IFAD's response to climate change through support to adaptation and related actions

Comprehensive report: Final version

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DONORS AND INVESTORS: UK DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID), TETRA PAK UK, THE CARBON NEUTRAL COMPANY, INASP, KATOOMBA GROUP, AMONG OTHERS 10

ENVIRONMENTAL CONSERVATION TRUST OF UGANDA (ECORUST): PROVIDES ADMINISTRATION AND FARMER TECHNICAL SUPPORT, SERVES AS TRUST FUND, CONDUCTS MONITORING ACTIVITIES, NEGOTIATES CARBON SALES AND REPORTS TO THE PLAN VIVO FOUNDATION. 10

THE PLAN VIVO FOUNDATION: REGISTERS AND CERTIFIES THE PROJECTS, ISSUES CARBON OFFSETS CERTIFICATES (PLAN VIVO CERTIFICATES), APPROVES THIRD-PARTY VERIFIERS, AND PERFORMS CONTINUOUS REVIEW OF PROJECTS. 10

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Foreword

The International Fund for Agricultural Development (IFAD) is an international financial institution and a specialized United Nations agency dedicated to eradicating rural poverty in developing countries. Working with poor rural people, governments, donors, non-governmental organizations (NGOs) and many other partners, IFAD focuses on country-specific solutions to empower poor rural women and men to achieve higher incomes and improved food security.

One of the challenges IFAD faces in agricultural and rural development work is the change brought about by global warming. Climate change in different agro-ecological zones means that farmers have to deal with a new range of uncertainties (i.e. rainfall and seasonal distribution, change of growing seasons, unavailability of water, droughts, floods, etc.) in addition to their everyday burden. This ongoing trend will put existing water, land and agricultural resources under significant pressure. These will increase existing vulnerability and may create new ones. IFAD, with a mandate of rural poverty reduction, must have a role, on its own and in association with others, to respond to climate change (adaptation and mitigation) from the perspectives of the poor rural people.

The project "Strengthening IFAD's capacity to mainstream climate change adaptation in its operations" has been implemented since 2008. This study seeks to strengthen IFAD's knowledge on areas of support most relevant in addressing climate change, in order to highlight any gaps in IFAD's response, and to develop strategic recommendations that build on the organization's comparative advantage. The work done so far capitalises on existing knowledge outside and within IFAD. The range of actions that either deliberately or fortuitously is contributing to strengthening IFAD's response to climate change is quite broad, as this report evidences.

This report is the result of a collaborative effort[1]. It has been compiled from an extensive desk review, findings from participation in international conferences and relevant forums, a number of interviews conducted through a focused questionnaire, and five field visits to develop detailed case studies and verify issues raised in project documents with evidence from the field. It is hoped that the findings will help build in-house capacity on the potential effects of specific adaptation and mitigation measures have on livelihoods of the rural poor. The lessons learned will contribute to enhancing integration of climate related issues both at strategic and project levels. A summary of this study has been published and translated in various languages for better diffusion in the different regions.

IFAD is committed to working closely with all its partners to reducing vulnerability of the rural poor, whose livelihoods are being impacted now. We can see a way forward that leads to rural economic growth and poverty reduction; the urgency is that we must act now.

[1] This study was carried out and the report written by Penny Urquhart, freelance sustainable development consultant, under the overall supervision of Sheila Mwanundu, Senior Technical Advisor, and with direct guidance from Ilaria Firmian, Associate Technical Advisor, of the Environment and Natural Resource Management Desk, IFAD Technical Advisory Division. Elisa Distefano, Consultant, wrote five case studies in Annex 5. Many thanks are due to them, as well as to Katiuscia Fara, Consultant, for her inputs and for providing the summary for section 3 of this report, to the IFAD Policy Reference Group on Climate Change and the Global Environment and Climate Change Unit, for their efforts in reviewing the document many times, and to Maria-Elena Mangiafico, Programme Assistant, for all her support. Many country programme managers, IFAD project and support staff, and partners from other organizations shared their time with generosity, and engaged in this exercise with open spirit, providing thoughtful and frank responses. Particular thanks are due to all the community members, government partners and IFAD project staff who gave so generously of their time in the Sudan; and to Rasha Omar, IFAD Country Programme Manager for the Sudan, for enabling the project visits in that country.

Acronyms

AfDB	African Development Bank
AIACC	Assessments of Impacts and Adaptations to Climate Change (UNEP/START/Third World Academy of Sciences (TWAS))
AsDB	Asian Development Bank
CBO	community-based organization
CDM	Clean Development Mechanism (of the Kyoto Protocol)
CGIAR	Consultative Group on International Agricultural Research
COSOP	country strategic opportunities programme/paper
CPM	country programme manager
DFID	Department for International Development (United Kingdom of Great Britain and Northern Ireland)
ECCM	Edinburgh Centre for Carbon Management
ESA	environmental and social assessment
ESIA	environmental and social impact assessment
ESRN	Environmental and Social Review Note
FAO	Food and Agriculture Organization of the United Nations
GECC	Global Environment and Climate Change
GEF	Global Environment Facility
GHG	greenhouse gas
GIS	geographic information system
GPS	global positioning system
GRTU	Gash River Training Unit
GTZ	German Agency for Technical Cooperation
ICBA	International Center for Biosaline Agriculture
ICRAF	World Agroforestry Centre
IDPs	internally displaced people
IEE	Independent External Evaluation
IFPRI	International Food Policy Research Institute
IISD	International Institute for Sustainable Development
IMI	Innovation Mainstreaming Initiative
IPs	indigenous peoples
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LDC	least developed country
LULUCF	land use, land-use change and forestry
MDG	Millennium Development Goal
MENR	Ministry of Environment and Natural Resources (Sri Lanka)
NAPA	national adaptation programme of action
NORAD	Norwegian Agency for Development Cooperation
NRM	natural resource management
NTFP	non-timber forest product
NWP	Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change (UNFCCC)
OECD	Organisation for Economic Co-operation and Development
PES	payment for ecosystem services
PIVs	5-hectare irrigated plots (*périmètres irrigués villageois)*
PPMs	hedges planted around market gardens (*petits périmètres maraîchers*)
PRA	participatory rural appraisal
PRESA	Programme for Pro-poor Rewards for Environmental Services in Africa (ICRAF)
PRSP	poverty reduction strategy process
REDD	reducing emissions from deforestation and forest degradation
RTT	rural roads, travel and transport
RUPES-I	Programme for Developing Mechanisms to Reward the Upland Poor of Asia for the Environment Services They Provide
RUPES-II	Programme on Rewards for, Use of and Shared Investment in Pro-poor Environmental Services
SBSTA	Subsidiary Body for Scientific and Technological Advice (UNFCCC)
SDC	Swiss Agency for Development and Cooperation
SEI	Swiss Foundation for Development and International Cooperation
SESA	strategic environmental and social assessment
SLA	sustainable livelihoods approach
START	Global Change **S**ys**T**em for **A**nalysis, **R**esearch and **T**raining
SWC	soil and water conservation
TAG	technical assistance grant
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
USAID	United States Agency for International Development
VARG	Vulnerability and Adaptation Resource Group
WFP	World Food Programme

1. Introduction

1.1 Background

There is international consensus that climate change is one of the most serious threats to sustainable development, both currently and in the future. Adverse impacts of climate change have already been observed on natural resources, food security, human health, the environment, economic activity and physical infrastructures (IISD 2007). Projections of future impacts are sobering: for example, by 2020, almost 50 million additional people may be at greater risk of hunger due to climate change. If a global temperature increase of 3-4°C is reached, changed run-off patterns and glacial melt could force an additional 1.8 billion people to live in a water-scarce environment by 2080 (UNDP 2007). Climate change is likely to worsen existing inequalities between women and men (Raworth 2008). In the increasingly interconnected world of today, a range of macro issues and stresses combine in a complex fashion with the expected impacts of climate change to augment these risks. These include the global financial crisis, recent rises in food prices and the uncertainty of fuel prices (Båge 2008).[2] Africa, one of the regions most vulnerable to climate change (box 1), will be hard hit by these external shocks, with nearly one third of the newly poor being in Africa, the region most severely affected by the current rise in food prices.[3]

Box 1. Regions and sectors most vulnerable to climate change

- Most vulnerable regions: Africa, Asian mega-deltas, small islands, the Arctic.
- Most vulnerable sectors: water in the dry tropics; agriculture in low latitudes; human health in poor countries; areas where activities depend on sensitive ecosystems, especially tundra, boreal zones, mountains; and ecosystems already stressed, such as mangroves and coral reefs.
- In all countries, even those with high incomes, some are especially at risk: poor people, young children, the elderly, the marginalized (IPCC 2007a).

As the 2007 report of the Intergovernmental Panel on Climate Change (IPCC 2007a) clarified, warming of the climate system is unequivocal and accelerating, and a certain amount of change in the climate is inevitable. This means that both mitigation and adaptation actions are essential. 'Adaptation' to climate change is the ability to respond and adjust to the actual or potential impacts of changing conditions in order to reduce harm or exploit opportunities. 'Mitigation' refers to actions to reduce greenhouse gas (GHG) emissions and enhance sinks for GHGs.

Over the past 30 years, IFAD has worked to help poor rural people in marginal or unfavourable agroecological conditions manage their natural resources more sustainably, increase their agricultural productivity and reduce their vulnerability to climatic shocks. Much of this work has been conducted under conditions of change – rising population densities, deteriorating natural resources, and increasingly uncertain and unpredictable climatic conditions (IFAD 2008a). In recent years, climate change has become a strategic priority for IFAD. The challenge for the Fund, as for other IFIs and development agencies, is that of finding ways to build in-house capacity on climate change issues and effectively mainstream adaptation[4] to climate change within its operations, in order to enhance the effectiveness of the activities it supports and strengthen the adaptive capacity of poor rural communities. One initiative designed to do this, and which is supported under the

[2] The World Bank has calculated that food price increases may swell the ranks of the world's poor by 100 million people.

[3] Of the 34 countries in crisis due to food price increases, 21 are in sub-Saharan Africa.

[4] 'Mainstreaming of adaptation' is defined as the effective and equitable integration of adaptation activities into the preparation and implementation of policies, plans and other activities focusing on promoting sustainable development, social progress and environmental protection (adapted from AsDB 2005).

Innovation Mainstreaming Initiative (IMI), is entitled Strengthening IFAD's Capacity to Mainstream Climate Change Adaptation in its Operations. This initiative has a number of components: reviewing other development agencies' experiences in mainstreaming climate change adaptation in their operations; conducting a portfolio review to learn more about how projects have dealt with climate change issues; organizing seminars and learning events; and developing design guidelines, methodologies and learning notes for mainstreaming adaptation measures.

1.2 Purpose of this report

This report documents a study carried out under the initiative just cited. The purpose of the study was to explore and analyse the range of actions supported by IFAD that either deliberately, or unintentionally but fortuitously, contribute to strengthening responses to climate change. The study identified lessons that can be used to enhance the mainstreaming of adaptation in IFAD operations, both centrally and at the project level. While the primary focus was on climate change adaptation, efforts in support of mitigation were also included. The objectives of the present report are to:

- Provide a comprehensive record of climate-change adaptation strategies relevant to IFAD's mandate, based on the experience of IFAD and selected partners and on priority issues from existing key reports, such as those of the IPCC;
- Highlight the range of activities in IFAD's portfolio related to climate change and analyse the actions being supported that either directly or indirectly support adaptation, and to a lesser extent mitigation; and
- Make recommendations on strategic options for mainstreaming in order to enhance IFAD's role in supporting responses to climate change – based on lessons learned from IFAD's own operations and the experience of other development agencies.

1.3 Approach and methodology

Given the pro-poor focus of IFAD, the review adopted the comprehensive view of adaptation set out in Eriksen et al. (2007), which stresses the need to incorporate considerations of both climate change and vulnerability to climate change into development activities, in order to address both vulnerability and poverty reduction. This leads to what these authors term *sustainable adaptation measures* (Eriksen et al. 2007, 3). This approach takes cognizance of the fact that failure to target poor people's adaptive capacity, processes that contribute to the vulnerability of poor people, and climate risks, through adaptation measures, can lead to development projects that increase vulnerability. This conceptual approach is consistent with links established by IFAD between climate change, poverty and vulnerability – for example, in the *IFAD Strategic Framework 2007-2010* (IFAD 2007a). The study looked for evidence of three ways in which development activities targeting poor people could support adaptation, even if project design had not specifically included climate change:

- Reducing climate risks to projects;
- Strengthening participants' coping and adaptive capacity in the face of short-term climate variability and long-term climate change;
- Targeting the causes of vulnerability to climate variability and climate change.[5]

The study included activities that promote adaptation to climate change and to climate variability. As Klein (2001) points out, while the mandate of the Global Environment Facility (GEF) requires it to make a distinction between adaptation to future, scenario-based climate change and adaptation to today's climate variability, both types of adaptation are very similar by nature and they can mutually reinforce each other. If one accepts that human-induced climate change is already taking place, the

[5] This is the categorization used by Eriksen et al. (2007).

distinction between the two types of adaptation becomes highly theoretical (Klein 2001). The understanding of adaptation in this report encompasses both autonomous and planned adaptation.[6]

The approach to the study was also consistent with the sustainable livelihoods approach (SLA), which seeks to understand the multiple risks and stresses impacting the various assets or capital of rural people and the differentiated and shifting ways in which they compose their livelihoods in response to this. In such an approach, it is important to recognize that climate is only one stress in a complex environment. Thus analyses and interventions need to consider the multifaceted nature of vulnerability.

The *methodology* of the study consisted of the following elements:

- Desk review of existing documentation, including policy papers, country strategic opportunities programmes/papers (COSOPs), relevant evaluations and selected loan and grant documents;
- Selection of a set of countries and specific projects for detailed exploration of adaptation-related actions, development of a focused questionnaire, and phone and e-mail interviews with country programme managers (CPMs) and relevant project staff or partners in order to update, further explore and validate information contained in the available documentation;
- Field visits to two programmes in the Sudan to develop detailed case studies and verify issues raised in project documents with evidence from the field, as well as to better understand the real constraints faced by country teams and operations staff on the ground;
- Integration of a number of case studies carried out in a separate consultancy – IFAD case studies from Brazil, Eritrea, Kenya and Mongolia; and the Plan Vivo case study from Uganda – as well as information from a field visit to Burkina Faso;
- Integration of findings from participation in international conferences and relevant forums;
- Analysis and synthesis of data gathered through the above steps to identify those areas of support most relevant in addressing climate change, in order to highlight any gaps in IFAD's response, and to develop strategic recommendations that build on the organization's comparative advantage.

The study used the following set of key *screening criteria* to identify loans and grants employing innovative, environmentally and economically sustainable practices with relevance for climate change, as set out in the terms of reference. Not all activities and programmes identified met all of these criteria, which were used, rather, as a flexible guide.

- Articulated linkages between rural poverty and vulnerability to climate variability and change;
- Diversity, including the types of natural resources and management strategies involved, and the local and/or national political and social context;
- Cross-regional value;
- Reliability of source;
- Robustness of evidence of positive impact, outcomes and results;
- Cost/benefit ratio;
- Robustness of evidence of successful replication;
- Potential for further scaling up;
- Gender and social inclusion, including issues that incorporate and promote social equality and equity;
- Capturing and articulating innovation and lessons learned, whether substantive or process-related.

[6] 'Autonomous adaptation' is the ongoing implementation of existing knowledge and technology in response to changes in climate. 'Planned adaptation' is the increase in adaptive capacity through mobilizing institutions and policies to establish or strengthen conditions favourable to effective adaptation and investment in new technologies and infrastructure (Easterling et al. 2007).

A number of *constraints* were identified in undertaking a portfolio review of IFAD's climate-change-related activities. One of these was the limitation of the key-word search function in the IFAD Project Portfolio Management System (PPMS) database. This meant that in the preliminary portfolio screening carried out prior to the commissioning of this consultancy, it was not possible to do a key-word search for 'climate change' or 'climate variability'. A further constraint was the lack of explicit consideration of climate variability, climate change and climate risks in project design documents. Thus, in order to understand if an intervention was related to climate change, a number of steps were necessary: initially considering the environment section of the design document; reviewing the Environmental Screening and Scoping Note; considering the project components; and factoring in the regional context. As most projects screened were ongoing, it was not possible to access useful documents such as completion and evaluation reports for a complete and comprehensive analysis. Thus the initial research was based mainly on President's reports, appraisal reports and, when available, on supervision reports, mid-term reviews and COSOPs. Time was limited for follow-up phone interviews with CPMs and key project staff or partners.

Lack of resources to verify findings was a significant constraint, as few trips were carried out. This meant that the analysis documented in this report relied largely on the desk review, a limited number of phone interviews, and case studies compiled for a separate consultancy. Given the mentioned constraints on IFAD monitoring and reporting, it was difficult to satisfy the criterion of robustness of evidence of positive impact, outcomes and results of the study when considering different projects and actions. Robustness of evidence of successful replication was similarly difficult to satisfy, given reporting constraints. A final constraint related to IFAD's limited experience with mitigation (IFAD 2008a). As a result, the study focused mostly on adaptation, while acknowledging the important synergies between adaptation and mitigation, and the organization's indirect contribution to mitigation activities.

1.4 Structure of this report

The report is divided into six sections:

- A summary of climate change challenges, including the severity of likely impacts on the poor rural people who comprise IFAD's target groups, the international response, and an overview of IFAD's evolving response;
- A summary of the experience of other development organizations in their efforts to mainstream climate change adaptation;
- A section analysing the suitability of key IFAD development approaches and principles of engagement, to serve as a basis for scaling up the organization's response to climate change;
- The main body of the report, focusing on concrete activities and consisting of a review of IFAD loans and grants in terms of support to activities supportive of adaptation to climate change. This begins with some general statements, followed by sections considering IFAD's support to approaches for adaptation in agricultural technology and natural resource management (NRM); research for pro-poor development; economic diversification; extreme events and climate-related risk preparedness; and approaches that support integrated adaptation planning and implementation. After this focus on adaptation, the report reviews the organization's existing and potential actions to support mitigation;
- A summary of lessons derived from the study;
- Strategic recommendations for consideration by IFAD to enhance the mainstreaming of climate change in its operations.

2. The climate change challenge – and responses

2.1 Impact of climate change on poor rural people

Most analyses of global climate change are in agreement that the poorest and most vulnerable people will be affected first and to the most significant degree.[7] The sectors particularly vulnerable to climate change are those on which rural people largely depend for their livelihoods: agriculture, forestry (including non-timber forest products – NTFPs) and fisheries; and water-related aspects of these. There is a strong correlation between IFAD's focus and that of the sectors considered particularly climate sensitive. Agriculture has long been a major IFAD focus, and efforts to combat deforestation, soil degradation and desertification have been central to its operations since IFAD's creation in 1974 in the wake of the great droughts and famines that had struck Africa in the previous six years. The organization's operational areas also comprise the vulnerable forestry, livestock and fisheries sectors, with forestry having mitigation potential.

As women constitute the majority of the world's poor, they are the most vulnerable to climate change. Poor women are more likely to become direct victims of climate change disasters. As recognized in a recent IFAD paper (IFAD 2008a), climate change also affects the day-to-day livelihoods of rural women. In many developing countries women do most of the agricultural work. Thus any increased workload is likely to fall to them, and reduced agricultural production means that they have to work that much harder to secure their family's food security. Erratic rainfall, drought and deforestation will increase the amount of time that women and girls spend collecting water and fuelwood, thereby limiting options for earning an income, becoming educated or participating in civic life. Climate change thus risks magnifying existing inequalities and reinforces the disparity between women and men and their capacity to cope.

The geographical concentration of chronic poverty overlaps with climate change vulnerability: Africa and Asia are considered the two continents most vulnerable to climate change, with sub-Saharan Africa having the highest levels of chronic poverty in the world, and South Asia containing the majority of the world's chronically poor people (Chronic Poverty Research Centre 2008). It is clear that climate change is a significant threat to IFAD's client base of poor rural people – the small farmers, herders, fishers, landless workers, artisans and indigenous peoples in rural areas that represent 75 per cent of the world's 1.2 billion extremely poor people.

climate change will exacerbate the existing vulnerabilities of poor people, thus placing additional strain on livelihood and coping strategies. Multiple stresses related to HIV/AIDS, land degradation, trends in economic globalization, and exposure to violent conflict aggravate exposure to climate risks and affect the capacity of poor people to adapt (Adger et al. 2007). It is clear that climate change and poverty are interlinked in complex and mutually reinforcing ways. The nature of the development pathway can have a significant impact on the level of climate change impact. As much as climate change can affect sustainable development and constrain achievement of the Millennium Development Goals (MDGs), sustainable development can reduce vulnerability (IPCC 2007a).

While climate change impacts will vary from place to place, requiring locally specific adaptation strategies, there are some general indications of the ways in which climate change will affect smallholder farmers:

- Increased likelihood of crop failure;
- Increase in diseases and mortality of livestock, and/or forced sale of livestock at low prices;
- Increased livelihood insecurity, resulting in assets sale, indebtedness, outmigration and dependency on food aid; and

[7] See, for example, IPCC (2007b and c).

- A downward spiral in human development indicators, such as health and education (IPCC 2007b).

For African farmers, Binswanger-Mkhize (2008) points out that obvious adaptation challenges are increased agronomic complexity and risk of shocks at farm and community levels, which imply changes in crops, cropping patterns, timing, agronomic practices and seed requirements.

The fates of poor communities and fragile drylands are intimately interrelated, with poverty as both a cause and a consequence of land degradation and desertification. Africa is especially susceptible to land degradation, which affects at least 485 million people or 65 per cent of the entire African population. It is estimated that two thirds of African land is already degraded to some degree and accounts for a 3 per cent annual loss in agricultural GDP. It is in Africa that the link between poverty, land degradation and desertification is the strongest. This is particularly relevant to IFAD's operations: from 1999 to 2005, IFAD committed approximately US$2 billion to programmes and projects related to the objectives of the United Nations Convention to Combat Desertification (UNCCD). As noted in the United Nations Framework Convention on Climate Change (UNFCCC), countries with "arid and semi-arid areas or areas liable to floods, drought and desertification" are "particularly vulnerable to the adverse effects of climate change". Desertification, in turn, reduces the land's resilience to climate variation, thus increasing vulnerability and threatening the ability of communities and ecological systems to adapt to such change.

Poor farmers on rainfed farms in low latitudes are immediately vulnerable to warming, and reductions in crop productivity are expected to have serious economic impacts. For example, African farmers on rainfed farms would lose annual net revenue of US$28 per hectare (ha) per degree Centigrade (◦C) (Kurukulasuriya and Mendelsohn 2008), while farmers in India would lose 9 per cent of their net revenue/ha/◦C.

Climate change is evidently a challenge that will make it more difficult to achieve the MDGs, particularly the first goal of halving the proportion of people living in extreme poverty by 2015. As such, it poses an additional threat to the successful achievement of the goals of IFAD investments. We should also not forget that achieving the first MDG would still leave some 800 million people living in absolute poverty and deprivation – many of whom will be chronically poor (Chronic Poverty Research Centre 2008).[8]

2.2 The international response

The framework for the global response to climate change is provided by the UNFCCC, which addresses both mitigation and adaptation to the expected impacts of climate change. Elements of the UNFCCC's framework for adaptation include the national adaptation programmes of action (NAPAs) of the least developed countries (LDCs), and various financing sources to assist developing countries in adapting to climate change, all administered by the GEF. Additional funding for adaptation and mitigation is provided by multilateral financial institutions and bilateral donors, and through the so-called voluntary carbon market. In 2009, UNFCCC parties met in Copenhagen, where the goal was to agree on a new global treaty for the post-Kyoto-Protocol period beyond 2012.[9]

[8] "The chronically poor are not a distinct group. Most of them are 'working poor', with a minority unable to engage in labour markets. They include people who are discriminated against; socially marginalized people; members of ethnic, religious, indigenous, nomadic and caste groups; migrants and bonded labourers; refugees and internal displacees; disabled people; those with ill health; and the young and old. In many contexts, poor women and girls are the most likely to experience lifelong poverty." (Chronic Poverty Research Centre 2008, 1).

