions that they are only suited for and related to environmental projects.

FURTHER INFORMATION

Wetlands International: <http://www.wetlands.org/IND>.

Image C-3. Fisherman in the Inner Niger Delta.



Sources: Wetlands International.

CASE STUDY C-5.

UN-WATER THEMATIC PRIORITY AREA ON WATER AND CLIMATE CHANGE

UN WATER AND WORLD METEOROLOGICAL ORGANIZATION (WMO)

UN-Water's Thematic Priority Area on Water and Climate Change (WCC-TPA) was established in 2008 (initially called the Task Force on Water and Climate Change). The core objective of the WCC-TPA is to strengthen the coordination of UN System actions related to water and climate change in order to facilitate assessment by Member countries of the impacts of climate change on water and adoption of strategies for meeting the challenges of climate change, both for adaptation and mitigation in the related water subsectors. WMO acts as coordinator of the group.

The 28 members and 24 partners of UN-Water each deal with water in accordance with their own mandate and expertise. A strong, unique voice stems from UN-Water through its wide spectrum of member agencies, as all outcomes, statements and decisions are built on consensus, providing robust decisions backed by all involved.

RESULTS

- A climate change adaptation UN-Water policy brief has been completed, entitled "Climate Change Adaptation: The Pivotal Role of Water", which reflects the consensus of members and partners;
- A shorter document was developed through consensus, entitled "UN-Water Key messages on Climate and Water";
- Guidelines are in preparation for UN-Water members to help facilitate the implementation of water-related climate change adaptation projects in the Member countries.

- Actions of UN-Water members and partners related to water and climate change adaptation have been mapped in order to increase transparency among programmes and actions of UN-Water members. This activity was done in order to shed light on questions including: What are UN-Water actions related to water and climate change adaptation? Who is doing what, where and with whom? What are the possible overlaps, opportunities for cooperation and gaps regarding the actions of UN-Water members and partners, in their support of the development of Member States' climate change adaptation strategies?

FURTHER INFORMATION

Materials prepared by UN-Water.

Available at http://www.unwater.org/downloads/UNWclimatechange_EN.pdf and

http://www.unwater.org/downloads/unw_ccpol_web.pdf.



THE NAIROBI WORK PROGRAMME
CLIMATE CHANGE AND FRESHWATER RESOURCES

D. CASE STUDIES ON ADAPTIVE ACTIONS ON THE GROUND



CASE STUDY D-1.

IMPACT OF CLIMATE CHANGE AND VARIABILITY ON WATER RESOURCES IN WEST-AFRICAN WATERSHEDS

ENVIRONMENT AND DEVELOPMENT ACTION IN THE THIRD WORLD (ENDA)

ENDA's initiative in West-African watersheds has several components, including the study of the impact of climate change and the variability of water resources. This case study highlights the practical measures undertaken in the Senegal River Basin, which includes construction of physical structures such as a dykes and anti-salt dam bridges, and implementation of socio-economic activities targeting agriculture, agro-industry, livestock and fishing. Some protection and restoration of ecosystem included micro-credit programmes, regional health programmes and integrated water and environment projects, among other activities.

In February 2007 a 'writeshop' took place in Dakar, Senegal. NCAP initiated the writeshop, which was carried out in collaboration with UNESCO and Stockholm Environmental Institute, and led in Senegal by ENDA. 36 participants attended the writeshop from governments, research institutes and NGOs from 10 countries in West Africa. The agenda focused on adaptation measures required in response to climate variability and change for water management in West Africa.

RESULTS

- A better understanding of the role of climate change and variability on water resources was created;
- A better management of the water resources of the Senegal River Basin was established;
- Livelihoods in Senegal River Basin was improved;
- The Permanent Water Commission is established and the Senegal water charter was ratified;
- Relevant players are actively engaged in the programme;
- A robust and flexible institutional and legislative framework was founded.

LESSONS LEARNED

After 30 years of experience with the Senegal River Development Organization (OMVS), lessons have been learned that may improve the future management of this and other cross-border basins. Lessons learned include:

- There is a need to establish a robust and flexible institutional and legislative framework as well as strong expression of political will to do so;
- There is a need to control and integrate water management to minimize the risks associated with the increasingly variable rainfall in this region;
- There is a need to consider and construct structures to protect against the intrusion of salt water;
- There are tremendous benefits of adapting operating and management rules at the regional and international levels;
- There are distinct advantages of improved facilities for planning, management and interlinked monitoring (e.g. reservoir management programme, flood propagation programme, GIS and performance indicators);
- Surveys and research and development help improve knowledge of basin ecosystems.

FURTHER INFORMATION

The synthesis report of a 'writeshop' workshop is available at http://www.nicap.net/no_cache/news-single-view/article/17/18/.

CASE STUDY D-2.

GROUNDWATER MANAGEMENT IN INDIA – ADAPTIVE ACTION ON THE GROUND

FOOD AND AGRICULTURAL ORGANIZATION (FAO)

The Andhra Pradesh Farmer Managed Groundwater Systems (APFaMGS) initiative was implemented in the state of Andhra Pradesh in India, with technical support from FAO. Partner organizations in this effort included Bharati Integrated Rural Development Society (BIRDS – a nodal NGO) along with a number of partner NGOs. FAO supported this novel project for adapting groundwater use to changing aquifer conditions as monsoon rainfall patterns varied from year to year. This involved empowering farmers to monitor groundwater resources in their specific hydrological units in order to make informed choices about groundwater pumping over cropping seasons.

The APFaMGS initiative included analysis of a 900-farmer sample survey; and of pumping behavior of farmers as well as remote sensing of cropping patterns. Approximately 6,533 farmers were trained to collect data that are important for understanding the local aquifers (IMAGE D-4). Farmers donated the land for the installation of 191 rain gauges. Farmers recorded data from each of these rain gauge stations. At more than 2,119 observation wells, farmers carried out daily and fortnightly measurements of groundwater levels, and also conducted fortnightly measurements of pump well discharges in 1022 wells (IMAGE D-5). In all, more than 4,644 farmers (male and female) were voluntarily collecting data. Additionally, APFaMGS introduced crop water budgeting to complement the participatory hydrological monitoring, whereby the quantity of water required for the proposed post-monsoon (winter) planting was assessed at the aquifer level, and compared with the amount of groundwater actually available. The data are maintained in registers kept at the groundwater management committee offices and are also entered on village display boards.

RESULTS

- Assessments based on these diverse data indicate that more than 500 communities in different agro-economic settings across the project area have begun to bring their water use in line with groundwater availability, which includes a reduction in groundwater extractions in the years when the recharge is low. This project is the first global example of large-scale success in community management of groundwater use;
- The farmer water schools have delivered 19,974 graduates who are equipped with skills to train and guide other farmers. The APFaMGS approach engages the farmers in data collection and analysis, thereby building their understanding of the dynamics and status of groundwater in the local aquifers;
- An estimate of the aquifer budget gives the farmers an important element of information on the risk to their cropping systems, and provides this information in time, before the planting of post-monsoon crops (rabi crops in Adhra Pradesh, India);
- The main vehicle for education and capacity building in APFaMGS is the farmer water school, a meeting of around 25–30 farmers once every 15 days, with the learning process grounded in the farmers' own fields. The farmer water school employs multiple learning cycles, and trained farmers learn further by becoming farmer facilitators and instructors for the school in their respective habitations.

LESSONS LEARNED

- The data analysis has indicated that factors pertaining to the profitability of crops, availability of groundwater and knowledge of improved agricultural techniques are the primary determinants of project participation;
- The establishment of a strong community process is crucial as the project is rooted in a strong participatory, capacity-building, and gender equity approach. It is significant that 2,084 female farmer volunteers were engaged in data collection, and 837 of the 2,064 farmer facilitators are women. This reinforces the fact that adequate community involvement ensures the sustainability of community-based projects;

- The sustainable management of groundwater is feasible if users understand its occurrence, cycle and limited availability;
- The APFaMGS experience provides field evidence of the viability of community-led groundwater management in certain hydrogeological conditions in India.

FURTHER INFORMATION

FAO: <<http://www.fao.org>>.

Image D-4. A groundwater manager presenting groundwater recharge, draft and balance at the annual gathering of groundwater users.



Sources: FAO.

Image D-5. Trained women farmer showing fellow farmers the method of measuring static water level in a monitoring well.



Sources: FAO.

CASE STUDY D-3.

BUILDING RESILIENCE OF THE KALANGA COMMUNITY IN SWAZILAND

GLOBAL WATER PARTNERSHIP (GWP)

With the aim of building on lessons learned at the local level, the Swaziland Water Partnership targeted an area that was beset with water challenges, conflicts and recurrent droughts – the KaLanga Community, which lies on the outskirts of Swaziland's capital city, Mbabane. The 9,600 people of the KaLanga Community are supplied with water from the Makhondvolwane earth dam that was constructed by the Ministry of Agriculture in 1973 to supply water to a 100-hectare livestock farm.

The Swaziland Water Partnership saw the opportunity to address local needs as part of the national integrated water resource management programme. In 2007, the KaLanga demonstration project was initiated to secure water for the people of the KaLanga Community by integrating water into poverty reduction at a local level. Initial survey findings revealed a lack of awareness among the KaLanga Community regarding the need for improved water quality, even though the incidence of diarrhoeal diseases was high.

In implementing the project, the Swaziland Water Partnership mobilised partner organisations that include the Ministry of Health and Social Welfare, the Ministry of Agriculture and the Ministry of Natural Resources and Energy's Department of Water Affairs, as well as NGOs such as the Africa Cooperative Action Trust, Lilima, and the Swaziland Farmer Development Foundation. These partners carried out various capacity-building actions, which included training in conflict resolution, vegetable production, dam maintenance, sanitation and hygiene, protection and fencing of the dam, and construction of water harvesters and ventilation-improved pit toilets.