[9] The Copenhagen Accord (www.denmark.dk/copenhagen_accord.pdf) is a disappointing deal compared to what was expected and needed. Developing countries did not get deeper emissions cuts from the United States, and they pushed back on longer-term targets or accepting internationally monitorable emissions reductions. Promises of extra finance were made, but are still vague. There was good progress on agriculture in the formal conference texts, but these were not agreed to and will continue to be negotiated in 2010, as will many other issues.

Progress made in adaptation actions so far has been slow and limited (UNFCCC 2007a), with much of the focus of the international community, until a few years ago, being placed on mitigation. At the same time, people all over the world are already adapting to climate change. While there is no scientific doubt about global warming, there are still some uncertainties about the significance and timing of the impacts to be experienced and the reduction of GHG emissions required. It is thus critical to take concerted action on both adaptation and mitigation. The growing recognition of the need for urgent action to promote adaptation to climate change has been reflected in the emphasis being placed by the UNFCCC on this issue through its Adaptation Programme. Moreover, adaptation was included – for the first time at the Thirteenth Conference of the Parties (COP 13) held in Bali in December 2007 – among the building blocks of the Bali Roadmap. This follows from the development in 2005 of the UNFCCC Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change (NWP), the first global framework to focus on adaptation. The NWP was developed to assist parties to the Convention – especially developing countries, including LDCs and small island developing states – in improving their understanding and assessment of climate change impacts, vulnerability and adaptation, and in making informed decisions on practical adaptation actions and measures to respond to climate change.[10]

2.3 IFAD's evolving response to climate change

Within this changing international context, IFAD has highlighted the need to provide additional space for the voices of poor rural people, who are the principal target group. IFAD-supported rural development programmes and projects increase poor rural people's access to land and other natural resources, financial services, markets, technology and options for livelihood diversification. IFAD works with a range of partners, including local communities, NGOs, governments and donors, to fight the underlying causes of rural poverty. It acts as a catalyst, bringing together partners, resources, knowledge and policies to create the conditions in which poor rural people can increase agricultural productivity, as well as seek out other options for earning an income.

The Fund's approach to climate change, which is grounded in its Strategic Framework, focuses exclusively on climate change issues as they affect poor rural people in developing countries, and on strengthening their long-term resilience to such change. The Framework identifies climate change as a major and growing challenge that will make poor rural people more vulnerable to poverty, hunger, displacement and increased uncertainty.

Partnerships with other United Nations and international development agencies, private companies, NGOs and civil society organizations are all critical in enabling IFAD to learn more about climate change and poor rural people, share its knowledge, strengthen its operations, leverage additional funding in support of poor rural people, and influence the global policy agenda (IFAD 2008a). Some key partners include the GEF, the UNFCCC Nairobi Work Programme,[11] the Global Mechanism of the UNCCD, the other Rome-based United Nations agencies (the Food and Agriculture Organization of the United Nations (FAO) and the World Food Programme (WFP)), the Consultative Group on International Agricultural Research (CGIAR) and CGIAR-supported research centres. In sub-Saharan Africa, IFAD supports, inter alia, adaptation to climate change within the framework of TerrAfrica – a regional partnership on sustainable land management – and its strategic investment programme.

[10] The NWP is structured around nine areas of work that are recognized as vital to increasing the capacity to adapt. Parties, intergovernmental and non-governmental organizations, the private sector, communities and other stakeholders implement activities that support the objectives of the NWP. Expected outcomes include enhanced capacity for adaptation; improved information and advice to the Conference of the Parties to the UNFCCC; enhanced dissemination and use of knowledge; enhanced cooperation to manage climate change risks; and enhanced integration of climate change adaptation with sustainable development. More information on the NWP can be found at http://unfccc.int/adaptation/items/4159.php.

[11] IFAD is a member of the NWP and participates regularly in the Forum of the Focal Points.

In addition to the orientation provided by the Strategic Framework and an increasing engagement with partners, recent key developments in IFAD's response to climate change include statements made by the President of IFAD, the Fund's role in meetings on climate change of the United Nations Chief Executives Board for Coordination, the development of a number of policy papers outlining further direction for the organization in addressing climate change, IFAD's participation in COP 13, COP 14 and the 5th World Water Forum, and the formation of the Global Environment and Climate Change (GECC) Unit. The GECC Unit is responsible for technical matters, such as undertaking and preparing activities for submission to the Adaptation Fund, assisting with forestry and land-use planning activities that can be funded by the GEF and by IFAD, and linking IFAD projects to the Clean Development Mechanism (CDM) of the Kyoto Protocol. The organization recently updated its environmental and social assessment (ESA) procedures, which included integrating climate change considerations and strategic environmental assessment.

The IMI project for Strengthening IFAD's Capacity to Mainstream Climate Change Adaptation in its Operations, of which this study was part, also intends to develop practical operational guidance as a next step. In addition, staff seminars on various climate-change topics have been held. A current initiative, known as CLIMTRAIN, is a staff training programme being implemented by the GECC Unit. The ongoing programme consists of three workshops focused on climate change and agriculture, adaptation and mitigation.[12]

Approximately 70 per cent of IFAD-supported programmes and projects are in ecologically fragile environments prone to severe environmental degradation (IFAD 2008b). As climate change threatens to increase drought and desertification in some already water-scarce regions, the need to conserve water becomes yet more urgent. This is an important consideration for IFAD, a GEF executing agency with recognized expertise in land degradation.[13] Some of the GEF-financed adaptation projects currently under development will be implemented by IFAD. In Mongolia, the Livestock Sector Adaptation Project, to be financed through the GEF Special Climate Change Fund, aims to increase the resilience of the Mongolian livestock system to changing climatic conditions by strengthening natural resource management, 'climate-proofing' pasture water supply, and building the capacity of herders' groups to address climate change. Further IFAD/GEF-supported activities for climate change adaptation include NAPA implementation projects in Sierra Leone and Mauritania. Under its current GEF engagement strategy, IFAD is exploring links between sustainable land management operations and climate change activities (IFAD 2008b). As executing agency, IFAD also cofinances GEF projects through its loans to countries.

Thus, in response to the growing magnitude of climate change, IFAD is increasingly integrating adaptation into its operations and taking steps to make mitigation programmes more beneficial to poor rural people. IFAD's approach is that, to meet the MDGs, it must not only help poor rural people cope with climate change, but must enable them to be part of the solution. The organization recognizes that, until now, it has not implemented adaptation options in a systematic way, focusing more on short-term climate variability than on predicted long-term changes (IFAD 2008c). This has been done by focusing on enhancing the coping capacities of poor rural communities in the following areas of work: (i) agrobiodiversity; (ii) soil and land management; (iii) water management; (iv) crop management; (v) livestock systems; (vi) capacity-building and technology transfer; and (vii) livelihood diversification.

[12] The first workshop took place in July 2008 and the second in November of that year. They included resource people from the UNFCCC and GEF secretariats, the World Meteorological Organization, the European Commission and the United Nations Institute for Training and Research.

[13] The GEF is one of the financial mechanisms of the UNFCCC. It works with countries to identify areas vulnerable to climate change, develop cost-effective response programmes, and enhance regional and national capabilities for dealing with climate change problems.

3. Review of mainstreaming experiences by development agencies

Given the linkages between climate change and development, adaptive policies can only be effective if integrated into a wider development agenda. While there have been strong calls for integration of climate change concerns into existing development frameworks, such as poverty reduction strategy processes (PRSPs), to support the MDGs, progress to date has been limited. Currently, only a few donors have begun to develop strategies to mainstream climate change adaptation into their development policies and plans.

The range of activities undertaken by the various organizations to address adaptation varies considerably. Apart from operational measures (tools and methodologies) developed to mainstream adaptation, there are other aspects that need to be taken into account to ensure that these measures are successfully adopted. The Organisation for Economic Co-operation and Development (OECD) recognizes five key areas for successfully mainstreaming adaptation: (i) awareness raising, in-house and with partners; (ii) high-level political commitment, especially within the organization; (iii) screening of development portfolios; (iv) development of operational measures; and (v) collaboration among agencies.

A clear understanding of the risks posed by climate change to development investments is key to the successful mainstreaming of tools and methodologies. Efforts to raise awareness of the urgency of addressing climate change impacts have had varying degrees of success in the organizations striving to increase both in-house and partners' understanding. Examples of initiatives that have been undertaken by almost every agency are dedicated websites, production of brochures, staff training, and organization of seminars. A good example of inter-agency collaboration aimed at increasing awareness of climate change issues has been the establishment of the Vulnerability and Adaptation Resource Group (VARG),[14] which focuses on disseminating existing knowledge and experience on integrating climate change adaptation into development cooperation. The three Rome-based United Nations agencies (FAO, IFAD and WFP) have also initiated a partnership on climate change.

Agencies that have carried out portfolio screenings to date are the World Bank, the German Agency for Technical Cooperation (GTZ), the Norwegian Agency for Development Cooperation (NORAD), the Swiss Agency for Development and Cooperation (SDC) and the Department for International Development (DFID – United Kingdom of Great Britain and Northern Ireland). Portfolio screening activities range from an analysis of agency documents (NORAD), and assessments of the degree of exposure to climate risks (the World Bank, GTZ, SDC, DFID and OECD), to examining the actual implications of climate change in development activities (OECD and the World Bank) (OECD 2007). In a report prepared for NORAD (Eriksen and Naess 2003), it emerged that most documents refer to climate vulnerability only in general terms, mostly in connection with natural disasters, with insufficient attention given to the development of strategies to address climate change impacts. Analysis carried out by the World Bank concluded that climate change and variability are not sufficiently addressed in its operations at project and country levels, with only about 2 per cent of project design documents mentioning climate change (World Bank 2006). The same was found to be true for German-funded development cooperation activities (OECD 2007).

Assessments were also carried out by the OECD and the World Bank to determine the degree to which development investments are at risk from the impacts of climate change. An OECD project carried out in 2005 analysed the composition of flows of official development assistance to six countries[15] and found that a considerable proportion would fund activities potentially affected by

[14] VARG is an initiative of several bilateral and multilateral donors, including GTZ, UNDP, DFID and the World Bank.

[15] The six country case studies of this OECD project were: Bangladesh, Egypt, Fiji, Nepal, the United Republic of Tanzania and Uruguay. Findings from the project are illustrated in OECD 2005.

climate risks. The analysis highlighted the need for: (i) incorporating climate risks into decision-making; (ii) increasing awareness of climate change within the development community; (iii) making climate information more relevant and usable; (iv) developing and applying climate risk screening tools; and (v) identifying appropriate entry points for climate change information in development activities. The study found that although some weather and climate considerations are routinely taken into account, not all climate risks are being incorporated into decision-making. Even when climate change is mentioned, specific operational guidance on how to take its impacts into account is generally lacking (Agrawala and van Aalst 2005). A review carried out by the World Bank on the vulnerability of its own project portfolio concluded that 55 per cent of the projects are sensitive to climate risks (OECD 2007).

While some agencies are addressing adaptation as part of their climate change policies, increasingly others are starting to work to develop tools to assess climate risks and to identify adaptation responses. Key operational measures developed to integrate climate change in development programmes and projects include: (i) programmatic and/or project guidelines to take climate risk into account; (ii) response options to climate risks; (iii) strategic and/or operational entry points; (iv) climate risk assessment tools; and (v) priority ranking of sectors, regions or activities that are climate sensitive (OECD 2007). Generally, most of these initiatives are in the early stages and much work is currently being commissioned, as is the case for IFAD and FAO. Other initiatives may be underway on a pilot basis, or tools may have been developed but not yet tested or made mandatory. Generally, agencies tend to have a risk management approach when addressing issues linked to adaptation to climate change, relying on several tools developed by disaster-risk-reduction practitioners. Annex 4 contains a brief overview of some of the methodologies adopted by other agencies.

4. IFAD's development approach as a basis for addressing climate change

4.1 A sound basis for climate change response

In exploring climate-change-related activities in selected loans and grants, this review has highlighted a number of approaches adopted and advocated by IFAD that can serve as important underpinning elements of the organization's response to climate change. These broad orientations include the championing of participatory approaches; adoption of a holistic approach to development, for example through use of the sustainable livelihoods framework; gender mainstreaming; and vulnerability assessment and targeting. Not only do these approaches exemplify good development practice, but they also provide a basis from which to expand the organization's response to climate change in a number of ways. As noted above and recognized by the IPCC in its Fourth Assessment Report, as much as climate change can affect sustainable development and constrain achievement of the MDGs, sustainable development can reduce vulnerability to climate change. Working with poor rural women and men through a targeted, participatory and empowering approach, which recognizes gender differences, constitutes an important process element of a holistic approach to sustainable development. They are also key principles of engagement as set out in the Strategic Framework, and thus constitute an important part of IFAD's comparative advantage, which should be harnessed in the scaling up of the response to climate change.

4.2 Participatory approaches

IFAD promotes the use of participatory approaches as part of its focus on the empowerment of rural people. The inclusion of local programming processes as one of the objectives of its Strategic Framework – and its emphasis on initiatives that respond to the needs, priorities, opportunities and constraints identified by poor rural people – underline this fact (IFAD 2007a). Apart from their important empowerment goals, participatory approaches are valuable for improving knowledge of the socio-economic aspects of development. Given a specific focus on climate issues, these methodologies can be fine-tuned to promote the integration of socio-economic information into impact and vulnerability assessments.[16] IFAD's approach to climate change is being designed to build on its core strengths (IFAD 2008a), one of which is a way of working that enables poor rural people themselves to define their problems and priorities, that builds on their local knowledge, and that recognizes that the experiences and needs of women and men are likely to differ.

Many IFAD projects strive to exemplify the important lesson that sustainability of project activities depends to a large extent on the degree of participation of 'beneficiaries' in the design, implementation and evaluation of projects. Indeed, as pointed out by the Sahelian Areas Development Fund Programme (FODESA) in Mali, in its input to this study, local people should not be considered beneficiaries, but rather stakeholders responsible for the initiation, implementation and management of project activities. The sense of being active and responsible participants is best promoted if decisions to implement the project are taken by communities themselves.

Participatory approaches employed in areas such as the Sahel have indeed highlighted linkages between human vulnerability and climate variability, due to the prevalence of serious drought in these areas ever since IFAD's inception. In the case of the FODESA project, this linkage is being made

[16] This relates also to subtheme a (v) of the Nairobi Work Programme: "Promoting the availability of information on the socio-economic aspects of climate change and improving the integration of socio-economic information into impact and vulnerability assessments".

more specifically with biodiversity issues.[17] Activities funded under a grant to PhytoTrade Africa (box 2) for organizational strengthening have included participatory rural appraisal (PRA) methods, including participatory resource assessment methods that were used in longitudinal case studies to assess the socio-economic, gender and environmental impacts of harvesting wild products such as baobab (Malawi), *mongongo* (Zambia) and *marula* (Zimbabwe).

Box 2. Inclusion of socio-economic and gender issues in Phytotrade Africa's activities

PhytoTrade Africa carried out longitudinal case studies in three countries to assess the socio-economic and environmental impacts of harvesting baobab (Malawi), *mongongo* (Zambia) and *marula* (Zimbabwe). PRA methods, including participatory resource assessment methods, were used in these studies. Information from the case studies shows the socio-economic impacts of trade in natural products. There is a need to strengthen environmental impact assessment (EIA) within these studies, which may also generate information on the risks related to climate change. The majority (90 per cent) of the primary producers are women, thus making the poorest people direct beneficiaries of developments in the natural products sector. Some case studies done in 2007 on *marula* production in Namibia and Swaziland and *mongongo* production in Zambia show that women control the use of income generated from natural products commercialization. In cases where women feel their cash income may be taken away from them by men, as in the case of *trichilia* production in Zimbabwe, strategies to avert this problem have been designed. In this case, the women opted to be paid for their natural products in the form of school items for their children, such as exercise books and pens, and household items such as soap, salt, sugar and cooking oil, rather than being paid in cash.

Source: Questionnaire submitted by PhytoTrade Africa.

Oral history and participatory video

In addition to the organization's championing of participatory methodologies in general, IFAD has recently supported a number of projects that adopt innovative approaches to participation and include a specific focus on environmental change. In Madagascar, where more than three quarters of the population is particularly vulnerable to environmental shocks due to dependence on agriculture, IFAD has provided a grant to Panos London for the project Capacity-Building of Indigenous Peoples in Rural Areas of Madagascar (box 3). The project is being implemented in the south of the island, where drought is a major and increasing climate risk. Panos is working with the Andrew Lees Trust to provide the Antandroy and Antanosy communities with a platform for sharing their experiences and knowledge and voicing their concerns and priorities for the future. As poverty and illiteracy are serious constraints on access to information and the ability of people to make their voices heard, techniques used are oral testimony and participatory video. One of the project's main aims is that responses to climate change and future development in the region will be informed by indigenous peoples' experience, priorities and realities.[18]

Box 3. Oral history, video and indigenous peoples' experience of environmental change in Madagascar

The goal of the IFAD grant Capacity-Building of Indigenous Peoples in Rural Areas of Madagascar is to increase understanding and awareness of the knowledge and experiences of indigenous peoples in rural areas of the country in relation to environmental change, and to build their capacity to make their development needs known to policymakers and influencers. People in the Androy region are agropastoralists whose subsistence activities have traditionally centred on livestock and the cultivation of crops such as corn and manioc. To counter poor harvests, people have increasingly taken up fishing. However, the lack of an early warning system makes people more vulnerable to cyclones, which appear to be increasing. Films and life stories have been recorded by Antandroy men

[17] The GEF has funded a component of FODESA: Biodiversity conservation and participatory sustainable management of natural resources in the inner Niger Delta and its transition area.

[18] www.panos.org.uk/?lid=23757 (accessed 13 November 2008).

and women, following participatory workshops in filming and oral testimony interviewing. They are currently being communicated to local and regional audiences via radio and community events. Subsequently, national audiences will be reached through a Malagasy and French publication as well as television and print media coverage. Participants worked in four groups related to the issues they wanted to address – animal husbandry, dunes, fishing and agriculture – and produced a total of six 10-15-minute films (www.panos.org.uk/?lid=23644).

The project is in line with IFAD's belief that the needs and initiatives of poor rural people must be voiced and heard locally and globally so that their views can inform development and adaptation strategies. In Madagascar, it is hoped that these testimonies will inform the Madagascar Action Plan, and that the films and life stories will contribute to increasing international awareness of poverty and climate change in Madagascar, through the voices and experiences of poor rural people themselves.[19]

Another initiative using video to highlight the issues and knowledge of indigenous peoples is the Anaconda Prize. This constitutes a successful initiative of the Regional Programme in Support of Indigenous Peoples in the Amazon Basin (PRAIA)[20] for the production of indigenous videos from the Amazon Basin, the Chaco lowland area and tropical forests of Latin America and the Caribbean. Approximately two thirds of the videos for the first two Anaconda events were produced by indigenous peoples.[21] This prize has the capacity to motivate people, with its emphasis on modern, high-quality indigenous cultural production and its potential for informing a wider audience of the problems, prospects, world views and surroundings of indigenous peoples of the Amazon Basin and similar areas (IFAD 2003a).

Participatory mapping

A recent study was carried out under the framework of the Development of Decision Tools for Participatory Mapping in Specific Livelihoods project. The study reviewed good practices in participatory mapping and visited IFAD projects in Kenya, Mali and the Sudan that use participatory mapping as a key component of their project activities in order to analyse the successes and further potential of this approach (IFAD 2008d).[22] Based on the review and the results of the field visits, the project developed the *IFAD adaptive approach to participatory mapping: Design and delivery of participatory mapping projects* (IFAD 2009a). The approach details a step-by-step process to aid in the design and delivery of participatory mapping initiatives, designed to support conflict mitigation and social inclusion in decision-making on the natural resources of indigenous peoples, forest-dwellers and pastoralists. When used in a responsible manner, participatory mapping can be an essential tool in enabling marginal groups to better represent and communicate their relationships to the land, and to increase their potential to secure rights to resources and lands (IFAD 2008d).

Participatory mapping has been used in Latin America and the Caribbean, where talking maps are participatory graphic planning tools that are used as the foundation for formulating community development plans. They have also been used to assist local governments in preparing local

[19] www.panos.org.uk/?lid=23759 (accessed 13 November 2008).

[20] The first phase of PRAIA (approved in 1992) focused on territorial recognition. Since then, most Amazonian countries have adopted constitutional reforms and legislation that recognize the rights of the indigenous peoples located on approximately 100 million ha of land. Phase II of the programme concentrated efforts on mobilizing technical and financial resources from other sources, on consolidating successful experiences and pursuing income-generating initiatives, especially those linked to the management of wildlife, ecotourism, etc. During both phases of the programme, support was provided to more than 130 small-scale projects. Phase III (approved in 2003) involves sharing and disseminating information on indigenous practices, and encouraging policy dialogue aimed at formalizing and broadening the scope of indigenous people's economic and cultural initiatives in the region.

[21] In the first contest (2000), 53 videos were submitted from seven Amazonian countries. The second contest (2002) was expanded to include participants from other countries with tropical forests and from the Chaco, and 78 videos were received from 11 countries.

[22] See annex 3 for more information on this report.

development plans – e.g. the corridor projects in Peru and Ecuador. Using such tools, communities elaborated goals in line with their own aspirations, visions and world views (IFAD 2007b).[23] In the North Eastern Region Community Resource Management Project for Upland Areas (NERCRMP) in north-eastern India, which deals with shifting cultivation, participatory GIS was important in assisting communities in systematically planning the most judicious use of their resources; and, if periodically updated, could prove a powerful monitoring and evaluation tool.

Participatory mapping can play an important role in the drive to gain secure tenure over land and natural resources for indigenous communities, which is a fundamental aspect of an integrated approach to adaptation, as discussed later in this report. An important lesson from a project in Indonesia, of relevance to many such approaches, is that the application of a participatory approach is, in itself, not a sufficient condition for sustainability.[24] Rather, the process must be embedded within strong village institutions, which take the lead rather than being driven from the outside, so that programme delivery is demand-driven.[25] A desk study of IFAD's Latin America and Caribbean portfolio revealed a need for intensive socio-economic diagnostic work and consultation with various communities, both at project design and during implementation, in order to capture the distinctiveness of these communities and develop differentiated strategies for interventions.[26]

An IFAD investment that combines the promotion of participatory land-use planning with policy support in the area of natural resource management is the Post-crisis Rural Recovery and Development Programme (PCRRDP) in Eritrea. This programme was initiated in 2006 in response to extreme environmental degradation caused by population pressure and unsuitable agricultural practices.[27] GEF cofinancing for sustainable land management activities is an integral part of PCRRDP.