RESULTS

- Water-related diseases with potential risks to health have been reduced;
- Three boreholes and 108 homestead water harvesters have been installed; two livestock drinking troughs have been constructed; and 98 homestead toilets have been built;

- The real benefits of implementing integrated water resource management principles have been demonstrated for the coordination, equity, stakeholder participation and decentralized management of water resources;
- The need for government to translate policies into practice has been revealed; for instance through the development of guidelines for local level integrated water resource management interventions.

LESSONS LEARNED

- Embed water-related climate change adaptation into water resource management plans and do not treat climate change as a separate 'environmental' issue;
- It is essential to build the capacity of local institutions to address climate change adaptation as part of the water security agenda in the development planning and decision making processes, in line with national development priorities;
- Collaboration and partnering between institutions involved in water resources management and climate change is vital and efficient, to avoid duplication and fragmentation;
- Involving local area traditional authorities early in the process ensures project acceptance and ownership, and can help defuse community conflicts. It is important to build on local knowledge as well as existing institutions;
- Quick wins help in creating commitment and ownership;
- Consensus-building and decision-support systems are useful tools for conflict management, adaptation and should be widely applied. Decentralized participatory multi-stakeholder platforms are key instruments for conflict management and adaptation.

FURTHER INFORMATION

Global Water Partnership: <http://www.gwp.org>.

CASE STUDY D-4.

PARTICIPATION FOR DEALING WITH WATER IN BANGLADESH

PRACTICAL ACTION

The char lands of Bangladesh are precarious islands or embankments made from silt deposition on the country's network of rivers. They are created as the major rivers wind their course through the plain, depositing silt and sand on one bank and eroding it on the other. The char lands are therefore particularly flood prone. Yet, because of the heightened competition for land in Bangladesh, seven million of the poorest and most marginalized people are forced to live on these temporary locations, and are increasingly vulnerable as the rainfall becomes more intense, and glacial runoff in Nepal and Bhutan contributes to higher volumes of water passing through the delta.

Communities have developed strategies for living on the chars, but chronic poverty and isolation from support combine regularly with the water hazard, and productive livelihoods can become impossible as land is submerged under floodwater for up to two months at a time. However, as in all situations of vulnerability, those living within the situation have the most experience and greatest knowledge of their context and needs, and they will have ideas on potential solutions. In order to build on this knowledge, Practical Action worked with inhabitants of the char lands in the northern Gaibandha district, in order to improve livelihoods and help communities prepare for climate change. At participatory consultations, community members expressed their needs and worked towards two broad solutions – linking communities into support networks and developing appropriate technologies to maintain livelihoods through flood periods.

RESULTS

- Networks created among youth volunteers established a disaster warning and response mechanism and a climate change awareness campaign;

- The formation of an early warning committee linked the char inhabitants into higher-level disaster planning, and connected them to local officers for fisheries, agriculture and health, which paid off by the provision of training and tree plantation and digging of culverts;
- Communities also identified 11 technologies that would assist their livelihoods;
- Portable stoves are very cheap to produce and reduce fuel consumption and smoke emissions, yet can be easily moved during flood periods;
- Duck rearing provided communities with flood-resilient livelihoods (egg production for sale) which can be converted into a source of household protein during prolonged flooding;
- Raising the plinth on which houses are built enabled homes to stay above flood levels, but could not be made available for all due to cost;
- Steel fish cages, which enable households to cultivate fish on the river, were initially too expensive to produce in high volumes, but when the steel was replaced with locally sourced bamboo, many more households were able to adopt the technology.

LESSONS LEARNED

- Low to no-cost adaptation measures using local capacity, technology and resources are sustainable and help improve livelihoods;
- Local knowledge is useful in designing and implementing adaptation actions on the ground.

FURTHER INFORMATION

<<http://www.practicalaction.org/practical-action-bangladesh-1>>.

CASE STUDY D-5.

PARTICIPATION FOR DEALING WITH CONFLICT OVER WATER IN SUDAN

PRACTICAL ACTION

Where water is scarce, both its shortage and potential solutions can create or exacerbate existing conflicts. Not only does violence threaten the lives of those involved, but it also heightens the vulnerability to natural resource shortages, limits the ability to enact adaptation measures and stalls development. This was a problem in Northern Darfur, where technologies for making the most of the water available were at the centre of conflict between user-communities. When the system for sharing the local hafir (a reservoir for capturing and storing runoff water after the rainy season) between Um Zoar and Sakari villages was removed, issues over access, planning and ownership emerged between the two villages, and threatened to result in armed clashes. In Abu Digeis, a dam designed to capture water in the rainy season and disseminate it to the surrounding agricultural lands failed to reach a village at the edge of the flood area during a particularly dry year in 2009 and conflict arose.

In both cases, the village members were brought together to identify the underlying causes of their disagreements and come up with a joint solution. In Abu Digeis, the village on the outskirts was encouraged to settle for greater access to the resources at the dam. At the hafir, a negotiation and consensus-building committee was established and Sakari accepted that the management should remain in the hands of Um Zoar, while they would contribute to the digging.

RESULTS

In the local disputes in Northern Darfur, Practical Action has been able to bring together village members using Ajaweed, a traditional system for conflict resolution and build upon this to mediate in disputes using participatory consensus building. In doing so, it has prevented the problems from escalating and put in place mechanisms for better management of water.

LESSONS LEARNED

- As water becomes even more scarce in the areas reliant on rainwater, conflicts are likely to become more widespread here and in other semi-arid and arid areas;
- Participatory consensus building is a good approach to resolving problems, and if all stakeholders are engaged in a participatory manner in the planning for natural resource management, then conflict and violence may be avoidable.

FURTHER INFORMATION

<<http://practicalaction.org/practical-action-sudan-1>>.



CASE STUDY D-6.

COMMUNITY-BASED APPROACH TO CLIMATE RESILIENT IN INTERNATIONAL WATERS MANAGEMENT

GLOBAL ENVIRONMENTAL FACILITY (GEF) SMALL GRANTS PROGRAMME, UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

Communities reliant on transboundary water bodies for their livelihoods and wellbeing are particularly susceptible to the impacts of climate change and to other environmental threats, which are often exacerbated by a changing climate. International waters projects of Global Environment Facility Small Grants Programme (GEF-SGP, implemented by UNDP) typically support techniques which prevent or reduce transboundary water pollution, sustainably manage coastal habitats, enhance water utilization efficiency, or promote integrated water resource management or integrated coastal management on a small scale, aspiring to make change at the regional or community level. Many of these projects have also reduced vulnerability and increased ecosystem resilience. These international waters projects incorporate interventions that increase resilience to the adverse impacts expected from climate change on vulnerable countries, sectors and communities.

RESULTS

Communities' capacities have been enhanced to manage international waters resources sustainably, with increased community and ecosystem resilience to climate change. In Thailand, for example, the SGP supported reforestation in Se Buy Basin of the Mood River area, Mekong River (IMAGE D-6), where reforestation actions and the planting of native species have served to increase ecosystem resilience. While the project successfully addressed these threats to international waters, the actions also serve to help the community to adapt to climate risks.

Innovative community-based technologies, methodologies and approaches have been piloted, demonstrated and scaled up. In Iran, a model of innovative artificial coral reef pyramid was designed using traditional and local knowledge and techniques, with the full participation of local fishermen in project design, implementation and maintenance. This has contributed to the rehabilitation of fishing grounds, increasing fishing productivity. This project was later scaled up by the government, and was the finalist for UNDP Administrator's Innovated Award.

Regional networking of communities and NGOs around shared water bodies has delivered effective international waters management. For example, in the South China Sea, a regional NGO forum was formed with participation from civil society and community leaders, in parallel with the Regional Scientific Conference and the Mayors' Roundtable, which brought government officials, scientists and civil society leaders together for enhanced collaboration in managing the shared waters.

LESSONS LEARNED

- Community participation and knowledge is key to achieving climate-resilient impact: as demonstrated by SGP-supported projects in places such as Iran and Ecuador, and local communities play key roles in increasing resilience to climate risks;
- Capacity building is an essential component of achieving effective climate resilience and an important component of successful ecosystem-based adaptation that leads to social, economic and environmental benefits. Capacity building and the provision of important data also helps communities to continue the project long after external intervention has been discontinued;
- Climatic variability and climate change have an effect on all aspects of development, thus adaptive management actions play an important role in improving livelihoods: SGP projects in Lake Jipe, the Nile River and other lakes and inland seas show how climate change can simultaneously affect these areas by undermining development progress and leaving communities vulnerable;
- Cooperation in the management of transboundary waters is essential for successful adaptation to climate change: whether located in Lake Jipe, which is situated between two countries, or whether on the Nile, which travels through ten countries, community-based adaptive management actions should take into account communities upstream and downstream that may be impacted by their actions, as well as incorporate the knowledge and contribution of other communities that share the same ecosystem and are subject to the same climate vulnerability and threats;