4.3 Sustainable livelihoods approach

The sustainable livelihoods approach is a useful tool for understanding the socio-economic aspects of vulnerability, especially to climate risks, which is an important step in adaptation processes. In the Sudan, the Gash Sustainable Livelihoods Regeneration Project (GSLRP), currently at the midpoint of implementation, provides an example of such an approach.[28] Project design for GSLRP was based on

[23] In Latin America and the Caribbean, they were: initiated by the Management of Natural Resources in the Southern Highlands Project (MARENASS – Peru); applied by the Development of the Puno-Cusco Corridor Project (Peru) and the Management of Natural Resources in the Chaco and High Valley Regions Project (PROMARENA – Bolivia); and are evolving into community cultural maps in the Market Strengthening and Livelihood Diversification in the Southern Highlands Project (Sierra Sur – Peru) and the Development of the Central Corridor Project (PROCORREDOR – Ecuador) (IFAD 2007b). Although an important innovation, the application of talking maps could be enhanced by geo-referenced systems such as the geographic information systems (GIS).

[24] In Indonesia, the East Kalimantan Local Communities Empowerment Programme (2003-2015) supports the participatory mapping of village boundaries and land use; helps develop the requisite district-level capacity for registration of claims relating to forest and agricultural lands; and fosters clearer understanding of the relative roles of customary and formal law. The programme also supports community-based reforestation initiatives.

[25] Similarly, the first Cordillera Highland Agricultural Resource Management Project in the Philippines supported a process of participatory mapping that included three-dimensional mapping, ground surveys and delineation of ancestral domains. The mapping activities followed the principle of 'self-delineation' as mandated by the Indigenous Peoples Rights Act. Both traditional technology and modern technology, including the global positioning system (GPS), were used to ensure accuracy of the data gathered and to minimize costs. The project led to the National Commission on Indigenous Peoples issuing the first certificate of ancestral domain title in July 2002 ((IFAD n.d.).

[26] This was felt to be important for all projects and programmes catering to both indigenous and non-indigenous groups or to diverse ethnic groups (IFAD 2007b).

[27] Programme activities include livestock and agriculture development and rehabilitation of rangeland and degraded watersheds.

[28] GSLRP aims to re-establish sustainable livelihoods for the predominantly poor population in the project area, located in Kassala State in Eastern Sudan, by combining rehabilitation of the spate irrigation system on the seasonal Gash River with

an SLA that sought to understand the multiple risks and stresses impacting the various assets or capital (human, social, physical, natural and financial) of rural people and the differentiated and shifting way in which they compose their livelihoods in response to this.[29] With its focus on strengths, vulnerabilities and livelihood strategies, the SLA helps develop resilience-building strategies that can be effective in increasing the capacity to cope with and adapt to climate-related impacts. These strategies can be built on for climate change adaptation. Adopting this holistic approach during the project inception mission of GSLRP led to a significant reorientation of the project design, from an irrigation rehabilitation project to a livelihoods development project with an equal focus on irrigated and rainfed agriculture.[30] The SLA used during inception was helpful in highlighting peoples' priorities, which included increasing incomes and access to basic social services such as water supply, education and health. The livelihoods assessment of GSLRP highlighted the need for a balance between agriculture, livestock and forestry, and definition of the right to land.

Use of the SLA potentially provides a platform for developing resilience-building strategies for adaptation to climate change. This still requires the conscious integration of climate information and, ideally, scaled-down climate projections, in order to take advantage of this platform.

4.4 Gender mainstreaming

As noted in its Strategic Framework, IFAD devotes special attention to gender differences and to empowering women, who account for a disproportionate number of the world's extremely poor. IFAD recognizes that women's social and economic advancement is critical to food security and the reduction of poverty, with women demonstrating their enormous potential as agents of change in IFAD's interventions. As stated in the gender plan of action (IFAD 2003b), in IFAD's development activities, gender mainstreaming implies assessing the implications for women and men of any planned action, including legislation, and ensuring that their concerns and experiences are taken fully into account in the design, implementation, monitoring and evaluation of all development activities. The aim is to formulate interventions that overcome barriers preventing women and men from having equal access to the resources and services they need to improve their livelihoods.

A briefing paper from Oxfam notes the secondary effects of climate change on women, using the increasing frequency and severity of droughts in sub-Saharan Africa as an example.[31] While droughts make crops fail, women's crops may fail faster, being grown on less-fertile common land, and without irrigation. This means women quickly have to find alternative ways to feed their families. They may turn to finding wild foods, which may also have become more scarce. Water scarcity means that diseases such as cholera and diarrhoea may intensify, especially for children and pregnant women. Since women spend longer hours collecting water and caring for sick children and parents, they also risk their own health due to fatigue, and lack time to voice their interests in community meetings. Men often migrate away from a drought area to sell their labour in town for cash. Women thus need to take on men's immediate roles, often without the resources that they had to draw on (sometimes this process can empower women, but not always). Women and girls cannot migrate for work as men do (they have childcare roles and no social mobility), so they may resort to brewing and selling beer locally, or even selling sex. In parts of Zambia, researchers have

more equitable land tenure linked to economically viable holdings, as well as the development of off-farm income-generating activities.

[29] A sustainable livelihoods approach begins with the strengths of people, explores their vulnerabilities and the strategies to address them, identifies links with and impacts of the policy and institutional environment, and encompasses peoples' own aspirations.

[30] While the use of the SLA resulted in a significant and positive redesign of the project, one lesson learned was that the project should have been implemented at the same time as government interventions to deliver basic services. This would have reduced unrealistic expectations for the project and provided some immediate benefits in the interim period, before incomes increased through agricultural production.

[31] This paragraph is largely taken from Raworth (2008).

found that when a new drought begins, the HIV infection rate rises for precisely these reasons (Raworth 2008). This graphic example provides a clear motivation for emphasizing gender issues even more strongly when planning for adaptation.

Concerning IFAD's operational procedures, the recently updated ESA procedures include a good coverage of gender, with reminders to disaggregate data by gender included in key places, such as the outlines for the Environmental and Social Review Note (ESRN) and the Environmental and Social Impact Assessment (ESIA). Beyond the ESA procedures, IFAD has a number of mechanisms for gender mainstreaming. These include the thematic reminders in *Memory Checks for Project and Programme Design – Household Food Security and Gender* (IFAD 1999); the Gender Learning Notes on IFAD's web site,[32] and *Mainstreaming a gender perspective in IFAD's operations: Plan of action 2003-2006* (IFAD 2003b). Authors of project documents are required to include disaggregated gender and poverty analysis data: division of roles and responsibilities; access to resources and benefits; participation in community affairs and decision-making; and perceived needs and constraints – disaggregated by gender and socio-economic categories. Apart from the empowerment and equity dimensions, IFAD's policy and programmatic focus on poverty targeting identifies poor rural women as the poverty group deserving more particular attention, in view of their roles as the most significant suppliers of family labour and efficient managers of household food security.[33]

Given that climate change risks magnifying existing inequalities and reinforcing the disparity between women and men and their capacity to cope, an increased emphasis by IFAD on climate change will necessitate maintaining its focus on gender mainstreaming, and in some cases even deepening it. A number of the examples and case studies discussed in this report contain additional remarks on gender mainstreaming in the context of climate variability.

4.5 Vulnerability assessment and targeting

Identifying vulnerable populations and ecosystems is a critical component of an effective approach to adaptation. Indeed, developing and disseminating methods and tools for impact and vulnerability assessments and for adaptation planning is one of the areas of the Nairobi Work Programme. The state of vulnerability is complex, as it is caused by the interactions between social, environmental, economic and political factors. Factors increasing vulnerability include poverty, changes in the environment and exposure to environmental hazards. A reduced ability to cope with change also causes greater vulnerability. Apart from exploring whether vulnerability reduction is specifically mentioned in IFAD project design documents and in activities to address it, a key question is the extent to which vulnerability assessments have incorporated climate risk information, and whether the methods employed are optimal to understanding the underlying causes of vulnerability. It is also important to consider whether climate risks are adequately considered in the causal basis for vulnerability.

Part of IFAD's strategic approach, in line with that of most international organizations, is to recognize that poverty is not just a matter of deprivation, but also of vulnerability to exogenous shocks. Thus a consideration of vulnerability has been an increasing focus of preparatory processes for loans and grants. An example is a 2005 study on how various forms of risk affect poor households in Asia and the Pacific, which was designed to aid the incorporation of a rural perspective into the PRSP review undertaken by the World Bank. IFAD has also provided assistance to partners such as WFP through its vulnerability assessments.

The Post-Tsunami Coastal Rehabilitation and Resource Management Programme aims to promote restoration and sustainable use of ecosystems along the east coast of Sri Lanka. One reason for

[32] Gender knowledge notes website, www.ifad.org/gender/learning/.

[33] IFAD (1998), p. 23; quoted in IFAD (2003b).

vulnerability is poverty, but the programme identified a number of environment-related factors that can cause vulnerability within target groups, including the destruction of mangroves for fuelwood, sand mining, coral mining, environmental (water) pollution, use of explosives in fishing, and overfishing. PRA findings indicate that target groups are very concerned about sea erosion, coastal environmental pollution and natural resource management. In addition to the vulnerability assessment, this project includes a number of climate-change adaptation measures, as discussed elsewhere in this report, as well as community-based restoration approaches in partnership with the International Union for Conservation of Nature (IUCN). While it is unfortunate that it can take a disaster to sharply heighten the profile given to ecological functions, this is often the case. The window of opportunity to raise the profile and understanding of the importance of intact ecological functioning for human development, and to ensure its integration into the national planning process, was specifically recognized in the design of the GEF-supported components for the Sri Lanka Post-Tsunami programme.

In many cases, it seems that IFAD projects have not included vulnerability assessment as such, but have rather begun on the basis of baseline studies. One example is the Development of the Central Corridor Project (PROCORREDOR) in Ecuador, where 'traditional' baseline studies were carried out that did not include analysis of natural resource endowments or the relationship to vulnerability. In general, more action is required to incorporate climate risks into participatory vulnerability assessments of the sort often carried out by agencies working on disaster risk reduction.

The Northern Regions Investment and Rural Development Programme (PIDRN) in Mali carried out a diagnostic enquiry to gather information on vulnerability and to draw up poverty maps at the level of each *commune,* which were then validated in workshops. Socio-economic indicators were developed to allow for an annual assessment of progress and to update the poverty maps. Box 4 indicates the environmental factors that contribute to the vulnerability of target groups.

Box 4. Climate-related factors driving vulnerability in Mali's northern regions

The Northern Regions Investment and Rural Development Programme (PIDRN) aims to reduce rural poverty by restoring social links and creating the conditions that support economic activity in an area hard-hit by drought and conflict. Promoting policy dialogue is an important feature of the programme. Activities involve 14 communes along the Niger River and will also include conflict prevention activities in five adjacent upland pastoral *communes*. Target groups are small producers with limited livelihoods owing to scarce financial and technical resources; nomadic herdsmen affected by environmental degradation and diminishing water resources; rural women with limited access to productive inputs; rural young people who lack training and control over resources; and marginalized social groups. Environmental problems linked to these vulnerability factors include: overexploitation of woody resources; degradation of pastoral resources, particularly around water points and in the valley of the Niger River; and sedimentation as a result of loss of vegetal cover, the increasingly arid climate, and wind erosion due to increasing wind velocities. Rainfall and flooding have become more irregular, with extremely high inter-annual variation.

Targeting

Pro-poor targeting is one of the principles of engagement set out in the current Strategic Framework.[34] An example of pro-poor targeting in an IFAD programme dealing with climate variability can be found in PIDRN in Mali. In this programme, over 80 per cent of the population in the regions covered is rural and almost 80 per cent is vulnerable to poverty and food insecurity.[35]

[34] The Strategic Framework notes: "We target poor, marginalized and vulnerable rural people who have the capacity to take advantage of the economic opportunities offered by IFAD-supported programmes and projects. We give special consideration to gender differences, and focus on women. We recognize the particular needs of indigenous peoples and ethnic minorities, especially in Latin America and Asia."

[35] PIDRN also evidences a strong overlap between poverty and conditions of environmental degradation or lack of access to/scarcity of natural resources in some of the target groups: small producers with limited livelihoods owing to scarce financial and technical resources; nomadic herdsmen affected by environmental degradation and diminishing water

While pro-poor targeting is central to the organization, it is not always simple to achieve. One project approach is to include an element of self-targeting. This usually occurs within the overall targeting policy of the organization. For example, while Sri Lanka's Post-Tsunami programme generally targets poor rural women and men in tsunami-affected communities in the programme area, self-targeting is achieved by the type and size of support (size of enterprise, loan ceilings, etc.) and through participatory assessments. Participatory identification of project participants through self-targeting is used to ensure that the poorest and most vulnerable people receive priority. Gender targeting is integral to this programme, as indeed is standard for IFAD programmes. In this case, the project design document requires that the percentage of women's participation in entrepreneurship development programmes be more than 75 per cent, with woman-headed households a priority in participant selection.[36]

4.6 Valuing indigenous and local knowledge

> *For adaptation to climate change, you must pay good attention to indigenous knowledge – it is a strong tool to help science move more rapidly than scientists would think.*
>
> – Technical assistance expert and long-standing IFAD partner, Western and Central Africa

IFAD recognizes the particular needs of indigenous peoples and ethnic minorities, especially in Latin America and Asia (IFAD 2007a). There is much evidence that indigenous and tribal peoples and ethnic minorities are disproportionately represented among poor rural people worldwide,[37] with several recent studies showing that the poverty gap between these peoples and other rural populations is increasing in some parts of the world (Båge 2007). While IFAD investments have targeted indigenous peoples for a long time, IFAD's Policy Engagement with Indigenous Peoples was adopted in September 2009.

Climate change is expected to have a very significant impact on the livelihoods of indigenous peoples, with many rural communities already being forced to adapt their way of life due to the changing environment (IFAD 2008e). Some indigenous communities are being displaced from their traditional lands and territories due to coastal and land erosion caused by large storm-driven waves and thawing of the permafrost. A number of IFAD's investments have been designed to recognize, recover and systematize local knowledge and culture, and more specifically to highlight the value of indigenous environmental knowledge.[38] More recently, investments have been specifically targeted at increasing understanding and awareness of the knowledge and experiences of indigenous peoples in relation to environmental change. This is the aim of the grant to Panos London for Capacity-Building of Indigenous Peoples in Rural Areas of Madagascar, which aims to simultaneously build the capacity of indigenous peoples to influence policymakers regarding their development needs.

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resources; rural women with limited access to productive inputs; rural young people who lack training and control over resources; and marginalized social groups.

[36] The worst effects of the tsunami were experienced by people living in weakly constructed and unplanned settlements close to the shore, women and children deprived of family breadwinners, and those with marginal livelihoods as cottage artisans (UNEP and MENR 2005). Thus, even more specifically, the programme must ensure that tsunami widows have priority as beneficiaries. Improved monitoring, from a bottom-up basis, is a further mechanism to be employed by the programme.

[37] While there is no universally accepted definition of the term 'indigenous peoples', it is United Nations practice to use the term to include groups that are referred to in different ways in different countries, such as ethnic minorities in China, tribal people in India, and hill people in Bangladesh. The United Nations Permanent Forum on Indigenous Issues estimates that these groups constitute 5 per cent of the world population (or 370 million), and 15 per cent of global poor people.

[38] Submissions made recently to the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) highlighted that many indigenous technologies already exist at the local level. What they need is deployment and dissemination, further improvement of design and quality (research and development capacity) and increased access to advanced materials (UNFCCC 2007b).

A range of programmes has been implemented in which rural communities, governments and IFAD have joined forces for the recognition or protection of access rights of indigenous peoples to their natural resources – both collective and individual – through the demarcation of ancestral lands, forests and water sources, support to more gender-equal entitlements, and advocacy (IFAD 2008e). One activity in Mexico with a strong focus on women's participation in economic activities, and their direct involvement in community and project decision-making, is the IFAD-supported Sustainable Development Project for Rural and Indigenous Communities of the Semi-Arid North-West (box 5).

Box 5. Sustainable development for rural and indigenous communities in Mexico

In Mexico, the distinction between those who are indigenous and those who are not constitutes a major social division, as is the case in many countries. IFAD's Sustainable Development Project for Rural and Indigenous Communities of the Semi-Arid North-West encompasses four states: Baja California, Chihuahua, Coahuila and Sonora, where the environmental resource base is fragile and degraded, and levels of poverty are high. The project, which runs from 2005 to 2011, specifically targeted areas with distinct indigenous populations.

A component for the development of human and social resources of poor rural communities and indigenous populations is strengthening their management and decision-making capacities to enable them to actively participate in community-based, self-managed development processes. Among other objectives, the component seeks to promote and support the organization and consolidation of community, producer and rural and indigenous women's groups and associations. Principal activities include: (i) participatory diagnosis of current development conditions and the updating/consolidation of microwatershed master plans; (ii) establishment of interdisciplinary development promotion teams; and (iii) specific training, development and empowerment plans for rural women, aimed at assuring both their participation in economic activities and their direct involvement in community and project decision-making.

The project has been working with indigenous groups to expand the inclusiveness of the rules governing the right to use of land in 'ejido' organizations (a form of communal ownership).[39] Traditionally, this system gives the right to use only to first-born sons, thus excluding younger children and women, and fuelling migration to cities. Clearly this is a complex issue and relates to long-standing cultural rules, and progress in this regard has not been simple. However, those who are not part of the ejidos cannot access public services, highlighting the importance of a more inclusive approach for vulnerability reduction.

One of the successes to date is the participatory development of plans by farmers, which are evaluated by the broader community and then approved by the Ministry of the Environment. Together with components of the project that deal with land rights, this approach has resulted in people being able to access public services. The project has thus improved the capacity of poor people and local organizations to present their ideas in documents or plans in order to access public services. It is working with the National Forestry Commission (CONAFOR) to further develop these methodologies and scale them up to other regions.

The linkages between security of land tenure and ability to adapt to climate change are becoming increasingly clear, especially in the context of indigenous peoples' access to land and the natural resources it contains. In the Philippines, the Second Cordillera Highland Agricultural Resource Management Project (CHARMP) is using an indigenous system to sustain the region's watershed. The project's experience has led governmental organizations and other stakeholders to examine local technologies and blend them with new and practical ideas for sustainable agriculture and agroforestry systems. This has been done using *Lapat* – an indigenous system whose name means 'to prohibit' or 'to regulate' (IFAD 2007c).[40]

[39] Some 26,000 ejido organizations, comprising 2.9 million members, own 50 per cent of Mexico's agricultural land. Mexico's crop production structure is highly oriented towards traditional crops (IFAD 2005b).

[40] Through this IFAD-supported project, the National Commission on Indigenous Peoples was able to administer tenurial rights, in the form of 'certificates of ancestral domain title', to three highland municipalities covering a total area of about 77,000 ha. See annex 3 for additional information on this project.

Indigenous peoples' cultural, spiritual and cosmological relationship with the land is reflected in their unique ability to care for their ecosystems. This includes a diversity of management practices that resembles contemporary scientific practices for ecosystem management and biodiversity, such as succession management, landscape patchiness management, resource rotation and multiple species management (IFAD 2007b). In addition, over the centuries indigenous peoples have created remarkable adaptive mechanisms to respond to changes in environmental and socio-cultural conditions. While many indigenous technologies are positive from the perspective of ecologically sustainable development and adaptation to climate change, these approaches can also have negative adaptation effects (an example is provided in IISD 2007), particularly given changing socio-political contexts. For example, the Mexican project described above has emphasized changing what project management has termed certain 'non-rational' indigenous technologies, most notably slash-and-burn cultivation. The latter practice is no longer appropriate, due to population pressure and limited land access, and is also thought to increase dryness in an already semi-arid area.

A desk review of the Latin America and the Caribbean portfolio focusing on indigenous peoples identified two areas as requiring more attention: further strengthening of and capitalizing on indigenous knowledge systems, and the role of women as knowledge holders (IFAD 2007b). On the other hand, there are good examples of technology blending from IFAD's Asia and the Pacific portfolio. The research grant to the International Centre for Integrated Mountain Development (ICIMOD) for the NERCRMP project in India aimed to improve existing shifting cultivation systems without compromising them, and to undertake policy dialogue with countries in the Himalayan region, where the system is widespread but considered 'primitive'. Positive outcomes included plot-size optimization, leading to considerable reduction in the area devoted to shifting cultivation, and a longer fallow cycle.

4.7 Summary: approaches to be fine-tuned for the response to climate change

Key IFAD principles of engagement – namely participatory and holistic approaches to development, gender mainstreaming, and vulnerability assessment and pro-poor targeting – exemplify good development practice. They also provide a sound basis from which to expand the organization's response to climate change. To date, IFAD programmes and projects have not focused on integrating the socio-economic aspects of climate change into impact and vulnerability assessments. However, there are a number of areas of practice where socio-economic information is gathered and used in project design – for example, participatory rural appraisal and participatory mapping. Both of these can support minority and indigenous communities in gaining secure tenure over land and natural resources – a fundamental aspect of an integrated approach to adaptation. Use of the sustainable livelihoods approach, which focuses on strengths, vulnerabilities and livelihood strategies, potentially provides a platform for developing resilience-building strategies for adaptation to climate change. Given that climate change risks magnify existing inequalities between women and men and the difference in their capacity to cope, IFAD's significant focus on gender mainstreaming is a valuable platform for responding to climate change. A number of IFAD's investments have been designed to recognize and recover local knowledge and culture, and to highlight the value of indigenous environmental knowledge. This is likely to be critical in speeding up adaptation responses, as it can lead to adaptive blending of indigenous and scientific technology.

5. Review of adaptation and mitigation activities in selected IFAD loans and grants

5.1 General observations

A preliminary screening of IFAD project design documents approved between 2000 and 2006 indicated that most of the documents for the 181 loans and 718 grants reviewed do not explicitly refer to climate change, although many designs do address climate variability. However, project documentation does not indicate that climate risks were well assessed at the project level; and they were rarely mentioned even for projects located in areas with high current climate risks, such as floods and cyclones. These broad findings are consistent with those of a number of portfolio reviews for international development organizations. However, this situation is beginning to change, with the language of climate change appearing more frequently in recent IFAD project documents. For example, a document of the Semi-Arid North-West project in Mexico makes overt mention of carbon sequestration – of relevance to mitigation actions – in the section dealing with environmental impact (paragraph 35): "Reduced soil erosion, better overall watershed management and restoration of biodiversity are among the expected direct environmental benefits, which will in turn facilitate the promotion and expansion of ongoing environmental-service payment schemes (carbon sequestration, soil and water management, biodiversity)" (IFAD 2005a).

A recent policy paper highlighted the increasing frequency with which results-based COSOPs make explicit reference to climate change as a factor impacting a country's agricultural sector and rural poverty. IFAD has noted that 12 of the 15 COSOPs presented at the Executive Board sessions of September and December 2007 and April 2008, and all eight COSOPs presented at the last two,[41] address issues of climate change in the country-specific context (IFAD 2008a).

Second, actions on the ground are beginning to incorporate climate change considerations, even if the project design documents were silent on this issue. Thus, while climate risks have not been mentioned specifically in the project design of the grant to PhytoTrade Africa, the work done by the organization takes cognisance of climate change issues. It promotes livelihoods based on locally adapted and evolved species that are already substantially more drought tolerant (given the drought proneness of the southern African region) than most exotic species.