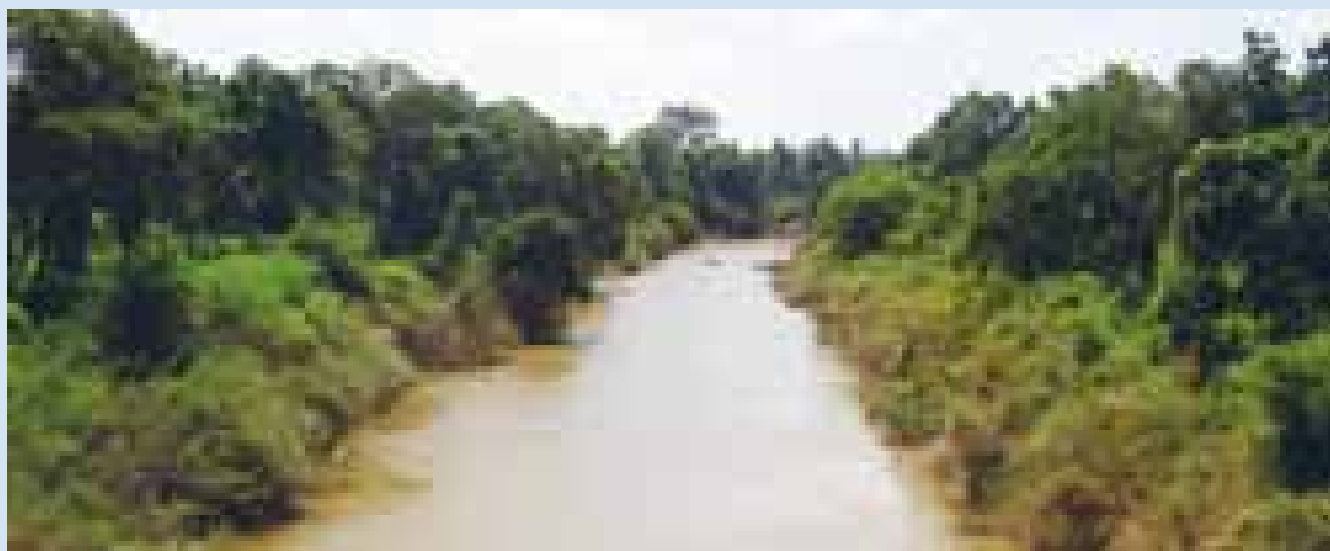
- Integration of climate risks into international and national water management policy is key: integrating climate change adaptation into national and international development and policy agendas influences the way resources are allocated and utilized, and allows climate change considerations to be included in all aspects of development at the local level.

FURTHER INFORMATION

http://www.thegef.org/gef/sites/thegef.org/files/publication/SGPIW_Report_CRA-lo.pdf.

Image D-6.

Se Buy Basin, Thailand.



Sources: UNDP.

CASE STUDY D-7.

COMMUNITY WATER INITIATIVE: ENSURING WATER SECURITY WHILE ADAPTING TO CLIMATE CHANGE

UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

The Community Water Initiative (CWI) was launched by UNDP to support the achievement of the Millennium Development goals. It receives financial support from Swedish International Development Cooperation Agency (SIDA), the governments of Luxembourg and Norway and other donors. The programme is implemented through UNDP's Global Environment Facility Small Grants Programme (SGP). Since 2004, CWI has provided more than US \$2.6 million in funding through 148 projects (up to US \$25,000 per project) in ten countries, bringing water supply and sanitation services to more than 370,000 people directly. The goal of the programme is to foster water security for local populations and the environment in a carbon-neutral and climate-resilient manner. The CWI programme also joins SGP efforts on environmental protection, which contribute to ecosystem and community resilience, and their capacity to adapt to climate change.

Image D-7. Environmental protection project in Tanzania.



Sources: UNDP.

RESULTS

- CWI projects have helped to foster water security by utilizing innovative technologies and local resources to develop water management systems that meet local needs and build capacity to cope with climate variability and change. This has been done by creating water storage facilities, which improve water quality and foster water management capacities. For example, in Moshi, Tanzania, a new waste water recycling facility has created a new source of irrigation water to buffer against declining water availability and climate change, which has doubled local crop production, reduced poverty and eliminated conflict over limited water supplies. In Sri Lanka, the use of bioremediation, by planting tree crops around public wells and gardens in the Kalpitiya Peninsula, reduced nitrate contamination in groundwater by nearly 80 per cent in four years, thereby creating safe water supplies and enhancing food and income generation under the threat of increasingly erratic rainfall and tropical storms.
- All CWI projects are community-based with technically, locally and culturally appropriate strategies and techniques.
- The provision of safe and reliable water resources has resulted in healthier people who are able to devote more time to other actions, such as income generation and education, and has provided the basis for economic growth (agricultural, trade, industrial, etc.).
- The participation of local people in CWI projects has also increased their technical, managerial and collaborative capacities, as well as fostered their involvement in other natural resource management projects. For instance, in Hadiya, Niger, a new well provided a local water supply that reduced the hauling time required by women and children (7–14km per day). This has allowed women to plant and sell seedlings for non-timber forest production, manage water contracts with local nomads and participate in the rehabilitation of a communal grazing area.
- Six international award-winning projects have been widely recognized and promoted globally through the SGP network and award organizations. A report on water and climate change incorporating ten case studies was launched during the World Water Day of 2010. CWI is nested with the GEF SGP framework,

and takes on a local community-driven approach with a global network to disseminate knowledge and experiences. CWI has succeeded in enhancing climate resilience through its local water initiatives.

LESSONS LEARNED

- The involvement of community leaders and members is essential for fostering local ownership that will help ensure the implementation and continuation of the project. For example, the Hadiya Village CWI project, in Niger, helped to catalyse additional funding from the GEF-SGP and Lutheran World Relief to continue land reclamation efforts and develop income-generating actions for women related to ground-nut production, oil extraction and trading. Additional income generated from related actions helps to ensure the ability of local communities to continue their investment in water and other development actions.
- Indigenous knowledge needs to be incorporated whenever possible. Traditional techniques for well drilling or acquiring the assistance of local spiritual

leaders on where to site wells is extremely beneficial. For example, in the Zukpuri traditional area in Ghana, knowledge of spiritual leaders was used to locate well sites. This promoted a collaborative process that was able to rise above local tensions.