A further example of the increasing integration of climate change considerations into field activities lies in the stated intention to incorporate climate change into project activities in PROCORREDOR in Ecuador, using the next supervision mission as a vehicle. In Sri Lanka, while it does not appear as though the Post-Tsunami programme was designed specifically to address climate change,[42] it is focused on environmental risks, including those that may have aggravated the impacts of the tsunami, as well as those caused by the tsunami. According to the programme coordinator, these include sea erosion, increased sea levels, water pollution, land degradation, coastal and lagoon pollution, and degradation of ecosystems, including salt marshes, coral reefs and sand dunes, which were identified at the project design stage. To manage these issues and risks, activities such as water-quality monitoring, sand dune and mangrove restoration, habitat conservation and awareness-raising on these issues are being included in the project, as well as alternative income generation activities and solid waste management.

Precise climate change/adaptation terminologies were not used in the project document for a grant to the International Center for Biosaline Agriculture (ICBA) to develop sustainable forage systems, adopted by farmers, that make use of salty water. However, the project is targeting the types of arid

[41] These were the COSOPs for Afghanistan, Bolivia, Cambodia, Jordan, Mali, Mexico, Moldova and Yemen in December 2007 and April 2008.

[42] Unless it is possible to state that the tsunami occurred as a result of climate change.

environment agroecosystems that are the most affected by climate change.[43] These are marginal agricultural lands that have degraded due to a combination of climate change and lack of appropriate adaptive management. Climate change impacts, particularly drought and high temperatures, are having the greatest effect on marginal lands already affected by drought, salinity, soil erosion and lack of sufficient water resources. The consequences of such changes are manifested in the removal of such land from production and the dislocation of the farmers living in such conditions.

Some IFAD projects now also include a GEF component that incorporates some consideration of climate change. For example, Morocco's Livestock and Rangelands Development Project in the Eastern Region – Phase II (2004-2011), which targets land degradation, included a project preparation study on climate risks and highlighted some adaptation measures as risk mitigation.

In general, however, questionnaire and interview responses to the present study exploring the integration of climate change into IFAD's operations indicated a lack of specificity in distinguishing between climate-related risks and environmental risks, even where responses reflected a sound understanding of environmental issues. This is not surprising, given that climate change has only recently gained more universal coverage and higher priorities. It does point to the need for greater sensitization on climate change issues if IFAD investments are to be made more climate-sensitive.

Emerging evidence of climate change in the field?

A number of responses obtained through this study indicated fascinating perceptions of climatic changes that are already apparent on the ground. For example, farmers involved in the tree diversification programme in West and Central Africa, funded through a grant to the World Agroforestry Centre (ICRAF), have indicated that river flows have diminished in some areas. Effects on different plant species are rare, but have been observed by traditional healers. This programme is responding by encouraging and assisting healers in growing these species in home gardens. While it is not possible to state conclusively that these changes are due to climate change, farmers are making this link, with some even feeling that poor soil fertility is due to climate change. While their preoccupation is with income generation, they are also making the link that planting trees will help counteract climate change.

PIDRN in Mali has identified very clear trends with respect to climate-related issues. This indicates a growing awareness of these issues since development of the project document, which addressed the impacts of drought but in a less complex way. Climate-related trends identified in a written response for this study include an increasingly arid climate, more wind erosion due to increasing wind velocities, and more irregular rainfall and flooding, with extremely high inter-annual variation.

Changing climatic trends were confirmed by a group of men who participated in the development of a case study for this review, in eastern Sudan. These GSLRP participants noted that over the past 10-15 years, rainfall had decreased and winters were less cold, and they mentioned an increase in dust storms. Interestingly, they provided indications that traditional systems for predicting seasonal weather are no longer so effective.

> *The system for predicting rain is that when there are stronger wind storms in summer, we usually expect more rain. We thought that 2008 would be a good year, but actually it was a bad one.*
>
> – Community leader, village on the east bank of the Gash River

Adaptation activities that have been observed in the area include water-harvesting techniques and diversification of livelihoods. More as a coping strategy, many men work as casual labourers in the Gash Agricultural Scheme. However, this complicates their crop-growing livelihood component, as they are not able to protect their fields from animals. To deal with climate variability, pastoralists plan movements according to their own forecasts; they cull if unfavourable climatic conditions are

[43] Abdullah Al-Dakheel, ICBA, personal communication, November 2008.

expected; employ breeding synchronizations (keeping males away from females until the beginning of the rainy season in June/July); and diversify the herd to spread risk.

5.2 Technologies for adaptation and for promoting community-based natural resource management

This section of the report highlights technologies from IFAD projects that are of relevance for adaptation, from the fields of agriculture, natural resource management, water conservation and management, and fisheries. Land tenure and community-based natural resource management are also discussed as important elements of adaptation strategies.[44]

5.2.1 A variety of technologies

The IPCC has noted that technologies for adaptation encompass *hard* technologies, such as drought-resistant crop varieties, seawalls and irrigation technologies, and *soft* technologies, such as crop rotation patterns. Many technologies have both hard and soft characteristics, and successful adaptation action would typically combine both. Analyses have shown the important role of soft technologies in helping countries adapt to the adverse effects of climate change (UNFCCC 2007b). Within these two broad categories, technologies can be further classified as traditional, modern, high or future technology (box 6).

Box 6. **Traditional, modern, high-tech and future adaptation technologies**
Traditional (indigenous) **technologies** that have been applied to adapt to weather hazards include those used to build floating vegetable gardens, traditional housing designs and dykes. Examples of **modern** technologies include those used to produce new chemical products (e.g. fertilizers, pesticides and solvents), improved designs (e.g. of sanitation systems, housing and commercial buildings), new varieties of crops (e.g. hybrid corn) and new water-use applications (e.g. drip irrigation). '**High-tech'** includes some of the more recently developed technologies resulting from scientific advances in recent decades, including information and communications applications, earth observation and geographic information systems (GIS), and genetic modification. **Future technologies** include those that have yet to be invented or developed; examples include a malaria vaccine, various forms of geo-engineering to reduce climate impacts, or crops that need little or no water (UNFCCC 2007b).

In many cases efforts to adapt to climate change can effectively build on strategies and measures adopted to combat desertification, including (adapted from Drynet 2007):

- Reforestation and protection and regeneration of forests
- Planting of hedges and combating of erosion and bushfires
- Production, transformation and value added to local cereals
- Efficient water management through hydro-agricultural developments
- Adoption of alternative energy sources that do not deplete natural resources
- Development and management of dryland pastures
- Development of market gardening and fruit production
- Rainwater harvesting and watershed management
- Dryland production of oil-bearing seeds

IFAD has a long history of promoting agricultural technological development, both in humid and arid zones. The organization has significant experience in combating desertification. It hosts the Global Mechanism of the UNCCD, and implements projects in arid zones to assist small farmers in managing scarce water resources, improving soil fertility and structure, reversing environmental degradation and coping with growing levels of soil salinity. IFAD's Special Programme for sub-Saharan African

[44] This is reflected in the Nairobi Work Programme as subtheme b (iii), "Promoting research on adaptation options and the development and diffusion of technologies, know-how, and practices for adaptation, particularly addressing identified adaptation priorities and building on lessons learned from current adaptation projects and strategies".

Countries Affected by Drought and Desertification (SPA), which ran from 1985 to 1995, provided a strong platform for responding to climatic issues in the region (IFAD 2008a). Aimed specifically at mitigating the impact of drought, increasing food security and reversing the process of desertification, SPA interventions covered small-scale irrigation, soil conservation, research on traditional food crops, marketing arrangements and non-farm income-generating activities. The lessons learned from the SPA have fed into more-recent initiatives across the region.[45]

While there is no doubting the organization's deep experience in these areas, clearly not all technologies promoted for desertification could have served to reduce poverty and promote adaptation. Given that climate change has only infrequently been considered in project design, there is a corresponding dearth of evaluations that interrogate this issue. Broadly speaking, many current national and international development policies and mechanisms of a range of organizations and countries serve to advance deforestation and biological manipulation, promote the extension of monocultures and water appropriation by powerful vested interests, allow contamination of natural resources by industrial and mineral production and result in the increasing poverty of rural people in the drylands (Drynet 2007). Such approaches are likely to be maladaptive. On the other hand, sustainable agricultural practices and soil and water conservation approaches that optimize use of environmental assets without damaging them (as often implemented by IFAD) already play an important role in combating land degradation and conserving water resources, and have the potential to increasingly assist people in adapting to climate change.

IFAD places particular emphasis on increasing awareness of why investment in agriculture and rural development is critical to meeting the MDGs. The organization has maintained a consistent focus on agriculture and rural development, even when overall aid to those areas was declining, and will continue to do so, given that the majority of poor people will live in rural areas for at least another 30 years (IFAD 2007a). Relevant technologies supported by IFAD over the years include those to modify land-use and agricultural practices, including crop and livestock management and water conservation. Regarding crop management, there has been an emphasis on developing and using crop varieties tolerant/resistant to drought or heat, salt, insects or pests, and improved seed. Land management techniques and practices include a range of soil conservation methods and agroforestry approaches, and integrated agricultural approaches that provide improved vehicles for dealing with complexity and change. Other relevant areas of IFAD-supported activities include various approaches to more-sustainable irrigation, support for sustainable fisheries management, and technologies for adapting infrastructure so that it is climate resilient. See annex 1 for a list of possible technologies for adaptation, developed for this study and used to support the questionnaire.

5.2.2 Agriculture, natural resource management, soil and water conservation and land management

> *Farmers in the Sahel have been adapting to climate change since the major droughts of the early 1970s and even more so since the mid-1980s.*
>
> – International development practitioner and academic with long-standing experience of IFAD investments

Concerning IFAD's priority sector of agriculture, climate change is increasing production risks in many farming systems and reducing the ability of farmers and rural communities to manage these risks on their own. Globally, resource-poor farmers and pastoralists are attempting to adapt to a range of effects of climate change, including: dwindling crop yields; desertification and land

[45] These include the Sustainable Rural Development Programme in Burkina Faso (adoption of new agricultural technologies to promote soil and water conservation); the Gash Barka Livestock and Development Project in drought-prone Eritrea (improved crop and animal husbandry, conservation farming and small-scale irrigation); and the Agricultural Development Project in Matam, Senegal, where desertification is increasing (uptake of drip irrigation).

degradation processes exacerbated by changes in rainfall patterns; rising sea levels, affecting in particular the livelihoods of coastal communities; diminishing natural resource productivity; and irreversible loss of biodiversity in some areas. IFAD has designed and funded projects that support agricultural technological development and implementation, with a focus, as well, on combating land degradation and conserving soil and water. In the Sahel region, this experience has extended for over three decades, constituting important support to farmers in adapting to drought and climatic variability. Many of the lessons learned and technologies developed through this experience are directly relevant to coping with longer-term climate change.

In Burkina Faso, the IFAD-supported Sustainable Rural Development Programme (PDRD) operates in an area characterized by increasing drought, erratic rains and land degradation.[46] The rainy season has become shorter, with less rainfall, which has also become heavier. Increased runoff has resulted in less organic matter in the soil. In the past, the area was forested and full of wild game, which, besides being an indicator of biodiversity, represented an additional resource. Reduced soil moisture translates into much smaller harvests for plots of the same size. A common refrain heard from farmers is that "the same surface of land which was enough for my parents to feed our family is no longer sufficient for me to feed my family". Started in 2006, the PDRD project has already attained achievements in terms of management of soil erosion – through indigenous soil and water conservation techniques such as planting pits (*zai*), half moons, drainage channels in lowlands, permeable rock dams, stone lines and stone bunds reinforced with grass strips.[47] A range of complementary measures have been taken to optimize the impact of soil and water conservation measures, such as the use of compost pits, natural phosphates and agroforestry. A major contribution of the PDRD programme is in formerly non-agricultural areas, long abandoned because the land there was thought to be "un-reclaimable" (locally these lands are referred to as "zipélé" – barren soils); yet, SWC techniques have proven that the vegetative cover of these lands can be regenerated and they can be brought back under cultivation. Soil and water conservation (SWC) on 12,000 ha has been accomplished (out of an objective of 18 600 ha) and the satisfaction of project participants is evident from the increasing demand for additional sites to be covered by the projects. Participants also point out that in the sites in which SWC techniques have been applied, soil cover and vegetation are regenerating.[48] SWC techniques and local/improved varieties are tested in demonstration plots, implemented in partnership with one of the national research institutes, Institut de l'environnement et des recherches agricoles (INERA).[49] Open days are organized for the whole community, so they can appreciate the pilot and ask questions.[50]

Mali's IFAD-funded PIDRN will be implementing a number of activities for soil and water conservation to address the climate-related vulnerabilities identified in project planning (see box 4 above). In the project area, crop development remains heavily dependent on natural rainfall and receding floodwaters, with rainfall extremely erratic, particularly in the north. Activities include

[46] Information on PDRD is based on a field visit and case study developed by the IFAD Technical Advisory Division: Environment and NRM in late 2008, unpublished internal report.

[47] Vegetative barriers are cheaper and self-maintaining compared with stone. Suitable grass species can be identified, especially local varieties, i.e. *Andropogon gayanus,* which can be used in combination with stone bunds that can then be taken away and reused in different contexts. This species is grown traditionally around field boundaries and is used for weaving mats. It is helpful in decreasing both water and wind erosion.

[48] To further support herders and farmers, the project encourages species such as dual-purpose cowpea, a legume crop, which simultaneously addresses the lack of haulms for livestock feeding and grain for human consumption. Moreover, dual-purpose cowpea is drought and pest/disease resistant and restores soil fertility.

[49] Only a relatively small number of farmers participate in the pilots (usually 25/30 trainees, who then become trainers). They undertake weekly measurements to test the evolution of the varieties and their response to the different techniques used (i.e. zai alone or zai + compost + NPK), and they can then make their own choice on the basis of the yields, but also of the many other parameters (such as cost of fertilizers) that are taken into account during the testing phase.

[50] A further local coping strategy is diversification of livelihoods. Farmers now tend to keep a small number of animals that they can sell in difficult times to buy food. Animals are fed with crop residues (fodder is not cultivated), and feeding livestock in the dry season is one of the major constraints on animal-raising.

systematically establishing windbreaks around 5-hectare irrigated plots known as *périmètres irrigués villageois* (PIVs); planting live hedges around market gardens or *petits périmètres maraîchers* (PPMs); disseminating cultural varieties and techniques, including seed adapted to local climatic conditions in the PIVs, and supporting the spread of the use of organic fertilizers and agroforestry; introducing pilot drip-irrigation technology activities; and active and passive restoration of pastures. An important adjunct to these activities is project monitoring of soil, water levels in wells and forage condition to track environmental change and the effect of project activities on this change.[51] A further example from Burkina Faso is presented in box 7.

Box 7. Indigenous soil and water conservation to address climatic variability in Burkina Faso

One of the major threats in the area of the Community Investment Programme for Agricultural Fertility (PICOFA)[52] is soil erosion. Coupled with the effects of climate variability (increased drought, shorter rainy period, excess runoff from heavy rains that causes further erosion), land degradation results in lower and less-reliable crop yields, reduced biomass for grazing and browsing, and poorer fuelwood supplies. The whole PICOFA programme is centered on soil fertility management issues, in particular the judicious blending, over a spectrum of different soil texture/moisture/etc., agro-climatic and socio-economic conditions, of organic and inorganic fertilizer. The project places emphasis on soil and water conservation techniques, making use of traditional skills and working through existing local institutions. These techniques are substantially contributing to reversing the degradation of the productive capacity of the land thus reducing farmers' vulnerability to climate change effects. Indigenous SWC techniques used include *zai* and *demi-lunes*, associated with income generating activities. RNA (régénération naturelle assistée) is also promoted, so much that some observers speak of a recent "re-greening of the Sahel".

Sensitization activities include farmer-to-farmer visits, targeted especially at women, who are considered major agents of change. These have persuaded non-participating farmers that SWC activities may be necessary for their land, too. Improved seed varieties are being tested and disseminated, associated with training in soil management techniques, such as appropriate sowing density to optimize plant growing. Income-generating activities, including seed production, are being supported, especially for women (shea butter, soap-making), to reduce reliance on vulnerable agricultural sectors and to ensure year-round cash availability. During interviews, many male farmers recognized that women's incomes are essential for survival during crises and for the education and health of children. Evidence of success lies in the increasing demand from other villages to participate in the project. Participants reported positive project impacts not only on income and food security, but also on human and social capital. These included: increased respect among people; increased social cohesion, partnerships and solidarity, especially for women's groups, whose key role as major actors in the production/consumption system was fully recognized by the community; and increased self-confidence in the face of extreme weather events as a consequence of social cohesion.

Source: Field visit and case study developed by the IFAD Technical Advisory Division: Environment and NRM in late 2008, unpublished internal report.

[51] PIDRN was designed to exploit the hydro-agricultural potential of the Niger River in the Tombouctou and Gao Regions. In these areas, crops are grown on floodplains and also around permanent lakes and depressions. The management goal for PIVs and PPMs is to enhance agricultural production, and for the *bourgoutières*, to feed livestock on *bourgout* reeds to ensure continuity of milk production in the dry season, as well as to generate financial resources for project participants. Apart from these technical and management activities, the programme also incorporates infrastructural components, including community health centres and water points; transport-related activities to reduce the isolation of the area, i.e. rural roads and purchase of a ferry boat; and capacity-building and empowerment components, such as literacy training, dissemination of information via rural radio, and development of community organizational capacities and collective management. Some of these activities have begun implementation. Thus PIDRN is a good example of a multicomponent IFAD programme that addresses a variety of livelihood needs.

[52] http://operations.ifad.org/web/ifad/operations/country/project/tags/burkina faso/1220/project overview.

In Southern Africa, the Lesotho Soil and Water Conservation and Agroforestry Programme (SWaCAP) successfully promoted Machobane farming, an indigenous concept that incorporates cash cropping and elements of more sustainable farming systems, including the recycling of organic materials and synergies between intercrops/relay crops.[53] Yields from fields cultivated under the system were triple those of monocropped plots. Between 1991 and 1997, the number of farmers adopting the system increased from 22 to 2,000. The Machobane approach emphasizes self-reliance, very few (if any) cash inputs, and requires participants to act as voluntary extension agents.[54] Unfortunately, the Machobane Foundation, which was supported by the IFAD SWaCAP project, is in a very weak condition at present, although some Basotho farmers and groups do continue to practise the system.[55] Again, sustainable agricultural approaches generally support retention of soil moisture and vegetation, which are likely to have positive effects for mitigation, as well as for adaptation to a changing climate.

GSLRP is using water harvesting as the critical mechanism for rangeland regeneration in the eastern state of Kassala in the Sudan from 2004 to 2012. Rangeland management interventions include water harvesting for reseeding degraded areas with forage crops; collection of rainfall and flood water for animals; and efforts to control fire outbreaks in the natural rangelands, through construction of fire breaks and awareness-raising among pastoralists.

Eritrea has special needs regarding adaptation to climate change, owing to its combination of low-lying coastal regions, arid and semi-arid areas, zones liable to drought and desertification, and areas with fragile ecosystems such as mountainous regions. Particularly vulnerable groups are subsistence farmers, pastoralists, rural dwellers and fishermen. The most limiting factor is rainfall, which is erratic and torrential, and quickly forms heavy floods with little chance to penetrate into the soil. Increasing climate variability is already affecting various sectors. The IFAD-supported Gash Barka Livestock and Agricultural Development Project (GBLADP) financed soil and water conservation structures, such as earth or brushwood bunds and terracing, to halt land degradation and increase availability of water for cultivation to improve crop productivity (IFAD 2008f). Microcatchment interventions were also performed to reduce run-off and increase infiltration. In addition, the project embarked on the construction of two medium-scale spate irrigation schemes covering about 1,100 ha and benefiting 1,000 farmers.[56]

The technological component of the Semi-Arid North-West project in Mexico has focused on soil conservation and agroforestry technologies and crop rotation. An important factor for success has been capacity-building at the local level – for example, through the training of community technicians, who are extremely important in disseminating technologies. Apart from focusing on farmers, these technicians also target indigenous leaders, and radio and the local press are mechanisms for further awareness-raising.

A relevant IFAD grant to the Secretariat of the Pacific Community, specifically targeted at climate change adaptation, promotes the development and dissemination of appropriate crops and technologies in recognition of the urgency of climate change. Companion activities will include the

[53]. J.J. Machobane, a Masotho, developed his farming system during the 1950s on his own farm. The technical parameters on which the system is based are: (i) intensive intercropping by growing several crops simultaneously or in relay in the same field; (ii) adequate soil fertility and moisture-retention capacity are achieved through localized placement of ash (household waste) and manure, combined with adequate weeding; (iii) ash and manure produced by a typical family are sufficient for one acre of land using localized techniques; (iv) one acre of land is sufficient to grow enough for home consumption and sale; and (v) intensive cropping on the above basis offers a further, synergistic means of enhancing soil and moisture conservation and reducing income fluctuations.

[54] Lesotho SWaCAP focused evaluation, www.ifad.org/evaluation/public_html/eksyst/doc/prj/region/pf/lesotho/s013leae.htm.

[55] Stephen Turner, independent consultant with many years experience in Lesotho, personal communication, 22 October 2008.

[56] Spate irrigation is discussed further in subsection 5.2.5 of this report.

valorization of indigenous and atoll technologies through action research and documentation, in order to support agriculture and fisheries. A similar activity will be managed by the Solomon Island Development Trust, recipient of a small grant through the IFAD Indigenous Peoples' Assistance Facility (IPAF). Funded by this grant, Babanakira and Kolina indigenous populations will be assisted in improving post-crisis resilience by merging valorized traditional and scientific knowledge.

Technologies for reducing exposure to environmental stresses

The review of IFAD investments in the Niger's Aguié department, which have systematically promoted farmer-managed natural regeneration, discussed below, indicates that reducing the exposure of plants to environmental stress is an important agronomic practice for advancing climate change adaptation. Lessening exposure to environmental stress also performs the function of mitigating land degradation (Drynet 2007). Other ways in which farmers reduce exposure to environmental stress include: retaining buffer strips of natural vegetation; creating windbreaks; mulching their crops; and through agroforestry, as supported by numerous IFAD investments.

5.2.3 Agroforestry interventions

Agroforestry projects funded by IFAD have increased the number of on-farm trees, which impacts local climate by reducing wind speed. This in turn decreases evaporation, lowers soil temperatures and reduces damage of sand blast to young crops. These effects serve to reduce the exposure of plants to environmental stress. As climate change impacts are felt more deeply, these interventions will become increasingly significant in enhancing the livelihoods of smallholder farmers and enabling them to better adapt to climate change.

A number of IFAD's agroforestry investments have encouraged farmers to use nitrogen-fixing trees. The contribution to enhanced productivity and food security has been significant, in many cases through innovative and participatory operational methods. For example, IFAD's investments in the Niger's Aguié Department have systematically promoted farmer-managed natural regeneration. In 2000, the Aguié Rural Development Project, for assisted natural regeneration, began implementation on 100,000 ha of land that had become unproductive as a result of widespread removal of trees for fuel, building and other purposes. Tree shoots emerging from the soil were an indication of the thousands of stumps and roots lying just below the surface. An evaluation found that, because of regeneration, vast tracts of the project area were now protected from sandstorm damage, with an average of 50 new trees per hectare, and that soil fertility was improved. Reforestation rates were lower in non-project areas. The unmistakeable benefits of tree regeneration encouraged farmers not directly involved in the project to adopt regeneration practices.[57]

In 2005 IFAD was concerned that despite investments in agricultural development for 20 years in the Niger, the country was in the grip of a serious famine. It is likely, however, that the situation may have been worse had IFAD not made its investments. It was striking that the children at the nutrition centres in the Maradi Region came mainly from villages where farmer-managed natural regeneration had not been practised.[58]

Apart from promoting agroforestry in arid and semi-arid areas, IFAD has also supported this approach in areas where trees are of vital importance to national economies and perform ecosystem functions of immense regional and global importance. A good example is the grant provided to ICRAF for three phases of a tree domestication programme. Working in the humid tropics of western

[57] A follow-up loan, Project for the Promotion of Local Initiative for Development in Aguié (PPILDA), was initiated in 2005.

[58] Chris Reij, Centre for International Cooperation, Vrije Universiteit, Amsterdam, personal communication, 27 October 2008.

and central Africa,[59] the programme has developed and implemented a domestication process that involves considerable research elements (discussed in subsection 5.3.2). While West African tropical moist forests are rich in biodiversity, unsustainable practices such as slash-and-burn cultivation and uncontrolled logging are drastically reducing the number of useful trees and plants, leading to the impoverishment of small-scale farmers. By supporting the integration of high-value tree species, the grant helps farmers produce marketable forest products, enabling them to diversify their sources of income, improve their nutritional base and restore the region's biodiversity.[60] A range of technologies are used in what the project terms *community-based pathways* for an improved supply of planting material. One aspect of the technological approach was to teach farmers to graft plant material using a simple model. This has led to farmers producing their own trees, with some trees now fruiting after three years, as opposed to 20 years. To overcome resistance to planting trees in cocoa plantations, shorter trees were developed to avoid overshading.

Recent literature suggests that agroforestry systems, if properly designed, are likely to have a higher ecological resilience to extreme climate events than annual cropping systems (Lin 2007). Due to their higher ecological resilience, agroforestry systems may play an important role in the adaptation strategies of smallholders to climate change, depending also on economic and institutional factors. IFAD's experience with agroforestry is thus likely to be extremely important as the organization scales up its response to climate change.

5.2.4 Community-based natural resource management (CBNRM)

A range of community-based natural resource management (CBNRM) approaches for the management of a diversity of resources around the world has been supported by development agencies, with varying degrees of success.[61] The experiences of CBNRM, largely for wildlife management and ecotourism in southern Africa over the last few decades, are particularly well known. While often not termed 'CBNRM', IFAD projects frequently include a component for developing local institutions for natural resource management and rural development. A recent compilation highlighted that community-based natural resource management was the focus of over 80 per cent of IFAD-approved programmes and projects for 2000-2004 (IFAD 2006a). These programmes and projects addressed a wide range of natural resource development issues – land, water, forests, rangeland, fisheries and rural institutions. Gender, governance, culture and partnership also assumed greater roles.

IFAD has had some successful experiences with CBNRM for rangeland management – for example, in a project for community-based rangeland management in the eastern regions of Morocco. This was initiated in 1991 in response to continued degradation of rangelands under state control. The plan was to reverse and rehabilitate rangeland degradation and improve the incomes and living conditions of the most impoverished households. The project empowered livestock producers to take responsibility for range management by forming range users' cooperatives, and it provided them with technical and financial support. This was a ground-breaking step at the time, as it entailed organizing cooperatives along tribal affiliations to promote and reflect traditional decision-making mechanisms and to select suitable livestock management systems. The approach was successful,

[59] The countries involved were Cameroon, the Democratic Republic of the Congo, Equatorial Guinea, Gabon and Nigeria.

[60] Key objectives of Phase II were: developing diverse, multilevel agroforestry farming systems; promoting adaptable livelihoods for resource-poor rural farmers; integrating and managing high-value fruit, medicinal, fuel and vegetable species; increasing and stabilizing annual farm incomes; reducing food and health insecurity; and increasing ecological resilience.

[61] CBNRM is founded on the principle that if a resource is valuable, and landholders and resource users have effective rights to use, manage and benefit from it, then sustainable use is more likely to ensue. CBNRM initiatives thus aim to achieve improved conservation and governance of the region's commons by devolving rights and management responsibilities to the local level, integrating local knowledge, providing economic (and other) incentives that improve livelihood outcomes for local people, and building institutional capacity (Shackleton et al. 2008).

with 44 cooperatives established in 15 rural communities involving 9,000 households. Productivity improved from 150 to 800 kilograms (kg)/ha, with only modest violations during resting periods – when grazing is 'deferred' – on 400,000 ha over a two-year period. Herders came to realize that collective action was a win-win situation, and was the best way to get the most out of limited range resources while maintaining long-term sustainability.

More recently, GSLRP is establishing rangeland users' associations (RUAs) in the Sudan's eastern state of Kassala (see case study 1 in annex 5), also in response to rangeland degradation and the drive towards increasing local-level management of resources. While initially designed as a strategy to deal with climate variability and increasing land degradation, it is likely that this project will be further developed to respond more specifically to climate change. This shift is a result of the recent inclusion of climate change as a key cause of vulnerability in the 2009 COSOP for the Sudan.

In Mongolia, the Rural Poverty Reduction Programme (RPRP) has established rangeland management and monitoring committees (RMMCs) at *bag* (subdistrict) and *soum* (district) levels. These are composed of herder group representatives, government officials and residents of the local centres. RMMCs are empowered to formulate local natural resource management maps and associated development plans. The key objectives of RPRP are to: reduce poverty; improve rangeland management and strengthen herder resilience to natural calamities; increase livestock productivity and value; support income-generating activities; and build stronger rural institutions and social and financial services. Women are a significant part of the target group. A recent case study noted that IFAD's intervention is providing concrete support to some of the most common and effective coping strategies – for example, responding to drought through rotational grazing or resting degraded pasture during the summer, and protecting the headwaters of springs and rivers with fences, stones, trees and bushes – thus supporting spontaneous adaptation. Findings of a participatory analysis suggest that RPRP is contributing to reducing participants' vulnerability to current climatic risks and to enhancing the resilience of natural systems to these risks, although measures adopted might not be sufficient to reduce the risks of incoming climate change impacts (see case study 5 in annex 5).

While past projects have not specifically implemented CBNRM as an adaptation response, IFAD's experiences with this type of resource management do have the potential to form part of local adaptation strategies, through conferring greater responsibility to local stakeholder institutions, which are then able to respond more flexibly to changing climatic conditions. A critical issue to overcome will be the tendency of planners and implementers of natural resource development projects to not always profit from the lessons learned, which was highlighted in a recent review of CBNRM (IFAD 2006a) – either information is lost or it is not easily accessible or changing circumstances may limit its value.

CBNRM, ecosystem services, poverty reduction and climate change

CBNRM can be an effective mechanism for making stronger connections between ecosystem services and poverty reduction, assuming that these links are identified, understood and accommodated in project planning. Given the reliance of poor rural people on ecosystem services, and the fact that climate change threatens all ecosystem services, it is clear that climate change poses a substantial risk to the natural resource-based livelihoods of many poor people. Factoring climate change into the equation can increase complexity: for example, climate change threatens biodiversity, while biodiversity underlies important supporting and regulating services such as nutrient cycling and soil fertility, pollination and carbon sequestration. While much remains to be understood of the relationship between biodiversity and regulating services, it is clear that if biodiversity is not managed effectively, future options will become ever more restricted and the resilience of these complex socio-ecological systems to disturbance and shocks will be compromised (Shackleton et al 2008). Thus it is essential that a precautionary approach be taken, given the gaps in our understanding, so as not to foreclose future adaptation options.

Activities with good potential to *increase the synergies between biodiversity conservation, the valuing of local and indigenous knowledge and rural poverty reduction* include project components that focus on using and adding value to medicinal plants. Examples include Morocco's Livestock and Rangelands project and the Semi-Arid North-West project in Mexico described above. Concerning IFAD's grant to PhytoTrade Africa, the research and development process that contributes to product development in most cases builds on local and indigenous knowledge. Studies on local uses of the various species have been undertaken and, where relevant, product development takes this knowledge into consideration.[62] PhytoTrade Africa is in the process of establishing an intellectual property trust that will ensure that intellectual-property-related issues are addressed and that there is equitable sharing of the benefits realized.

The GEF component – Biodiversity conservation and participatory sustainable management of natural resources in the inner Niger Delta and its transition area – of the FODESA project has recently begun implementation in one of the most highly stressed regions of Mali, the Mopti region. Mopti stands out for its many deteriorating ecosystem services, high population density and high levels of poverty. The delta region is prone to recurrent drought, erratic rainfall, intense wind erosion and desertification. Activities to deal specifically with risk of drought and flooding include establishing a local ecological planning process and a strategy for wetlands conservation and management. A principal feature of the component is the promotion of linkages between socio-economic development and activities for environmental protection.[63] While implementation has only just begun for the above project, it does highlight the possibility of improving the linkages between ecosystem services and poverty reduction, which will be an important component of sustainable adaptation approaches that target poverty and vulnerability.

5.2.5 Water management and irrigation

Rising affluence, urbanization and irrigation are increasing the demand for water throughout arid and semi-arid regions, while climate change is negatively affecting water supply in many parts of the world. The situation could worsen dramatically: if a global temperature increase of 3-4°C is reached, changed run-off patterns and glacial melt could force an additional 1.8 billion people to live in a water-scarce environment by 2080 (UNDP 2007). Many countries already have no option but to balance the supply and demand for water as efficiently, sustainably and equitably as possible. Practical water-related adaptations with multiple benefits include rainwater harvesting, floodplain restoration, more-efficient water use, improved water storage and reuse of wastewater. Resilience-building for smallholder farmers, especially in drought-prone areas, will need to include increased buffering capacity through better management of soil moisture, and a combination of surface water and groundwater storage (IFAD 2008g). An important focus will be on improved water management in rainfed agriculture. The subject of water presents a number of maladaptations as a result of existing climate change policies, such as the headlong race for mitigation through biofuels and hydropower. While appropriate storage of water is important for adaptation, poorly planned flood, water-storage and transfer infrastructures represent maladaptations (SIWI 2008). It is important to recognize that, as with other thematic areas, climate change impacts on poor people combine in complex and mutually reinforcing ways with other impacts, such as severe and rapid degradation of water resources from non-climate drivers.

Irrigation schemes

Irrigation schemes have in many cases been shown to contribute to a rise in the productivity of land cultivated by small-scale farmers. However, negative environmental impacts of irrigation are equally well-known, and social conflict over access to this important new resource is a further challenge.

[62] In addition, primary processing of natural products, for example Marula nut-cracking, uses traditional methods.

[63] See annex 3 for additional information on this project.

This review of IFAD loans and grants included several examples of diverse forms of irrigation schemes, including spate irrigation, which many feel has great potential to enhance adaptation to climate change, as well as more conventional irrigation schemes.

The most recent spate irrigation project supported by IFAD is GSLRP, located in the Gash River Delta in the eastern part of the Sudan (box 8). Pressure on water resources in this area relates to the large number of displaced people and to population growth. While something of a neglected area, improvements in spate irrigation could play a significant role in enhancing adaptability to climate change in some of the most fragile areas on earth (van Steenbergen et al. 2008). Not all predicted climate changes are negative for spate irrigation, with much dependent on the flood regimes. In most cases where spate irrigation is practised, floods are expected to increase, but clearly an important issue concerns the timing and size of the floods.[64]

GSLRP (2004-2012) was designed to address the problem of the GASH spate irrigation scheme becoming overburdened by a large expansion of the number of sharecroppers, which had led to a decrease in the average area cultivated by households and a decrease in the herd size per household, insecure access to water for livelihoods and fragmented management of the scheme. Investments in GSLRP include land-tenure reform, water governance, scheme irrigation, support to improved crop husbandry and rangeland management. The following case study highlights the adaptation-related activities and options for enhancing climate resilience under the project (see case study 1 in annex 5).

Box 8: Spate irrigation, sustainable livelihoods and climate variability in the Sudan

The project in brief: The Gash Sustainable Livelihoods Regeneration Project (GSLRP) aims to re-establish sustainable livelihoods for the predominantly poor population in the Gash River Delta area, located in Kassala State in eastern Sudan. The project was prompted by the severe effects on the economic base of recurrent drought, population pressure due to large numbers of people moving into the area, and deterioration in the infrastructure of the Gash flush irrigation scheme. The ephemeral Gash River, which rises in the Eritrean highlands, responds rapidly to storm rainfall in the catchment area and is characterized by intense flood flows extending over an effective period of 60-70 days from July to September, with high silt loads. GSLRP combines rehabilitation of the spate irrigation system on the seasonal Gash River with more-equitable land tenure linked to economically viable holdings, and the development of off-farm income-generating activities. Apart from rehabilitation of the irrigation scheme, the other project components are animal production and rangeland management; community development, capacity-building and empowerment; financial services and marketing; and institutional support for water users' associations, the Gash Agricultural Scheme and agricultural service providers. By improving the living standards of the majority of poor people in the area, the project will assist in reducing social tensions.

Activities that support adaptation: While GSLRP was not designed as a climate-change adaptation project, its focus on rehabilitating the spate irrigation system and associated livelihoods emphasizes climate variability. While spate irrigation is inherently risky, it harnesses one of the variables that may increase with climate change: floods. Key GSLRP activities that address climate variability, or that indirectly reduce the risks associated with climate change by enhancing resilience and adaptive capacity, are the following:

Elements of the development approach that are relevant to adaptation planning are: putting livelihoods instead of infrastructure at the core; a strong focus on gender mainstreaming (climate change could exacerbate gender inequalities); the participatory approach, including in negotiations on land-tenancy reform; and linking environmental remediation with economic loci;

The *use of the sustainable livelihoods approach (SLA)* in project design, which focuses on strengths, vulnerabilities and livelihood strategies, provides a platform for developing resilience-building strategies for adaptation to climate change;

[64] Out-of-season floods usually make no contribution. In many areas, they are not diverted and, at best, are allowed to spread over outwash areas. Large floods are of limited use, but can cause chaos with local infrastructures unless carefully managed. However, more-frequent, moderate floods can increase returns from spate irrigation. An increase in temperature, predicted at 1.5 per cent globally, would also have numerous relevant effects.

A strong *role for spate irrigation* in climate change adaptation in fragile areas, which, although it is risk prone, is capable of dealing with variability and contributing significantly to food security;
River training activities that are likely to play a strong role in climate change adaptation, through flood damage mitigation; minimizing water losses through breaches and evaporation; maximizing use of the river flow; and preventing erosion of the riverbed and banks;
Sustainable methods for dealing with pressures on natural resources, such as rangeland regeneration and water harvesting; mesquite eradication and reforestation with indigenous species; and simultaneously increasing livestock productivity and reducing numbers;
The *financial services and marketing component is a critical link* to add value, unlock alternative income-generating enterprises and develop market chains for more diversified livelihood strategies.
Project actions that increase vegetation cover, reduce degradation of rangelands and encourage development of community forestry are also likely to increase the capture of carbon, and thus play a role in mitigation.

Source: Urquhart (2008).

As the case study indicates, while GSLRP was not designed as a climate-change adaptation project, its focus on rehabilitating the spate irrigation system and associated livelihoods emphasizes climate variability. The 2008 mid-term review has causally linked positive impacts on improved household nutrition, food security and household assets to water-harvesting and rangeland revegetation activities, as well as to the rehabilitation of the spate irrigation system – both actions that also support adaptation to climate change.

Apart from spate irrigation, IFAD investments have supported other forms of irrigation, sometimes in association with rainwater harvesting. An example is an IFAD-supported project in Malawi that is helping reduce the risks associated with rainfed farming by supporting rehabilitation and development of new irrigation systems, reservoirs and rainwater-harvesting structures. In Senegal, as well as in the Sudan, IFAD has supported the introduction and promotion of drip irrigation. A key activity of the Rural Diversification Programme in Mauritius has been to develop new irrigation schemes, rehabilitate existing schemes and establish water users' associations to own and manage them. The focus of this component was on the north and eastern regions of Mauritius, where poverty is concentrated, with the aim of helping farmers grow at least two, and sometimes three, crops.

Many IFAD projects have included components for irrigation of small plots, such as the PIVs of PIDRN in Mali. In this project, the small irrigated plots are fed by branches of the river, to fill in any gaps in rainfall and thus prevent retardation of the agricultural calendar. This is consequently a technique for harnessing the potential for small-scale irrigated farming in the vast floodplains of the area, and thereby reducing climate risks to agricultural production. In Madagascar, the Upper Mandraré Basin Development Project (PHBM) has had great success in transforming a drought-prone area in the south of the country from a situation of food insecurity and isolation into a thriving agricultural area with better connecting infrastructure, which now exports food beyond its borders. Further information is contained in Box 9 below.

Box 9 Food security through irrigation in drought-prone southern Madagascar

Before the Upper Mandraré Basin Development Project (known as the PHBM, based on its French acronym) was initiated in 2001, Mandraré was one of Madagascar's poorest regions. It is also the driest area in the otherwise relatively fertile island of Madagascar. Famine was recurring, insufficient food was produced and rice irrigation had fallen into disuse. The IFAD-financed project rehabilitated irrigation systems based on small rivers in the area, restored roads and other infrastructure, and introduced more intensive farming methods. The second phase of the project increased the number of communes and villages taking part and introduced a microcredit network, based on a similar, successful system in the north-east of the country. The project has promoted a more sustainable method of rice production, the SRI, which builds on local practices and uses local varieties, and has led to significant positive impacts. These include an increase in average yield of 3 to 4 tonnes per hectare, with low inputs – farmers in the south make use of green manure to fertilise their crops-

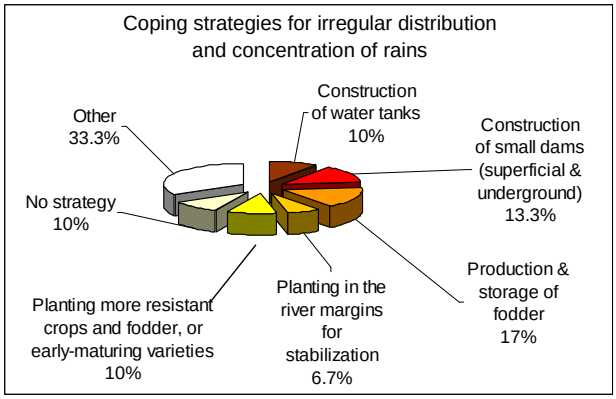
compared to 1.5 tonnes per hectare before the project. Even in a bad season, such as 2005, in which 50% of production was lost, the area could still feed itself. As the Country Programme Manager noted, "The population in this area were fed by the WFP before". In good years, surplus produce is exported - up to 25 000 tonnes of rice to the whole southern region. In the second phase of the project, smallholder farmers were encouraged to diversify production through 100 mini-projects for growing vegetables and crops such as cassava, maize and vegetables were supported. Farmers produced approximately 200 tonnes of cabbage, tomatoes, onions, garlic and carrots, as well as 4.5 tonnes of maize and manioc seeds and more than 8 tonnes of rice seeds. Further project actions included introducing basic farming machinery, encouraging local farmers to form producers' associations to help commercialize the crops, and supporting cattle breeding. The Mandrare project has become a model for replication by the government in Madagascar: from a typical area-based intervention, it slowly transformed into a value-chain project promoting agricultural products and market links. The strengthening of farmers' organizations and the local development plans of the communes will facilitate the long-term sustainability of the project activities. Concerning adaptation to climate change, important factors include the promotion of more climate-sensitive crops and varieties, such as cassava and sorghum. The high plateau of the Mandraré region has also benefited from an increase in rainfall, apparently linked to global climate change, which assists with environmental sustainability of the irrigation project.

Source: *Benoît Thierry, IFAD CPM, personal communication 19/11/2008; http://www.ruralpovertyportal.org/english/regions/africa/mdg/mandrare.htm*

An IFAD-supported intervention in north-eastern Brazil has introduced agricultural technologies adapted to semi-arid conditions and promoted irrigation schemes and technologies. The Sustainable Development Project for Agrarian Reform Settlements in the Semi-Arid North-East (Projeto Dom Helder Camara (PDHC)) is addressing the problems of uneven distribution of rain, aridity of land and reduced infiltration.[65] Farmers are gradually introducing important changes, shifting from their traditional subsistence, rainfed production practices to drought-resistant, diversified production systems. IFAD is supporting some of the farmers' spontaneous adaptation strategies, and introducing innovative coping strategies. Training in agroecological technologies and practices for the production and conservation of fodder is improving the supply of animal feed and reducing malnutrition and mortality in herds. Improved management of water resources is strongly supported by IFAD through the introduction of simple techniques for localized irrigation (e.g. drip and sprinkler irrigation), accompanied by infrastructure to harvest and store rainwater, such as small superficial and underground dams,[66] wells (*poços amazonas*, *poços artesianos*), roof tanks or 110 m^2 concrete catchment areas. Project participants have noted that the introduction of water management practices allowed production during seasonal dry periods, drastically reducing the need for supplementary off-farm employment (see case study 6 in annex 5).

[65] It is doing this through technical assistance services based on demonstrations and a combination of training and credit to ensure that farmers adopt the technologies appropriate to the weather conditions and availability of natural resources.

[66] The underground dam is a technology that allows the capture and storing of rainwater under the soil, without flooding the best land for planting, and minimizing the climatic risks associated with seasonal dry periods and cyclical droughts.



Frequency of different strategies adopted by farmers to cope with the impacts of irregular distribution and concentration of rains. The category 'other' includes: exploitation of plants from the caatinga,[67] localized irrigation, natural control of pests, adoption of soil and water conservation techniques, and vegetable production.

5.2.6 Coastal management and fisheries

Possible climate-change impacts on marine resources have significant implications for activities in the fisheries sector. A number of IFAD projects currently promote more-sustainable utilization of fisheries resources and value-adding through diversification activities. For example, the recently completed Rural Diversification Programme in Mauritius responded to the identified depletion of fish stocks in lagoons by providing credit, fishing gear, boats and technical support for fishermen to increase their catch from outside the lagoon. While the President's report for this loan did note the risks of fish resource depletion for project activities, it is unclear whether or how this has been avoided. Fish-aggregating devices were used to encourage plankton and attract fish. While this was successful from a catch perspective in Mauritius, in Rodrigues a constraint has been the lack of boats able to venture beyond the lagoon, as the sea is rougher here than just off the coast of Mauritius. A follow-up programme, the Marine and Agricultural Resources Support Programme (MARS), will further promote non-fishing activities to reduce the unsustainable (for the national treasury) payment of bad weather allowances, received by fishermen when they are unable to go out to fish due to weather conditions. This is expected to have the effect of reducing pressure on fisheries resources, as well as a positive effect on agricultural productivity and food security.

The artisanal fishery development component of the Sri Lankan Post-Tsunami programme strives to incorporate local traditional fishing technologies into the project and to introduce modern ones to improve quality and productivity. It is further expected to improve post-harvest technologies and minimize post-harvest losses through the introduction of suitable modern technologies.

Dealing with sea-level rise and flooding

In the humid zones, IFAD projects have devoted attention to the consequences of cyclones, floods and rising sea levels. An example from Bangladesh is the Smallholder Agricultural Improvement Project, which aimed to transfer technologies such as small embankments and drainage schemes. These actions strengthened the capacity of small farmers to cope with increased flooding, early and late floods, or early flood recession.