- The strength of many CWI projects is their transferability. They provide valuable examples and experiences for other communities. Project members from the Zukpuri traditional area in Ghana have used their training to construct more than 30 wells for the 16 communities in the Upper West Region, providing more than 26,000 people with access to safe supplies of water.

FURTHER INFORMATION

UNDP. 2010. UNDP Community Water Initiative: *Fostering Water Security and Climate Change Adaptation and Mitigation*. Available at <http://sgp.undp.org/downloads/CWI%20-%20Local%20Adaptation%20to%20Climate%20Change%20Knutson%2015%20April%202010.pdf>.

Image D-8. Water Project in Mauritania.



Sources: UNDP.

CASE STUDY D-8.

PROGRAMME OF PILOT PROJECTS ON ADAPTATION TO CLIMATE CHANGE IN TRANSBOUNDARY BASINS UNDER THE UNECE WATER CONVENTION

UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE (UNECE)

The programme of pilot projects on adaptation to climate change in transboundary basins under the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) aims to support countries in their efforts to develop adaptation strategies and measures in transboundary basins. It also aims to create positive examples demonstrating the benefits of and possible mechanisms for transboundary cooperation in adaptation planning and implementation. Finally, it supports implementation of the UNECE Guidance on Water and Adaptation to Climate Change and provides a forum for exchange of experience, good practices and lessons learned regarding adaptation projects. The programme was started in 2010. The pilot projects mainly focus on developing adaptation strategies, which create a basis for further action and only to a very limited extent, on the funding and implementation of the relevant measures. Depending on local needs and other existing projects, the programme of pilot projects focused on different expected impacts of climate change and climate variability such as increased floods, water scarcity or droughts.

The programme includes different types of pilot projects. A limited number of pilot projects are directly supported by the Water Convention in the framework of the Environment and Security Initiative (ENVSEC) in cooperation with other ENVSEC partner organizations such as UNDP, UNEP and OSCE; as well as local partners. Also included in the programmes are a number of projects that are already ongoing and several initiatives focusing on climate change adaptation in transboundary basins that have their own implementing framework. Some examples are:

- Pilot project on the Chu Talas Basin in Central Asia, shared by Kazakhstan and Kyrgyzstan;
- Pilot project on the Dniester Basin in Eastern Europe, shared by the Republic of Moldova and Ukraine;
- Pilot project on the Sava River Basin in South-Eastern Europe, shared by Bosnia and Herzegovina, Croatia, Serbia and Slovenia;
- Pilot project on the Neman River Basin in Eastern Europe, shared by Belarus, Lithuania and the Russian Federation;
- Activities regarding water and climate change adaptation in the Rhine Basin, implemented by the International Commission for the Protection of the Rhine;
- Project AMICE on the Meuse Basin, shared by Belgium, France, Germany, Luxembourg and the Netherlands, implemented by 17 partner organizations, lead by the Etablissement Public de l'Aménagement de la Meuse (EPAMA);
- Project 'Dauria going dry' on the Amur/Argun/Daursky Biosphere reserve, shared by the Russian Federation, Mongolia and China, implemented by WWF Russia and Daursky Biosphere; and
- Activities on water and climate change on the Danube River Basin, implemented by the International Commission for the Protection of the Danube River (ICPDR).

RESULTS

- Ukraine and the Republic of Moldova have prepared a detailed proposal on how to jointly assess and address the impacts of climate change, especially floods, in the Dniester Basin (joint implementation to start in 2011);

- After a long absence of multilateral cooperation on the Neman River Basin, experts from Lithuania, Belarus and the Russian Federation have started to cooperate again and to discuss joint river basin management under climate change conditions. They realized that all countries had prepared some climate change impact assessments for their parts of the basin, but using different methods and models that led to diverging results. These assessments will serve as the basis for discussing joint actions in the future;
- Riparian countries of the Rhine formed an expert group for climate change and applied a common multi-model methodology for the entire Rhine catchment in order to assess the future impacts of climate change.
- Technical issues, particularly those relating to climate change impact assessment, are better discussed at the expert level, especially in contentious transboundary basins. But, the political level needs to be involved as well in order to ensure ownership and acceptance of the project results;
- In general it is better to perform joint modelling and to develop joint scenarios for transboundary basins. But, in some cases if all participating countries have already completed their modelling, it may be preferable to compare the model results and, if necessary, harmonize them at the border.

LESSONS LEARNED

After just under a year of implementation the first lessons learned include the following:

- Often, many more actions on water and climate change have already been conducted in the basins than expected. Therefore, it is important to start the project with a thorough baseline study and to establish links with numerous relevant actors such as local and national authorities, academia, NGOs, relevant business and international organizations;

FURTHER INFORMATION

UNECE: <http://www.unece.org/env/water>.

Project details are available at

http://www.unece.org/env/water/water_climate_activ.htm and at <http://www1.unece.org/ehlm/platform/display/ClimateChange/Welcome>.

UNECE. 2009. *Guidance on Water and Adaptation to Climate Change*.

Available at http://www.unece.org/env/water/publications/documents/Guidance_water_climate.pdf.

Image D-9.

Dniester wetlands.



Sources: UNECE.

CASE STUDY D-9.

CLIMATE CHANGE ADAPTATIONS IN THE WATER SECTOR IN EGYPT

WORLD METEOROLOGICAL ORGANIZATION (WMO)

The Ministry of Water Resources and Irrigation in Egypt requested WMO to assist national experts in undertaking scientific studies for the assessment of climate variability and change impacts on the availability of water resources. Within its initiative on climate change adaptation, and in collaboration with the Nile Sector of the Ministry of Water Resources and Irrigation in Egypt, WMO organized a national workshop to launch the pilot project on climate change adaptation in the water sector in Egypt in May 2008.

The Ministry of Water Resources and Irrigation planned to undertake this project in collaboration with WMO due to the urgent need for adaptation in the water sector and to provide necessary input to all sectors dealing with water issues. The specific objectives of this project are:

- Create a national environment to facilitate the use of climate information in water resource planning, the operation of water infrastructures and in disaster management;
- Carry out scientific assessments of the impacts of climate change on water resources and build awareness;
- Assess the impacts of climate change on existing or proposed water system operation rules, system design and sizing, policies and water use strategies;
- Develop knowledge through applied research in water management issues related to climate predictions, variability and change, and thereby contribute towards sustainable development by evolving adaptation strategies for planning and operation of water resources infrastructure and disaster management.

RESULTS

- The main outcome of the project is the enhanced cooperation among various stakeholders within the country including ministries, governorates, water boards, universities/institutes and local communities to consider climate risks in water resource planning, management and operations and to develop adaptive measures and policy options;
- The completion of a scientific assessment of climate variability and change on availability and quality of water, along with the assessment of demand under climate change scenarios has helped water managers to incorporate the results in the mid-term review of NWP 2017 and the formulation of future NWP.

LESSONS LEARNED

The impacts of climate change on agriculture, energy, disaster management, recreation sector (tourism) and ecosystems are manifested largely through water availability and its quality. Scientific assessment of climate change therefore forms an essential input in adaptation strategies in other sectors.

FURTHER INFORMATION

World Meteorological Organization:
<<http://www.wmo.int>>.





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For further information see <www.unfccc.int/adaptation>