As projections for climate change are revised upwards, there is an increasing urgency to implement effective technologies that can moderate the effects of sea-level rise. In some cases, the only option

[67] Within the Sertão region, the caatinga is the predominant vegetation, found only in Brazil. Composed of xerophilous and prickly species, with few grass species, it is characterized by rich biological diversity and high rates of endemism.

will be migration. For example, as Burton (2008) points out, Bangladesh faces a major problem in sustaining the livelihoods of millions of people living very close to sea level in the outer *chars* or silt islands and delta lands. Problems related to climate change, such as sea-level rise, salinization of groundwater and cyclones, are currently being experienced, some at an accelerating rate and intensity. In the next few decades, 10 to 20 million Bangladeshis will be obliged to adapt by migrating. In locations where migration will be the ultimate solution, IFAD's experiences in supporting displaced people in restoring their livelihoods, and in dealing with related situations of conflict, as discussed later in this report, will be invaluable.

In other instances, coping with sea-level rise can be pursued through in situ NRM interventions that restore natural buffers and protection mechanisms. The IFAD-supported Post-Tsunami programme in Sri Lanka includes a number of activities designed to promote coping mechanisms for sea-level rise, including: creating awareness of the issue and possible ways to deal with it, developing/retaining green belts, and restoring mangroves to buffer both sea-level rise and the impacts of storms or future extreme events such as tsunamis. Sand dune restoration is a related activity, also designed to reduce the impact of wave erosion. The GEF grant, Participatory Coastal Zone Restoration, that complements the Post-Tsunami programme provides assistance in considering the incremental costs of country-driven initiatives for green restoration. It includes a focus on subsequent conservation measures to rehabilitate the devastated areas of the coastal ecosystems, mitigate further land degradation to reduce potential damage arising from future human-induced and natural events such as cyclones and tsunamis, and eradicate invasive alien species spread by the tsunami.[68]

Water pollution is predicted to increase in areas susceptible to increasing water scarcity as a result of short- and long-term climate variability. In Sri Lanka, the Post-Tsunami programme includes a number of activities to deal with water pollution in lagoons and coastal areas – pollution that could result in degradation of fishery resources and consequent loss of income for target populations. These activities include water-quality monitoring, fishery management plans, solid waste management, and alternative income generation activities.

5.2.7 Land tenure and climate change

Over the years, IFAD-supported projects have recognized that poverty is strongly linked to insecurity of tenure, as well as to land and natural resource degradation. A number of projects have specifically tackled the question of securing access to land. One such example is the Semi-Arid North-West project in Mexico, discussed above. A further example, with a strong gender focus, is the IFAD-supported activities in Nepal. Through a programme involving 40-year leasehold arrangements and training, indigenous communities, and more particularly women, are successfully engaging in forest rehabilitation and biodiversity management. These kinds of initiatives provide better management of natural resources and protection of biodiversity, reforestation, more-secure access by women to resources, and reduced conflict among ethnic minorities (IFAD 2008e). In Indonesia, the East Kalimantan Local Communities Empowerment Programme is helping indigenous communities gain more-secure tenure over land and natural resources and resolve conflicts over land. This action is particularly important given the devastating effect of deforestation on natural resources and the indigenous communities that depend on them. Such deforestation has been widespread over the

[68] The programme employs environmental conservation technologies to rehabilitate the natural systems that protect coastal communities against climate risks such as storm surges. Apart from this, it incorporates sustainable fisheries activities to assist fishers in coping with and adapting to increasing climate variability. A further area for intervention is energy use, including substitutes for fuelwood consumption.

past 30 years, owing to the activities of private companies, combined with the effects of forest fires and land clearance for estate crops.[69]

The linkages between security of land tenure and the ability to adapt to climate change are becoming increasingly clear, especially in the context of indigenous peoples' access to land and the natural resources it contains. Concerning mitigation, large-scale monoculture plantations for biofuels have already produced forceful expropriation of indigenous land and territories (IFAD 2008e). In these cases, so-called mitigation has led to maladaptation for indigenous peoples.

More-secure land tenure makes investing in sustainable technologies such as soil rehabilitation possible for poor farmers, as has been demonstrated by the Project to Support Development in the Menabe and Melaky Regions in Madagascar. This project builds around the following strategic thrusts: (i) the link between the two components of land tenure security and sustainable productive development (mainly in terms of land access and use by disadvantaged populations such as migrants and management of communal land based on representative farming systems) and (ii) a regional perspective (complemented by institution-building to be implemented nationally under the National Land Use Management Plan – PNF and its framework of decentralised land use management), while the project interventions are organized in a decentralized manner (identifying "clusters" of rural communes where the project is implemented), encouraging demand for intercommunal action. Curbing soil erosion enhances the value of land allocated to poor farmers. Moreover, as also highlighted by this project, the vulnerability of women is exacerbated by their relative insecurity of access and rights over resources and land. Assurances that farmers will be able to work their land under a recognized certificate of ownership, or a legally recognized long-term lease are imperative for farmers to be able to enrich and even maintain the land (using fertilizers, regular weeding, etc.), to invest in production (zebus, farm equipment), to plant fruit trees or reforest, and to make sustainable investments in diversification workshops or crop intensification programmes. Such assurances are also required by banks when farmers must ask for an investment loan, and this is one of the conditions for access to credit. This is clearly an important prerequisite for households farming irrigated plots and for producers wishing to invest in diversification and intensification programmes introduced by the project.
In Madagascar, land-tenure conflicts may increase as population grows, land becomes scarce and communal lands are mismanaged. Climate change impacts could exacerbate this process. This growing crisis is worsened by a weak land administration system and lack of secure tenure. Through various programme loans and grants, IFAD has been working with the Government of Madagascar to improve the situation through a process of 'learning by doing' (IFAD 2006a). The country's rural land-tenure administrative system was developed gradually over a 10-year period, in parallel with three IFAD-funded programmes and a grant project, each with a focus on rural land-tenure issues. Each project contributed valuable knowledge and experiences to the next – and to the process of empowering poor rural people. While not specifically developed as an adaptation response, the process of *learning by doing* is an extremely important one for successful adaptation.

A further example of strengthening land rights lies in IFAD investments in India, where programmes have included the titling of tribal hill lands and facilitating land rights for women in the State of Orissa, and support to the government definition and protection of tribal land rights in Andhra Pradesh. Some 17,175 land titles, registered in the names of both husband and wife, were distributed to 6,837 tribal peoples in 236 villages (IFAD 2008e). The provision of land rights has not only opened up new opportunities for income generation, such as horticulture and small livestock raising, but has also promoted sounder environmental management practices, as many of the new landowners have ended the former practice of shifting cultivation. In many cases, more sustainable

[69] Indonesia is the largest exporter of wood and wood products in South-East Asia. By law, all forest resources come under state administration, with exploitation rights being leased to private companies.

environmental management practices can be positively correlated with adaptation to climate change.

5.2.8 Summary: technologies for adaptation and CBNRM

A significant number of technologies promoted in IFAD projects have direct relevance for adaptation to longer-term climate change, although they are initially focused on climate variability. These include technologies from the fields of agriculture, natural resource management, water conservation and management, and fisheries, as well as approaches that focus on community-based natural resource management and securing land tenure.

Technologies for adaptation. IFAD has funded projects to combat land degradation and conserve soil and water in the Sahel region for over three decades, and elsewhere, providing important support to farmers to adapt to drought and to climatic variability. Many of these projects include sustainable agricultural approaches that generally support retention of soil moisture and vegetation, which are likely to have positive effects on mitigation as well as adaptation to a changing climate. Practical water-related adaptations with multiple benefits from IFAD projects include rainwater harvesting, floodplain restoration, appropriate irrigation systems, improved water storage, and re-use of wastewater, all of which can build resilience for smallholder farmers, especially in drought-prone areas. IFAD has been one of the few agencies to support improvements in spate irrigation, which could play a significant role in enhancing adaptability to climate change in some of the most fragile areas on Earth. Other technologies relevant for adaptation in IFAD's portfolio include sustainable fisheries management and interventions to address sea-level rise and flooding. Of particular importance is IFAD's support to agroforestry systems, which, if properly designed, are likely to have a higher ecological resilience to extreme climate events than annual cropping systems.

Community-based natural resource management. IFAD's experiences with community-based natural resource management, although not specifically implemented as an adaptation response, do have the potential to form part of local adaptation strategies. Through community-based natural resource management, local institutions for natural resource management and rural development are developed and their capacities are built. They are able to identify stronger connections between ecosystem services and poverty reduction and accommodate them in project planning. This is an important component of sustainable adaptation approaches that target poverty and vulnerability. Finally, the linkages between security of land tenure and the ability to adapt to climate change are becoming increasingly clear, especially in the context of indigenous peoples' access to land and natural resources – long a focus area for IFAD.

5.3 Research for pro-poor development

5.3.1 Importance of pro-poor research in supporting climate change responses

While agricultural research played a major role in rapidly increasing agricultural production and reducing rural poverty in Asia in the last half of the twentieth century, there has been a disengagement over the past two decades. Progress in productivity gains has slowed, environmental damage has increased, climate change is accelerating and the number of people going hungry is rising. All these situations call for reinvesting in agricultural knowledge, science and technology for achieving equitable and sustainable development (IFAD 2009b). Since publication of the *IPCC third assessment report: Climate change 2001* (IPCC 2001), much research has been carried out on the impacts of climate change on developing regions; however, further research is still required, especially in Latin America and Africa (IPCC 2007b). An important area for IFAD contributions is the promotion of research, testing, validation and introduction of adaptation options (including

indigenous and new technologies) in the agriculture and rural development sector. Given the increasing emphasis on vulnerability, research relating to methods and tools for impact, vulnerability and adaptation assessments is a further opportunity for contribution. The demand for systematic approaches, strategies, practices and technologies for adaptation is growing throughout the world (IPCC 2007b). Research on adaptation options and dissemination of findings are high priorities, calling for intensifying existing cooperation between research institutions, development organizations and farmers.

5.3.2 Research to address climate variability

Through its grant programme, IFAD has a long history of supporting research institutes and other bodies in testing, adapting and disseminating technologies to address climate variability, which is a source of valuable lessons for the mainstreaming of adaptation to climate change.[70] Increasing the resilience of developing-country agriculture in the face of climate change will require the development of improved crop varieties and animal breeds. It will also require more prudent and integrated management of crops, animals and the natural resource base that sustains their production, while providing other vital services for people and the environment (IFAD 2009b). A number of research areas supported by IFAD have addressed these imperatives.

A successful example of research to address climate variability is the partnership between IFAD and the International Maize and Wheat Improvement Center (CIMMYT) to create and deliver stress-tolerant maize varieties to poor farmers in sub-Saharan Africa. IFAD's experience has led it to recognize the importance of blending traditional knowledge with scientific research, and the need to develop stronger alliances for sharing knowledge of responses to climate variability (IFAD 2008e).

IFAD has taken a lead in mobilizing interest in and donor support for research on some important 'neglected' food crops of poor people. Examples of successes are the research on plantain, bamboo and rattan, and cassava. For instance, cassava research has been supported over the entire lifespan of the agricultural research/technical assistance grant (TAG) programme, with a range of technology products generated along the way. These have included: improved cassava varieties, highly cost-effective biological control technology of two major cassava pests, transfer of improved cassava varieties from Africa to Latin America, and development of a global cassava policy. The impact of long-term involvement in the cassava programme on poor rural people in Africa has been notable. By 1994, US$27 million had been spent on biological control of the cassava mealybug in response to a new development in the 1970s, when the mealybug began to devastate cassava fields throughout Africa and threaten the food security of millions. The benefits to poor farmers whose fields had been saved was estimated at US$4.5 billion, or more than 160 times the cost of the control measures (Swindale 1997). Others have estimated the cost-benefit ratio at 149:1.

IFAD has supported three phases of a TAG to ICRAF for the Diversification of Smallholder Farming Systems in West and Central Africa through Cultivation of Indigenous Trees. For the sake of brevity, all three phases will be collectively referred to hereafter as Tree Domestication in West and Central Africa. The first phase, subtitled Farmers Can't Eat Cocoa (2000-2002 – Grant No. 456), focused on the formulation and testing of integrated strategies for the domestication and marketing of priority, high-value agroforestry tree species.[71] During this period, considerable capacity and knowledge were developed by ICRAF and its partners. This led to a second phase, Smallholder Farming: Indigenous Trees – Phase II, subtitled Growing Out of Poverty (2004-2007 – Grant No. 697), which focused on

[70] While a number of IFAD loans do not have an overt focus on research, they may in fact have ongoing links with research institutions. For example, while it is not a specific project component, the Sustainable Development Project for Rural and Indigenous Communities of the Semi-Arid North-West in Mexico works on appropriate varieties with local universities through a network.

[71] Tree 'domestication' is defined as taking trees from their natural habitat and adapting them, using simple propagation techniques, to farmers' needs.

the integration and management of trees in farming systems. The programme aimed to facilitate the development of various productive agroforestry systems in order to enhance the livelihoods of resource-poor rural farmers. The second phase included integration of high-value fruit, medicinal, fuel and vegetable species, and fine-tuning of existing work packages for high-value tree propagation and cultivar development – adapting them to the means, capacities and farming systems of grass-roots partners and target groups. Finally, the grant has merited yet a third phase, the Programme for Promoting Rural Innovation through Participatory Tree Domestication in West and Central Africa (approved in September 2008 – Grant No. 1058). Of relevance to climate change adaptation, the TAG has led to a gradual reduction in the practice of slash-and-burn agriculture in these humid tropics areas. Small-scale farmers now do not burn fields that have been left to lie fallow for several years, owing to the presence of trees. Apart from the adaptive benefit of enhanced soil conservation and fertility, the greater number of trees also increases the chances of sequestering carbon for mitigation purposes.

In 2004, IFAD provided a grant to ICBA for the Programme for Saving Freshwater Resources with Salt-Tolerant Forage Production in Marginal Areas of the West Asia and North Africa (WANA) Region – An Opportunity to Raise the Incomes of the Rural Poor (2005-2009). Through this grant, IFAD has supported research and development for salt-tolerant forage crops and techniques for irrigation with salty water. This promises to be particularly relevant to adaptation to climate change in areas where sea-level rise will cause intrusion into groundwater, as well as in post-disaster situations – for example, entry of sea water into productive fields in Sri Lanka after the December 2004 tsunami, which rendered them unusable for months or perhaps longer.

This grant has funded an applied research process, building on traditional farming methods, to integrate the use of saline water into an overall strategy of sustainable semi-arid and arid farm system management (box 9). The ICBA grant targets marginal agricultural lands that have become degraded due to a combination of climate change and lack of appropriate adaptive management.

Box 10. Promoting climate change adaptation through salt-tolerant forage in integrated systems

The grant to ICBA for the Programme for Saving Freshwater Resources with Salt-Tolerant Forage Production in Marginal Areas of the West Asia and North Africa (WANA) Region has very strong relevance to climate change adaptation. It constitutes a novel approach to the development of methods and techniques that enable national agricultural research systems (NARS) and farmers to find ways of using marginal water resources and degraded soils to achieve economic and sustainable production in an integrated forage-livestock system. The objectives of the programme are to:

- Identify species of forage grasses, legumes and shrubs that are tolerant of salinity and thus suitable for degraded and marginal lands in WANA, resulting in higher incomes for resource-poor farmers; and make them available to NARS and farmers for testing and evaluation;
- Identify irrigation and drainage management systems for sustainable use in saline irrigated forage systems, and make them available to targeted NARS and farmers;
- Develop optimized systems for saline irrigated forage production and demonstrate these to farmers, in particular women farmers involved in livestock husbandry, in seven countries in the WANA Region;
- Enhance capacity of national researchers in all aspects of saline irrigated forage systems; and
- Integrate researchers, extension agents and farmers into collaborative networks for saline irrigated forage production.

Poverty and vulnerability are linked to lack of access to productive land and water, aggravated by unpredictable rain, high temperatures and salinity; few crop and livestock options are available to support the livelihoods of poor farmers and pastoralists. Saline water and saline soils are constraints across the major farming systems of the region. These systems include small-scale irrigated, mixed (rainfed, dryland), pastoral and arid, where the degree of poverty is high and the potential for poverty reduction is moderate to high through intensification and diversification. Livestock play an important linking role in these systems.

Specific project technologies relevant to climate change adaptation are:

- Land-use changes to maximize sustainable yield under increasing climatic variability, particularly land degradation, drought and salinization;
- Modification of crop varieties and crop calendars in response to increasing seasonal variability in rainfall and temperature, mainly through the introduction of genotypes more suited to the favourable growth period and salinity conditions;
- More-appropriate irrigation systems (e.g. no further salinization), with a more-efficient use of irrigation water through improved application techniques;
- Improved integrated water management;
- Diversification of farming systems, including integrated crop/livestock systems that include conventional forage and shrub and tree systems;
- Use of locally adapted genotypes to harsh environmental conditions and creation of sustainable seed production systems and seed banks; and
- Development of climate-adapted strains, e.g. salt-tolerant varieties of forage.

The project is built on the strong participation of local farmers and on incorporating local knowledge, including available relevant genetic resources, into its activities. At a recent regional workshop, project partners concluded that project approaches and activities are making an impact in terms of improving farm productivity and increasing crop diversification and the options available to farmers. As an indication of success, NARS and farmers are seeking to expand activities to more farms in the targeted region and elsewhere. While capacity-building has progressed considerably, on-farm training in many aspects of the production and utilization of forage under salinity/marginal conditions is still needed by farmers and NARS. The project has developed two manuals on on-farm forage utilization techniques and on seed production of salt-tolerant crops. Strengthening of extension services and building farmer awareness are important requirements for expansion. According to the project, seed production for targeted varieties/genotypes is the main step needed for scaling up and adoption by a sizable number of farmers. Only in this way can the expected impact on poor farmers' livelihoods be achieved in marginal environments subject to extreme climatic changes. A second, scaled-up phase is planned.

Source: Questionnaire completed by ICBA for this study.

IFAD investments have indicated the value of creating synergies between indigenous/local knowledge and applied scientific research. A good example is Tree Domestication in West and Central Africa, funded through an IFAD grant to ICRAF. This programme was highly influenced by farmers themselves, as they identified the tree species they wished to propagate and the phenotype that would best serve their needs. Farmers were thus real partners in the programme, which had its origins in local knowledge. ICRAF and its partners provided technical and research support and development, and worked to empower farmers in marketing. Of the 7,600 farmers involved by the end of Phase II of the programme, approximately 3,000 were women. Farmers also evaluated programme activities and trained other farmers. Annual action plans were developed on the basis of meetings with farmers.

In 2004 IFAD awarded a TAG to the International Plant Genetic Resources Institute (IPGRI) for the Programme for Empowering Sahelian Farmers to Leverage their Crop Diversity Assets for Enhanced Livelihood Strategies. The programme applies a 'diversity field' approach[72] for on-site conservation and sustainable use of plant genetic resources. This approach is based on a research/action/training system implemented in the field, enabling collective training processes to be established for researchers, developers and farmers in order to enhance their collective innovative capacities with regard to plant genetic resource management and use. Farmers test plant genetic material and observe and analyse the data gathered, using their own selection criteria. The main issues related to

[72] A 'diversity field' is a large field, identified collectively by local inhabitants. It is divided into different sets of plots separated by a central path. The number of plots may vary depending on the particular location and the number of varieties available for testing. There are thus different varieties for each species, of local origin (either from the local village or from other villages in the region) or suggested by research, NGOs or extension services on the basis of identified constraints.

climate variability are drought, increased *Striga* infestation,[73] and other pests and diseases. Various plant varieties and techniques are tested against these factors. The diversity field approach modifies the intervention approaches of research and development bodies, enabling research experts to work *with* and not only *for* local people. Development agents and research experts quickly gain a clearer understanding of farmers' viewpoints and their capacities for knowledge-sharing and joint research. Technical, scientific and indigenous types of knowledge are also disseminated among farmers through the conservation and optimization of genetic diversity at village and inter-village levels, including through seed fairs.

5.3.3 Summary: pro-poor research and climate change

IFAD has a long history of supporting research institutes and other bodies to test, adapt and disseminate technologies in order to address climate variability, which is a source of valuable lessons for mainstreaming adaptation to climate change. Examples of IFAD-supported research that are especially relevant for adaptation to climate change include: developing stress-tolerant maize varieties in sub-Saharan Africa, improvements in 'neglected' food crops (for example cassava) of poor rural people, formulation and testing of integrated strategies to domesticate and market high-value agroforestry tree species in West and Central Africa, and research and development for salt-tolerant forage crops and saltwater irrigation techniques in West Asia and North Africa. IFAD-supported research has also focused on creating synergies between indigenous/local knowledge and applied scientific research, and on promoting empowering action-learning processes towards this end. Recently, IFAD has stepped up its efforts to build scientific capacity and influence policy and institutional reform to facilitate the adoption of improved responses to climate change threats, as well as help in the transition to improved land management practices.

5.4 Economic diversification

5.4.1 Evolving approaches to diversification

Economic diversification is becoming increasingly important as an adaptation strategy to increase economic resilience and decrease reliance on climate-vulnerable economic sectors.[74] At the sectoral level, increased economic resilience is often achieved by adapting existing practices to reduce exposure to risk (UNFCCC 2007c). In the agricultural context, for example, increased resilience may be achieved by improved water management practices. Or it may involve diversifying the mix of crops planted and adding value to the primary products – which is the focus here. Reducing reliance on vulnerable sectors involves diversification of livelihood strategies.

Since its establishment, IFAD has viewed the development of off-farm enterprises in rural areas as a means for improving the well-being of poor rural people and for empowering rural women. Support to indigenous women microentrepreneurs has proved a very effective way not only to support women's economic empowerment, but also to increase household incomes in many countries in Latin America, Asia (IFAD 2008e) and other regions. The organization has gained considerable experience in diversification approaches, as well as in rural finance interventions. Key lessons from this experience are relevant to support to climate change adaptation, in the sense of reducing

[73] *Striga*, commonly known as witchweed, is a genus of 28 species of parasitic plants that occur naturally in parts of Africa and Asia. Although most species of *Striga* are not pathogens that affect human agriculture, some species have devastating effects on crops, particularly those planted by subsistence farmers. *Striga* appears when soil moisture is very low.

[74] This is reflected in the Nairobi Work Programme as subtheme b (v), "Promoting understanding and the development and dissemination of measures, methodologies and tools including for economic diversification aimed at increasing economic resilience and reducing reliance on vulnerable economic sectors, especially for relevant categories of countries listed in Article 4, paragraph 8, of the Convention".

reliance on natural resource sectors that are vulnerable to climate change, and of adding value to products that can still be sustainably harvested despite climate change impacts.

5.4.2 Role of diversification in adapting to climate change

More-diversified livelihood strategies can lead both to enhanced incomes and to spreading the risk for poor people, whose livelihoods are largely based on natural resources. Diversification strategies are thus important in managing current climate risks, particularly for subsistence agricultural communities, and will be critical for future adaptation to climate change. Financial services and marketing, discussed below, are the critical links in adding value and unlocking alternative income-generating enterprises, and in developing market chains.

An example from Mauritius highlights the importance of diversification in moving away from water-intensive crops such as sugar. While not developed to promote adaptation to climate change, the Rural Diversification Programme, nearing completion, is playing an important role in implementation of the country's non-sugar-sector strategic plan. An innovative aspect of this programme has been the marketing information system developed, which includes Short Message Service (SMS) alert messages sent via cellphones and using the mass media. While the programme itself has not included links with climate information, the management location within the agricultural extension unit has allowed it to take advantage of an existing system set up by this unit some years ago, prompted by extremely heavy rainfalls.

> *Diversification strategies for managing current climate risks are in use in settings as varied as subsistence agricultural communities in northern Nigeria, the Sudan, Mexico, the Lao People's Democratic Republic and the Philippines; smallholder commercial farms in Argentina, Mexico and Thailand; and pastoral systems in Mongolia. Recommendations from these and other studies urge further economic diversification, as important for future adaptation to climate change. However, there are significant constraints on diversification that are identified in several* Assessments of Impacts and Adaptations to Climate Change (AIACC) *studies. Success will require integration of development strategies with adaptation planning.*
>
> – GLOBAL CHANGE SYSTEM FOR ANALYSIS, RESEARCH AND TRAINING (START) 2007

The IFAD-supported grant to ICBA for research and development of salt-tolerant forage crops and techniques for irrigation with salty water, discussed above, includes a crop diversification component that is highly climate adapted. Small-scale farmers can benefit from producing salt-tolerant forage for their animals, or through marketing part of their forage product. Feed shortages are an acute problem in most of the WANA Region. Due to limited agricultural land and water resources, the farming system has relied mainly on cash and economic crops. Developing specialized forage farming systems based on salt-tolerant forage and marginal-quality water can help overcome this problem, at least in some localities within the dry environments where saline groundwater is used for agricultural production, and in salt-affected areas in prime agricultural lands where saline drainage water is available. Such systems can sustainably ameliorate feed scarcity in small-scale crop/livestock farms and will contribute to intensifying and diversifying on-farm production, expanding farm enterprises and securing farm livelihoods.

5.4.3 Creating new value chains from tree products and medicinal plants

An example of IFAD-supported activities that target mainly rural women is the grant to PhytoTrade Africa[75] to support the creation of new value chains from tree products in arid zones (box 10),

[75] PhytoTrade Africa is the commercial name used by the Southern African Natural Products Trade Association, a membership-based organization established in 2001 with support from IFAD. The association is developing a sustainable natural products industry in southern Africa that will be of benefit both to people and to biodiversity.

including beverages, cosmetic oils and health-care products in eight countries in eastern and southern Africa.[76]

Box 11. PhytoTrade Africa – building value chains for plant products

The global market for cosmetics and 'nutraceuticals' based on natural products is growing rapidly. PhytoTrade Africa works to create economic opportunities for poor rural communities in the dry and marginal areas of southern Africa by linking them to markets for plant products such as wild fruit and seeds harvested from common woodlands. The aim of the PhytoTrade Africa programme is to enable poor rural communities to generate supplementary incomes through sustainable exploitation of natural products such as baobab, *marula*, Kalahari melon seed, *Ximenia* [spp.], *Trichilia emetica*, *mongongo*, *Kigelia africana* and devil's claw. This programme seeks to bring new, community-derived natural products to the market with appropriate intellectual property protection. The majority of the association's members are small-scale women entrepreneurs and civil society organizations involved in transporting and processing the products and, increasingly, in exporting them. The work of PhytoTrade Africa focuses on building value chains that connect harvesters with markets, and on supporting and linking market players along the value chain.

In 2006 almost 30,000 rural harvesters – over 90 per cent of them women – sold raw or value-added plant materials to PhytoTrade Africa members for a total value of US$384,000. The revenues make a small, but important contribution to building the economic livelihoods of some of the poorest people in the region. Evidence of impacts includes increased incomes to groups of poor rural people, the majority of whom are women; enhanced self-esteem on the part of the primary producers; increased awareness of the importance of sustainable harvesting; and premiums on organically certified products. The primary processors involved, who are members of the trade association, have realized increased opportunities for marketing their products, as well as being able to network with other players in the natural products sector.

Economic diversification, in the form of shifting from agricultural production to trade in natural products, is contributing towards improved livelihoods. This has created economic opportunities for poor rural people who, in some instances, have used income generated from natural products to set up new investments, such as joining savings clubs or starting up small businesses or investing in livestock. Areas of innovation include the development of new cosmetic and health products that utilize ingredients from the focal species. Innovative partnerships have also been established between primary producers and commercial partners, e.g. between the Eudafano Women's Cooperative and Body Shop International under the Body Shop community trade programme.

Source: Questionnaire completed by PhytoTrade Africa.

Given the drought-tolerant nature of the locally adapted and evolved focal species used by PhytoTrade partners, the efforts to support commercialization of these indigenous species and to build up a viable natural products industry are to a large extent an appropriate strategy for adaptation to climate change. Drought limits the number of crops that can be grown in the region and increases the frequency of crop failure; thus people depend more and more on indigenous plants for their day-to-day survival. This causal chain can be expected to intensify, given scenarios for decreased rainfall for much of the region. In order to understand and address current and expected impacts, PhytoTrade Africa's impact-monitoring team gathers and analyses data in various relevant thematic areas on an annual basis. Initiatives include the development of technologies to make the processing of natural products more efficient, while at the same time ensuring that sustainable harvesting techniques are adopted.

> *The biggest threat to our work is that, as climate change starts to limit the number of crops that can be grown in the region, and to increase the frequency of crop failure, people will come to depend more and more on indigenous plants for their day-to-day survival (e.g. the current increase in the demand for indigenous fruits in Zimbabwe because of increased vulnerability), with resultant competition for the fruit. Whilst I don't think there are likely to be any major threats to the sustainability of these resources (since greater demand usually leads people to start nurturing and*

[76] Botswana, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe.

even cultivating the trees), it may push up the price of the fruit to beyond economically viable levels for our businesses.

– Gus Le Breton, PhytoTrade Africa CEO

Regarding diversification approaches involving medicinal plants, the Semi-Arid North-West project in Mexico focuses on plants used not only for the health of humans, but also for animals and vegetables. A desk review of IFAD's Latin America and the Caribbean portfolio from the perspective of indigenous peoples' issues identified the need to broaden initiatives aimed at commercial utilization of medicinal plants in order to strengthen traditional medicinal systems (IFAD 2007b).

Under Tree Domestication in West and Central Africa, farmers have increased their incomes through the production of high-value fruit, which may also be more climate-change-adapted than cocoa. For example, the same weight of bush mango has three or four times the value of a bag of cocoa. While cash crops such as cocoa and coffee have been produced since colonial days, the pricing system has not been favourable to farmers. The grant was based on the idea that the integration of indigenous fruit trees could help alleviate the impact of falling prices.

The cash crops introduced in colonial times are not really working for farmers anymore. You need to feed yourself.

– Technical assistance expert and long-standing IFAD partner, Western and Central Africa

5.4.4 Marketing and rural finance interventions

Effective marketing is one of the key success factors in diversification. Phase II of Tree Domestication in West and Central Africa included the design and evaluation of a community-based marketing information system with partners at the national level in Cameroon. ICRAF and its partners worked to group farmers according to their interest in different kinds of high-value fruits – for example, bush mango – and organized them into grouping cells. In addition to training in quality of production, farmers were trained and empowered to improve their negotiating skills. The cells were then brought together with wholesalers from the city, and farmers were able to speak with one voice to ensure favourable terms for their products. The marketing intelligence system included information on prices being obtained in the cities. Assistance with transformation and packaging were further components of the marketing system.

Regarding rural finance, IFAD projects have met with severe limitations in terms of implementing rural credit. Lessons from earlier rural credit interventions, for example in Mexico, have included the realization that an alternative would be to establish community-based social, investment and productive funds, and to support local microfinance services. The microcredit component of the Mauritius Rural Diversification Programme, while having a positive impact on helping unemployed people and youth start small enterprises, has been plagued by high levels of debt. Programme management believes that cooperative credit societies would have been preferable, as peer pressure is what motivates people to pay back loans.

While marketing and development of viable rural finance systems may not appear to be related to climate change, they are critical components that can make or break diversification approaches, which in turn are increasingly recognized as a key component of adaptation strategies.

5.4.5 Diversification through tourism

The idea behind promoting rural tourism is to reduce dependence on agriculture-based products by promoting a shift to off-farm activities, and thus improve the natural resource base and environmental services. IFAD has had varying experiences in this regard.

In Latin America and the Caribbean, projects with ecotourism activities (actual or planned) are to be found in Bolivia, Guatemala, Mexico, Panama and Peru (IFAD 2007b). There are a number of

successful examples from the Andean region, linked to cultural assets, and in the Amazon, projects have showcased environmental and cultural assets of indigenous groups. For example, the Mapajo Indigenous Eco-tourist Project (Beni, Bolivia), funded by the IFAD grant PRAIA, constitutes an indigenous initiative to create and diversify employment, increase income-generating opportunities for indigenous communities, preserve biodiversity and promote intercultural understanding. The project involves six communities of Chiman and Moseten indigenous peoples and is located on the Quiquibey River in the Pilon Lajas Indigenous Territory and Biosphere Reserve, near Madidi National Park. In 2003 some 23 people (half of which were women) received a regular monthly income under the project, depending on the number of tourists involved and the tasks required. People of all ages (151 men and 129 women) benefited directly, while all indigenous communities involved benefited indirectly, since the project helps preserve habitat and livelihoods.

While the Semi-Arid North-West project in Mexico has had notable successes in terms of its participatory planning methodologies and in making forestry practices more sustainable, the component that aimed to create microenterprises in the form of nature-based tourism has not yet taken off. Project management staff attribute this to the complexities of attempting to initiate tourism enterprises in remote areas that lack existing primary attractions. In Mauritius, linkages between small-scale producers and tourist hotels were included in the project design of the Rural Diversification Programme, but the component has not yet been implemented. While there is the possibility of linking it with a similar attempt by the National Productivity Council, constraints relate to the reluctance of farmers to work in groups, which would be necessary to ensure a consistent supply to the hotels.

While tourism development is an attractive strategy for diversification in many areas, it is important to consider the climate sensitivity of international tourism. For example, high-end ecotourism often relies on international long-haul travellers, a market that may become very unreliable in response to a number of factors linked to climate change and oil prices. The current global financial slowdown is a more-immediate factor likely to impact heavily on long-haul tourism. Tourism development may also not be viable in areas considered dangerous, particularly in the international market.

5.4.6 Summary: economic diversification

Economic diversification is becoming increasingly important as an adaptation strategy, to increase economic resilience and decrease reliance on climate-vulnerable economic sectors. More diversified livelihood strategies can lead to enhanced incomes and can diminish the risk for poor people whose livelihoods are largely based on natural resources. IFAD has gained considerable experience in diversification approaches as well as rural finance and marketing interventions, which are critical components that can make or break diversification approaches. IFAD-supported examples include diversifying away from water-intensive crops like sugar in Mauritius; creating new value chains from tree products in arid zones in Southern Africa, in projects that largely target women; and promoting rural tourism in Latin America to reduce dependence on agricultural-based products and shift to off-farm activities.

5.5 Extreme events and climate-related risk preparedness

5.5.1 Linking climate change and disaster risk reduction

An important area for adaptation is understanding the impacts of and vulnerability to current and future climate variability and extreme events – and the implications for sustainable development.[77] There are many possibilities for synergies between disaster risk reduction[78] and climate adaptation, with both approaches aiming to develop resilient communities with reduced levels of vulnerability. Both approaches are ways of managing uncertainty. This includes tackling risks as well as considering how to prepare for events that cannot be predicted (LCA Network 2006). One difference is that, apart from extreme events, adaptation to climate change also involves adjusting to changes in mean climate variability, which has not been a customary focus of disaster risk reduction.

Hundreds of thousands of poor people in developing countries live with constant threats to their lives and livelihoods due to weather-related natural disasters – drought, flooding, landslides, soil erosion and desertification (Practical Action 2007). These threats include homelessness, loss of possessions and livelihoods, and risks of injury and death. Recent years have seen an increasing focus on disaster risk reduction that highlights many synergies with climate change adaptation. Scientific evidence points to human-induced climate change as the underlying cause of the rise in hydrometeorological events over the past decade.[79] Natural disasters are increasing in number and intensity, with extremely severe costs in human lives and social and economic infrastructure. In this context, important components of adaptation strategies are a better understanding of the risks associated with environmental change and climate change, and development of mechanisms to manage these, such as early warning systems.

In the context of climate-related risks and extreme weather events, the level of risk depends on exposure to the hazard, the vulnerability both of people's livelihoods and of human settlements, and the status of disaster mitigation activities. A further key factor is the ability of people to protect themselves and to cope with hazards (Uitto and Shaw 2006). Adaptation has often followed natural disasters. Improving risk management and preparedness, especially with reference to extreme events, are two important components of adaptation. Specific mechanisms include early warning systems, drought contingency plans, response to flooding, awareness-raising and water management.

5.5.2 IFAD's support to risk preparedness and coping with extreme events

While the internal scan of IFAD's portfolio that preceded this study cannot be considered conclusive, it appears that almost no loans or grants designed prior to 2004 included an explicit consideration of climate-related risks in the context of adaptation to climate change. However, responding to environmental change, in the form of drought and flooding, has been a feature of many projects since the organization's inception. In some projects, activities have been directed towards enhancing traditional coping strategies related to extreme events.

Many IFAD projects, particularly those in the Sahel region of Africa, have been very concerned with *responding to drought*. While a number of these projects are analysed elsewhere in this report, in

[77] This is reflected in the Nairobi Work Programme as subtheme a (iv), "Promoting understanding of impacts of, and vulnerability to, climate change, current and future climate variability and extreme events, and the implications for sustainable development".

[78] The approach of disaster risk reduction argues that the causes of disasters lie in people's vulnerability, rather than in the natural hazards themselves, thus necessitating interventions that build community resilience. This is in contrast to the more-technocratic approach to disaster management.

[79] IPCC (2001) found that climate change is likely to create more extreme precipitation episodes, increasing the potential for flooding, landslides and avalanches. Evidence also suggests that hurricanes and cyclones are increasing in intensity.

terms of project actions to address drought conditions, such as soil and water conservation technologies, these activities are relevant to a discussion of extreme events. Projects in North Africa and the Middle East are also very concerned with drought – for example, the Livestock and Rangelands project in Morocco responds to limited rainfall and drought periods. A good current example of a project responding to multiple stressors, including drought and people displaced by civil war, is GSLRP in the Sudan (see box 8 in subsection 5.2.5 and case study 1 in annex 5).

Early warning systems are an important component of disaster risk reduction and have received more attention recently – for example, in the Cairo Principles for Post-tsunami Rehabilitation and Reconstruction of February 2005, which include reducing the vulnerability of coastal communities to natural hazards by establishing regional early warning systems (UNEP and MENR 2005). More recently, some IFAD investments have included an explicit focus on aspects of disaster management, including early warning systems, such as the system for pastoral risk management being developed in Ethiopia. This is an activity of the Pastoral Community Development Project, which responds to drought and the need to create sustainable livelihoods for herders in arid and semi-arid lowlands. In partnership with the World Bank, the project aims to establish early warning systems and disaster preparedness plans through a participatory approach to programming, implementation and monitoring. The aim is to improve the resilience and ability of participants to cope with external shocks and to reduce poor rural people's vulnerability to drought and other natural disasters, thus indirectly contributing to enhanced adaptation to climate change. Initial activities will include strengthening the institutional capacity of indigenous social organizations.

The December 2004 tsunami in Sri Lanka made it abundantly clear that key natural life-support systems had been badly damaged – some by the tsunami itself and others beforehand, undermining livelihoods and increasing vulnerability to environmental shocks. One aim of the reconstruction processes in Sri Lanka, supported by IFAD, was that these should avoid rebuilding existing vulnerability to natural hazards (box 11). Thus a multi-hazard risk approach was used during the recovery phase to ensure that communities and assets were less vulnerable to the impacts of future disasters.

Box 12. Buffering capacity of ecosystems – the Sri Lanka tsunami

The ability of intact, healthy coral reefs to absorb and dissipate over 90 per cent of the energy from waves has been demonstrated in locations all over the world. However, prior to the December 2004 tsunami, the coral reefs of Sri Lanka were far from pristine. In many areas they had been almost destroyed by mining of coral rock to make lime and cement, and elsewhere they were still recovering from a major coral bleaching event in 1998, which was caused by unusually high water temperatures. Thus the reefs of Sri Lanka were already stressed and weakened where they still existed, and even in protected areas they had long been vulnerable, because management capacity was too weak to prevent the use of destructive fishing techniques.

An assessment after the tsunami revealed the buffering capacity of ecosystems in areas where mangroves and vegetated dunes were relatively intact. For example, at Odu lagoon and Nasiva village in the Batticaloa district, the tsunami was about 6 metres high at the shore and penetrated up to one kilometre inland, across a mixed landscape comprising beach, mangrove-fringed lagoon, coconut plantation, scrub forest, home gardens and the village. This complex environment evidently absorbed and dissipated much tsunami energy, and by the time the wave reached the village, it was less than 40 cm high and caused no loss of life. In general, extensive stands of mangrove appear to have played a positive role in buffering the inland landscapes from the tsunami by reducing the energy of the incoming waves and absorbing the tsunami waters into a network of mangrove creeks and channels. Agricultural lands such as rice (paddy) fields, roads, human settlements and buildings were observed to be relatively undamaged in those sections of the coastline that had continuous, thick stretches of mangroves (e.g. between Akkraipattu and Batticaloa; Sallithievu and Vaharai), compared with similar areas where such mangrove systems were absent. Other coastal forests proved much less able than mangroves either to survive or to moderate the impact of the tsunami. At Yala and Bundala National Parks, vegetated coastal sand dunes completely stopped the tsunami, which was only able to enter where the dune line was broken by river outlets (UNEP and MENR 2005).

In Sri Lanka, the Post-Tsunami programme is the main medium-term recovery initiative of the two IFAD programmes providing support to the areas affected by the 2004 tsunami. This programme, which runs from 2005 to 2011, focuses on the economic and social recovery of the coastal communities. An important component is direct support to community-based projects to improve the conservation and management of coastal resources, including replanting of mangroves, repopulation of coral reefs and conservation of salt marshes, and to social and economic infrastructure development, including the construction of housing, social infrastructure and feeder roads. Environmental restoration activities such as restoring mangrove ecosystems and reconstructing sand dunes are actions that will contribute to reducing vulnerability now and in the future, as they will strengthen the coast against future environmental shocks and hazards.[80]

In Mongolia, devastating weather hazards, such as drought and *dzud*,[81] are common afflictions of nomadic pastoralists, with clear indications that their frequency and magnitude are increasing due to global warming (UNFCCC National Communication – in AIACC 2006). The IFAD-supported RPRP[82] has established a *dzud* emergency fund to enhance the resilience of herder households to unusual weather phenomena and to mitigate the worst effects on the poorest people. The fund can be used during extreme events, for example to acquire emergency fodder/hay supplies for herders, to be distributed on a grant basis (see case study 5 in annex 5).

A recent IFAD investment specifically targeted at promoting adaptation to climate change is the Increasing Community Resilience to Natural Disasters through the Use of Traditional Coping Strategies on the Weather Coast Guadalcanal Communities in the Solomon Islands. This grant aims to involve the Babanakira and Kolina indigenous groups in enhancing traditional coping strategies to build their resilience to disaster, and to merge these practices where necessary with modern scientific and technical knowledge.

5.5.3 Insurance and risk mitigation

Additional IFAD investments currently in preparation will address extreme events and climate risk preparedness. For example, an index-based weather insurance project is being developed in China to improve the ability of poor farmers to manage risk and facilitate investment in agricultural activities that require a higher initial investment. This is expected to break the cyclical poverty that farmers are exposed to as a result of regular crop failures induced by erratic weather events. Through a public-private partnership, the incomes of poor rural people will be insured against weather hazards to reduce the risk of the "short-term shock – long-term impact" syndrome. The Support Programme for Rural Microenterprise Poles and Regional Economies (PROSPERER) in Madagascar will experiment with microinsurance and risk mitigation. Regarding the activities of other organizations, which may provide useful lessons, the World Bank has noted that the use of weather derivatives is most effective as part of a broader risk management strategy. Swiss Re, a leading global reinsurer, has recently entered into a weather derivative contract with the World Bank to insure Malawi's farmers against a drought-related shortfall in maize production. This is an

[80] These activities are funded under a GEF grant that is fully blended into the IFAD loan. The objective is to mainstream restoration and management conservation of globally important ecosystems affected by the tsunami in the reconstruction process, in order to support sustainable livelihoods and reduce vulnerability to climate change along the eastern coast of Sri Lanka. The project design is founded on overcoming barriers to the restoration of coastal ecosystems, including lack of technical knowledge of low-cost restoration methods and the low priority given to environmental issues during the tsunami relief and reconstruction programme.

[81] *Dzud* is caused by heavy snowfall, extremely low temperatures, or drifting windstorms that reduce or prevent animals from grazing. This phenomenon leads to widespread animal mortality from hunger, freezing and exhaustion (AIACC 2006). The absence of snow in winter is also a type of *dzud* ('black *dzud*').

[82] Discussed further in subsection 5.2.4 and in Annex 5 of this report.

example of an ex ante disaster risk-management strategy designed to mitigate the financial impact of drought for a country that is heavily dependent on income from its agricultural production.[83]

5.5.4 Climate-resilient infrastructure

Rural roads, travel and transport (RTT) and other types of rural infrastructure form part of IFAD's broader agenda for rural development. The organization's Strategic Framework includes RTT-related objectives under its fourth strategic objective on access to markets. As poverty reduction through accelerated agricultural growth cannot happen without adequate rural infrastructure, the budgets for infrastructure components in IFAD loan investment programmes have been significant: the *Independent external evaluation of IFAD (IEE)* (IFAD 2005b) noted that investments in roads, irrigation and water infrastructure are the largest stand-alone investments IFAD makes. Given the importance of RTT for rural poverty reduction, and the relative magnitude of the investments for IFAD, it is critical that the rural infrastructure developed is climate resilient and optimally maintained. Sustainable maintenance of infrastructure was rated by the IEE as low, highlighting the need for increased emphasis on this area, to both improve the status quo and ensure improved performance under increasing climate change impacts. With regard to sustainable maintenance of RTT infrastructure, a recent review highlighted the importance of IFAD investments promoting technologies and standards in line with local resources, capacities and know-how (Lema, de Veen and Abukari 2008). As Klein (2001) points out, the increasing robustness of infrastructural designs and long-term investments is an important component of anticipatory adaptation.

Changing rainfall patterns and increased frequency of extreme events such as floods, cyclones and landslides may pose serious threats to the sustainability of access roads (Lema, de Veen and Abukari 2008). Moreover, road designs and implementation standards need to be adjusted to ensure adequate protection of the catchment area and environmental resources. IFAD examples of climate-proofing of infrastructure include submersible bridges in Bangladesh, flood-protection interventions in the cyclonic environment of Mauritius, 'green roads' in Nepal and environmentally friendly road construction in Bhutan.

In Bangladesh, flooding poses a particular challenge to road development. While many donors fund road projects, IFAD's comparative advantage is its focus on development of smaller rural and village roads in difficult areas (Brett 2008). An example of this is 'submersible roads', which are built with concrete rather than bitumen, so they can withstand being flooded. Submersible roads do not require high embankments, which reduces cost, removes the need to acquire more land, and does not further disrupt the flow of flood waters – which can create local drainage problems and reduce fish production. This approach also avoids construction problems related to the need to compact soil on new embankments. In line with its targeting policy, IFAD also focuses on ensuring that maximum benefits flow to poor rural people during preparation, construction and maintenance. Project community groups, known as labour contracting societies (LCS), undertake construction of roads made from concrete blocks. A significant amount of employment is generated, including for the women who make many of the blocks. Most block-making takes place in the September to November period, when little other work is available and many poor households have to reduce food consumption and borrow from moneylenders to survive. Destitute women were engaged under LCS for routine maintenance of roads, tree plantation and caretaking. Further positive impacts include: transport costs reduced by 39 per cent; greatly increased accessibility to education, health, family planning and social facilities; improved linkages to inputs and markets; and agricultural yield increased by 19 per cent (Brett 2008).