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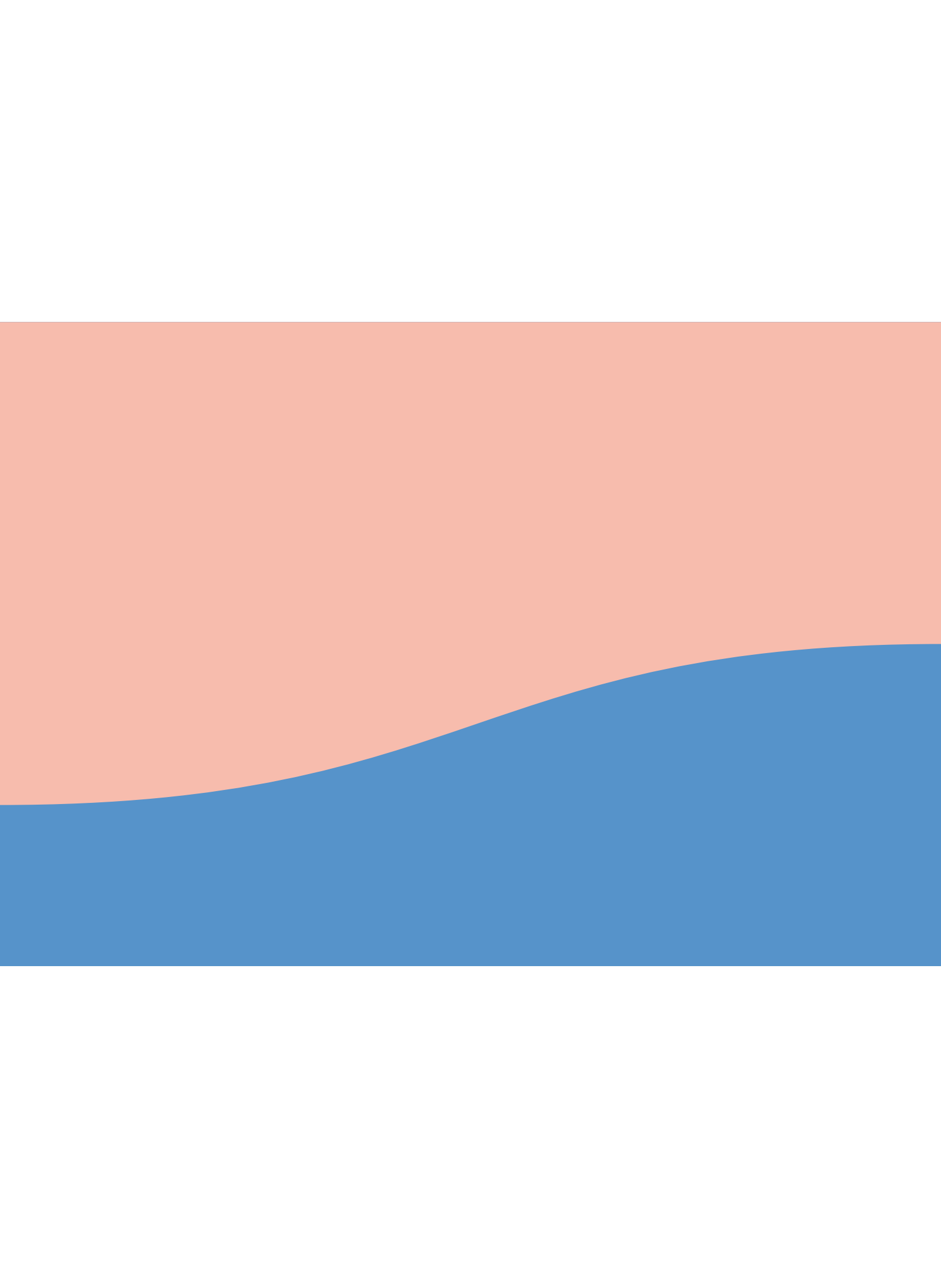
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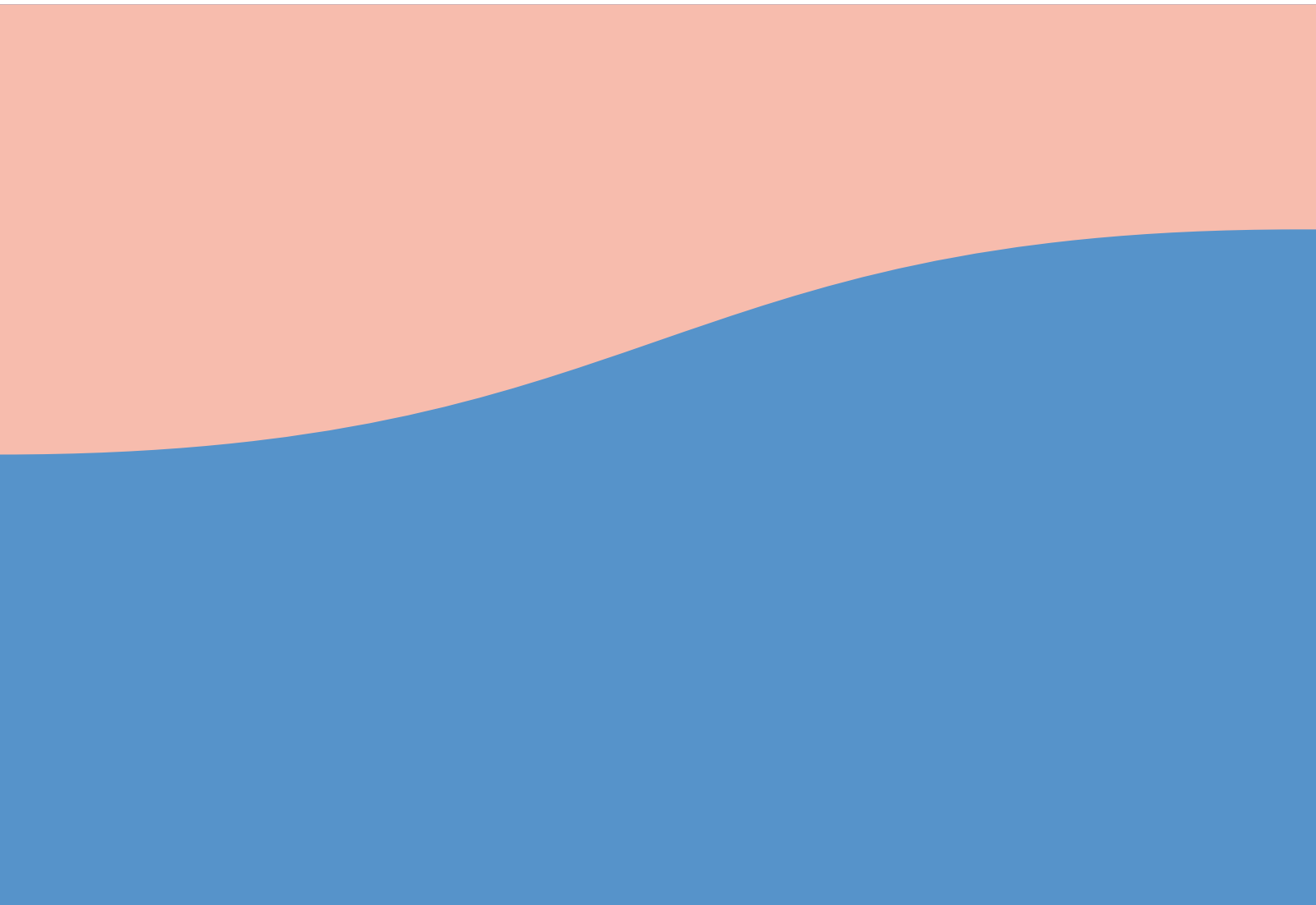
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