In Madagascar, lack of market access is a major constraint on smallholder incomes, with only 21 per cent of households marketing their production. Apart from weak farmers' associations and

[83] See annex 3 for more information on this initiative.

lack of information on market opportunities, bad roads complicate the situation and increase transaction costs. IFAD and other donors are supporting the Government in implementing a major road rehabilitation programme. The island has also been hit increasingly by cyclones, a shift that is related to climate change. Cyclones are common in Madagascar, but in recent years they have grown in intensity and frequency. This has been one of the major factors exacerbating rural poverty in the eastern cyclone-prone regions, together with political factors and stagnation in the cash-crop sector. These causes have cumulatively had a major impact on communities' living conditions. Seven cyclones hit the country in 2007, with Cyclone Ivan in early 2008 being the worst since the 1980s. With a force equal to that of hurricane Katrina in New Orleans, and winds of over 200 km/hour, it destroyed crops, livestock and buildings and left more than 150,000 people homeless. The eye of the cyclone passed over the area of the IFAD-supported Rural Income Promotion Programme (PPRR) on the eastern coast of the island.[84] The infrastructure put in place by the IFAD project was fortunately cyclone-proof. It survived the impact and provided an important basis for the recovery effort. This provides further proof of the devastating consequences of climate change for the world's poorest communities, and vindicates IFAD's approach of designing climate-proofed infrastructural components.

The implementation of the first cycle of the IFAD-supported Western Uplands Poverty-Alleviation Project in Nepal, financed under the Flexible Lending Mechanism (FLM),[85] includes a 'green roads' component.[86] The green roads approach is a low-cost road-building technology appropriate to Nepal's fragile mountain topography.[87] Using manual labour to generate off-farm employment, Nepal's green roads combine local resource mobilization, labour-based construction, environmentally friendly technology and self-help capacity. Participatory, transparent management processes and decentralized decision-making maximize benefits to poor and vulnerable groups.

These innovations in environmentally friendly and climate-proofed roads can be replicated in other locations, depending on contextual suitability. Further important infrastructural interventions for IFAD are irrigation systems, discussed previously in subsection 5.2.5 of this report.

5.5.5 Summary: extreme events and climate-related risk preparedness

An important area for adaptation is to understand the impacts of and vulnerability to current and future climate variability and extreme events and their implications for sustainable development. Scientific evidence points to human-induced climate change as the underlying cause of the rise in hydro-meteorological events over the past decade. Responding to environmental change, in the form of droughts and flooding, has been a feature of many IFAD projects since the organization's inception. More recent IFAD investments have included an explicit focus on aspects of disaster management, including development of an early warning system in Ethiopia, rehabilitation of ecosystems in Sri Lanka, and the establishment of a *dzud* emergency fund in Mongolia. Additional IFAD investments being prepared will address extreme events and climate risk preparedness: for

[84] PPRR aims to improve small producers' access to markets by strengthening commodity chains. Some 50,000 ha of rice and over 100,000 ha of other crops were flooded by Cyclone Ivan. Fruit and spice trees were uprooted, vegetable gardens and orchards destroyed, pigs and poultry killed, and fishing boats and nets lost.

[85] The overall objective of the FLM is to introduce greater flexibility into the Fund's project design and implementation in order to: match project time frames with the pursuit of long-term development objectives when it is judged that a longer implementation period will be required to meet those objectives; maximize demand-driven beneficiary participation; and reinforce the development of grass-roots capacities. The specifics of an FLM loan include: (i) longer loan periods (10-12 years) to allow for the achievement of sustainable development objectives; (ii) a continuous and evolving design process through implementation of distinct three- to four-year cycles; and (iii) clearly defined preconditions – or 'triggers' – for proceeding to subsequent cycles.

[86] www.ifad.org/gbdocs/eb/90/e/EB-2007-90-INF-2-REV-1.pdf.

[87] http://nird.ap.nic.in/clic/nepal_rds.html.

example, an index-based weather insurance project in China, and climate-resilient infrastructure, such as submersible roads in Bangladesh and cyclone-proof roads in Madagascar.

5.6 Towards integrated adaptation planning and implementation

5.6.1 A range of relevant activities

The UNFCCC has noted that adaptation planning and practices are in the early stages of implementation and very often centre on NAPAs for LDCs, which often focus on flood and drought management (IISD 2007). A limited number of responses to this study indicated some kind of interaction between the IFAD project and the relevant NAPA. Although this was not a systematic area of enquiry, it does appear as though these kinds of interactions have been limited, which may be indicative of the divisions within countries between ministries of agriculture (often a key IFAD partner) and ministries of environment, which often drive the NAPA process. Nevertheless, the GEF views IFAD as an important partner for NAPA implementation in LDCs, given the priority of agriculture in many NAPAs, together with IFAD's experience in this sector. This means that IFAD can implement the relevant projects and facilitate access of LDCs to GEF funding. NAPA projects can be blended into IFAD's portfolio, which will also enhance the climate resilience of the portfolio (Bouzar 2007).

As IFAD has not had an articulated and specific approach to adaptation to date, the organization has not yet developed a comprehensive approach to adaptation planning, nor to developing comprehensive adaptation implementation strategies in projects. However, many of the development planning activities and approaches supported by IFAD are of direct relevance. The organization has rich and growing experience with recognizing and building on local and indigenous knowledge, and a number of interventions have specifically highlighted the role of local and indigenous knowledge in adapting to short-term climate variability, if not long-term climate change.[88] IFAD's experience in dealing with conflict – often over access to natural resources – and supporting development approaches for displaced people is of clear relevance in coping with the possible impacts of climate change. Linkages between security of land tenure and the ability to adapt to climate change are becoming increasingly clear, especially in the context of indigenous peoples' access to land and the natural resources it contains. This section also discusses IFAD's experience with integrated development approaches and land-use plans; development approaches that have evolved from technological interventions to social processes; approaches that make stronger connections between ecosystem services and poverty reduction; and the more recent drive to promote targeted adaptation practices through small grants.

The organization has also begun developing operational tools to help staff integrate climate change risks and adaptation measures into planning and practices – for example, through the enhancement of coverage of climate change issues in the updated ESA procedures. These are discussed further in later sections of this report.

Clearly, a range of other IFAD-supported activities are of relevance to adaptation planning approaches. These include soil and water conservation and management to prevent waterlogging and erosion, improving water productivity, and rangeland management (e.g. rehabilitation of pasturage and stock routes). These activities fit more appropriately in the section dealing with technological approaches, and are consequently discussed there. IFAD approaches to capacity-building, extension and advisory services would also form part of a comprehensive approach to adaptation planning and practice.

[88] A current intervention in Madagascar, Capacity-Building of Indigenous Peoples in Rural Areas (discussed in section 4.2, box 3), more specifically explores individual strategies for adaptation to climate change by using oral testimony and participatory video to highlight, value and gain support for local and indigenous knowledge of environmental change.

5.6.2 Integrated agricultural approaches

A number of IFAD projects have adopted an integrated approach to agricultural development that has proved successful in a number of instances, and which may provide a more appropriate vehicle for coping with complexity and change. This includes a number of the more complex agricultural interventions mentioned above. In the current context, where the impact of climate change on the natural resource base is dramatically increasing, adoption of location-specific integrated management of natural resources for higher productivity and better resilience to erratic climatic events is becoming even more crucial. Such integrated systems also need to be sensitive to local conditions affecting rural people and receptive to local and traditional knowledge.

More recently, projects adopting an integrated agricultural approach have been designed to incorporate climate change issues more specifically. One example is the Mount Kenya East Pilot Project for Natural Resource Management (MKEPP), which includes GEF cofinancing. This project aims to increase the resilience of the ecosystem to human and natural stress. Key objectives are environmental conservation and rehabilitation, and improvement of river basin management to conserve water catchments and directly benefit downstream populations in arid and semi-arid areas. Strategies to achieve these objectives include changing NRM practices and improving agricultural practices and technologies. MKEPP has introduced an innovative participatory approach to river basin management, based on empowerment and the involvement of water users in decision-making, with a legal basis in the new water bill, which confers a major role to community-based organizations (CBOs) in water management at the river-basin level.

Despite increasing climatic hazards related to glacier retreat, a decrease in and erratic pattern of rainfall, and an increase in temperature and drought, stakeholders assess MKEPP as contributing to strengthening the resilience of natural and farming systems to short-term climate variability, and as promoting adaptation through a range of different activities (see case study 4 in annex 5). The most effective practices were reported to be: introduction of water supply infrastructure such as water-harvesting tanks, earth dams and spring development; rehabilitation of degraded lands and hilltops; and protection of riverbanks through planting and agroforestry. Local farmers note that positive effects so far include increased vegetation and tree cover, with forest rehabilitation and protection having resulted in stabilization of the water levels in rivers and reduced siltation in some areas.

An example of an integrated approach specifically targeting adaptation is the grant to the Indian Ocean Commission (IOC), currently in preparation. The Regional Initiative for Smallholder Agriculture Adaptation to Climate Change in the Indian Ocean Islands will be implemented in Comoros, Madagascar, Mauritius, Reunion and Seychelles. The grant will support implementation of conservation-based agricultural approaches and techniques as a climate-change adaptation measure at farm and village levels, in order to achieve soil protection, bring added value to agricultural products and improve market access.[89] Networking, knowledge-sharing and capacity-building will be the main activities of the grant (box 12).

Box 13. Regional Initiative for Smallholder Agriculture Adaptation to Climate Change in the Indian Ocean Islands

The intention of this recently developed grant to the Indian Ocean Commission is to increase the use of conservation techniques in the region, capitalize on lessons learned and widen the focus and outreach of these techniques. The techniques include: (i) tilling practices to preserve soil structure; (ii) organic fertilization in connection with parallel livestock activities; (iii) plant protection through use of eco-friendly and natural products and practices where feasible; (iv) choice of varieties adapted to the area; (v) rational optimization of water use; (vi) improved energy consumption through better-

[89] The proposed grant will mainly enhance and support existing knowledge-sharing networks, set in place by IOC, on conservation agricultural practices in the region, with a special focus on small-scale farmers and how these networks could help improve their livelihoods through more-sustainable agricultural practices in the context of adapting to climate change.

adapted technologies; (vii) adapted soil and water conservation works; (viii) agroforestry and reforestation with species useful to people and livestock; (ix) reduction of pollution, especially in marine coastal areas and coral reefs; and (x) better use of traditional and local know-how (IFAD 2008h).

A knowledge-sharing output of the grant aims to facilitate access to and use of information and management tools related to conservation agriculture and climate change. The grant further aims to strengthen the economic viability of conservation agriculture and to demonstrate longer-term benefits in terms of reduced land degradation and improved soil productivity through better carbon sequestration. Most of the activities will be implemented through existing rural development projects in the islands. The climate change focus will be further strengthened through the proposed activities of developing and improving land-degradation monitoring systems (monitoring plans, environmental and socio-economic indicators) for integration into relevant early warning and information systems at national, regional and global levels (i.e. FAO-SARD,[90] AMESD[91]). Conducting climate-change vulnerability assessments of smallholder agriculture on islands that have not yet developed NAPAs will add to the climate-specific nature of the grant.

While the above grant concerns many 'traditional activities' supported by IFAD, including agricultural development technologies and activities to combat land degradation, *a number of less traditional features have been included to sharpen the climate focus of activities*. These include demonstrating carbon sequestration benefits and conducting vulnerability assessments that are specifically focused on climate change, as well as a strong focus on conservation agriculture and networking and knowledge-sharing.

As climatic variability changes, the technology of production will need to change as well. Adaptive learning and the ability to make rapid shifts will be important mechanisms to safeguard production and livelihoods, and will need to be synthesized with the type of integrated approaches outlined above for a more climate-resilient developmental approach.

5.6.3 From technological interventions to social processes

Successful adaptation strategies will need to encompass the area of social and behavioural change. In this regard, an interesting development of relevance to adaptation planning is the transformation of projects from being *technical* interventions into *social or process* interventions. While it is not clear how widespread this evolution is in IFAD investments, an example from one of the TAGs to ICRAF illustrates this intended change. The final evaluation of Phase II of Tree Domestication in West and Central Africa recommended an additional phase to promote tree domestication, not only as a *technical* intervention, but also as a *social or process* intervention. This third phase (IFAD 2008i) has the same main fields of action (tree propagation and management, marketing and enterprise development, organizational support), but in a renewed strategic framework. This enables the programme to realize Strategic Framework objectives that seek to ensure better access to skills, improved agricultural technologies, and competitive markets for agricultural inputs and produce for poor rural people. The focus shifts from technological aspects to change, by featuring socio-economic issues and capacity-building, and through a renewed emphasis on product transformation

[90] FAO has launched the Conservation Agriculture for Sustainable Agriculture and Rural Development (CA for SARD) project (www.fao.org/sard/en/sard/754/1458/index.html) as a multi-stakeholder umbrella framework that engages civil society, governments and intergovernmental organizations in a joint effort to make rapid progress towards achievement of the Agenda 21 vision for SARD.

[91] African Monitoring of the Environment for Sustainable Development (AMESD) is a pan-African initiative arising from the 2002 Johannesburg World Summit on Sustainable Development and promoted by the African Union. It is a common priority of the major regional integration organizations in Africa, including the Indian Ocean Commission. AMESD is financially supported by the European Commission and seeks to achieve greater coherence and efficiency in existing information systems. IOC has a crucial role in AMESD with respect to cyclone monitoring and forecasting, and island and coastal vulnerability.

and marketing. The programme is being implemented in Cameroon, the Democratic Republic of the Congo and Nigeria.

Given that adaptation to climate change requires strong and flexible change management, ideally through a process of action learning, this evolution towards a social process holds interesting possibilities for enhanced support to adaptation processes. Also on the subject of change management – through a farmer-led process – IFAD's Project for the Promotion of Local Initiative for Development in Aguié (PPILDA), in the Niger, has systematically promoted farmer-managed natural regeneration (FMNR). This project is widely held to be extremely successful, and many useful lessons can be drawn from it.[92] FMNR is a reforestation technique that relies on the presence of remaining live tree roots, and uses silviculture and coppicing techniques to regrow pre-existing rootstock material.[93] Over 30,000 km² of land in danger of desertification have been revegetated through FMNR in this area alone.

5.6.4 IFAD's experience with conflict situations

A number of IFAD investments over the years have been concerned with the age-old conflicts over land and other resources between nomadic pastoralists and settled agriculturalists. IFAD programmes and projects have funded interventions to address these and other unresolved conflicts, for example in parts of South and South-East Asia and the Sudan, and to keep a minimum of rural development activities functional despite the collapse of government services – as in Burundi, Peru, the Sudan and in countries without recognized governments such as Somalia. IFAD investments have also accelerated the reactivation of the production potential of vulnerable households soon after the formal end of hostilities, as in Bosnia and Herzegovina, El Salvador and Rwanda. They have addressed the changed structure of the IFAD target group, specifically by dealing with people who had lost their development potential as a result of crisis, such as orphans and people affected by HIV/AIDS. An example of the latter is the Uganda Women's Effort to Save Orphans project, supported by the Belgian Survival Fund Joint Programme (IFAD 2006b).

A number of lessons from these experiences are relevant to climate change adaptation, particularly actions to reduce conflict over scarce natural resources and to accommodate large numbers of internally displaced people (IDPs) and those who may be termed 'environmental refugees'. Forced migration due to climate change is beginning to receive increasing attention globally, and this is an area for further exploration by IFAD, particularly in terms of how IFAD investments can support the livelihoods of people in migration and in situ, based on past experiences in supporting displaced people in recovering and enhancing their livelihoods.

The ongoing Western Sudan Resources Management Programme (WSRMP) (2004-2012) focuses on development of a natural resources governance system and on mapping and servicing traditional stock routes to reduce conflict between pastoralists and agriculturalists (box 14).

Box 14. Natural resources governance for conflict management and development in the Sudan

The project in brief: The Western Sudan Resources Management Programme (WSRMP) focuses on establishing a governance system for natural resources in the Kordofan region, western Sudan, to build up traditional rainfed agriculture and improve economic conditions for impoverished small-scale farmers and herders. The region was at the epicentre of the last civil war, resulting in a breakdown in governance. Severe degradation of natural resources, while related to repeated droughts, is also caused to a significant degree by unsustainable practices. A central project activity is the mapping of traditional stock routes to increase access to services and reduce conflict between pastoralists and

[92] Chris Reij, Centre for International Cooperation, Vrije Universiteit, Amsterdam, personal communication, 27 October 2008.

[93] *Wikipedia*, s.v. Farmer Managed Natural Regeneration, http://en.wikipedia.org/wiki/Farmer_Managed_Natural_Regeneration (accessed 28 October 2008).

agriculturalists. Other NRM actions include developing and disseminating appropriate agricultural technologies such as agroforestry systems, restoring rangelands through reseeding and raising environmental awareness. Supporting project activities include alternative income-generating enterprises, rural microfinance and marketing, institution-building, community development and rural roads.

Activities that support adaptation: WSRMP was not conceived of as a climate-change adaptation project when it was designed four years ago. However, many of the activities being implemented by the programme directly address climate risk and variability, or reduce vulnerability and thus indirectly reduce the risks associated with climate change. Key activities are the following:

The systematic approach to developing a NRM strategy, which underpins the programme in a fundamental and very positive way;

Strategies for resolving land- and water-based conflicts through: demarcation of stock routes; strengthening of traditional conflict-resolution mechanisms; activities to increase security of tenure through registration of customary rights; and land-use planning and control to protect routes and associated pasture and water for transhumants;

A focus on nomadic pastoralists, which keeps a livelihood strategy open that may become increasingly important as the effects of climate change are felt;

Methods to build up traditional rainfed agriculture in a sustainable and climate-sensitive way, such as early maturing varieties, agroforestry as a risk reduction strategy and water-harvesting technologies;

Activities to enhance the resilience of ecosystems, and also of the livelihoods of people who depend on them, such as rangeland reseeding, integrating biodiversity and specifying improvement of this as a project outcome, and a focus on agrobiodiversity, which can lead to the identification and development of additional climate-resilient varieties;

Rural finance and market components as a critical link to add value and unlock alternative income-generating enterprises and develop market chains, for more diversified livelihood strategies and enhanced incomes;

Approaches to participation and empowerment, community organizational development and integrating gender aspects, which help strengthen resilience in general, and environmental awareness workshops that specifically include climate change.

Programme actions that increase vegetation cover, reduce degradation of rangelands and encourage development of community forestry are also likely to increase the capture of carbon, and thus play a role in mitigation (Urquhart 2008).

This case study highlights a number of activities that support adaptation, including a *focus on nomadic pastoralists*, which keeps a livelihood strategy open that may become increasingly important as the effects of climate change are felt.

5.6.5 Innovation and climate change

IFAD's Strategic Framework views innovation as central to improved development effectiveness and to enabling poor rural people to develop better strategies to face emerging challenges.[94] The 2007 IFAD Innovation Strategy recognizes that climate change is one of a range of evolving challenges and opportunities facing poor rural people. Globalization, change, environmental degradation, migration, the spread of communicable diseases such as HIV/AIDS, and non-conventional conflict are further examples of this changing context. In such circumstances, good practices may quickly become obsolete. Thus making a positive and lasting impact on rural poverty requires the capacity

[94] Innovation is one of the six principles of engagement in the Strategic Framework, which sees IFAD's comparative advantage in its working with national partners to develop and implement innovative projects and programmes, and commits IFAD to "focused and systematic innovation in what it was set up to achieve: strengthening the agriculture-based livelihoods of poor rural people in developing countries". This entails developing and testing innovative methodologies, institutional arrangements or technologies in all interventions in IFAD country programmes. To improve impact, innovation must be accompanied by systematic scaling up of successful practices through partnerships (IFAD 2007a).

both to implement tried and tested practices and to respond to new challenges and opportunities as they emerge – in short, to innovate (IFAD 2007d).

This exploration of IFAD's response to climate change has identified a number of innovations of direct relevance to dealing with climate variability and long-term climate change. These include some that are research-related, such as the development of salt-tolerant forage and stress-tolerant maize. The collaboration with the Africa Rice Center (AfricaRice) illustrates the potential of innovative partnerships. Through the IFAD grant for adaptive research and dissemination of the New Rice for Africa (NERICA), AfricaRice developed a hybrid for use in low-rainfall contexts, with varieties suitable for a range of ecosystems. A follow-up grant[95] will enable AfricaRice to scale up successful methods of participatory varietal selection and a community-based seed system approach, with a focus on IFAD loan projects.

A link between innovation and empowerment is the recognition that poor rural people develop their own adaptive strategies in response to new challenges and opportunities resulting from trade liberalization, dismantling of state welfare programs, climate change, conflict, and pest outbreaks, among others (IFAD 2007d). This recognition shapes IFAD-promoted technological and institutional innovations. An example is IFAD's support to PhytoTrade Africa, which has already enabled the organization to learn much about value chains in product markets and how its target group can best engage in them; about livelihood opportunities for poor communities living in low-potential rural areas; and about issues such as bioprospecting, and Fair Trade and organic certification for natural products.

While additional work is needed on the monitoring side, to link resource use to conservation, these lessons occur in the nexus of market access for poor rural people and improved natural resource base management, which is a critical component of the poverty/environment interface for IFAD.[96] The extent to which the intersection between market access and improved natural resource management corresponds to the climate change/poverty linkage has not been conclusively demonstrated yet, but it is highly likely that activities that serve to improve natural resource management, while at the same time enhancing livelihoods for the poorest rural people in marginal environments, would be positive for adaptation as well. Risks to this proposition include climate change impacts on the wild plants from which the products are derived, highlighting the importance of adaptive management linked to robust monitoring systems.

5.6.6 Summary: integrated adaptation planning and implementation

IFAD has not yet developed a comprehensive approach to adaptation planning. However, many of the activities and approaches supported by IFAD are of direct relevance for developing a clear approach to adaptation planning. For example, a number of IFAD projects have adopted successful integrated approaches to agricultural development. These approaches are providing an appropriate vehicle for coping with complexity and change, which will be of value for adaptation responses. These include: a grant to support conservation-based agricultural approaches and techniques as a climate change adaptation measure; and a GEF-cofinanced project in Kenya to increase the resilience of the ecosystem to human-induced and natural stress. As successful adaptation strategies will need to promote broad social change, another relevant recent development is the transformation of some projects from being *technical* interventions into *social or process* interventions. For example, the second phase of an indigenous trees programme in West and Central Africa will shift its focus from the technological aspects to socio-economic issues and

[95] Programme for Enhancing Smallholder Access to New Rice for Africa (NERICA) Seeds for Alleviating Rural Poverty in Western and Central Africa.

[96] PhytoTrade is now developing studies to monitor social and environmental issues, including sustainable harvesting, the nature of the relationship between companies and community producers, and whether the nature of the institution affects poverty impact.

capacity building. Given the growing possibilities for large-scale forced migration due to climate change, IFAD's experiences in addressing conflict also hold relevance for responding to climate change – particularly those actions to reduce conflict over scarce natural resources and to accommodate large numbers of internally displaced people and environmental refugees.

5.7 Mitigation

5.7.1 Agriculture and mitigation

The aim of mitigation is to reduce emissions of GHGs and to enhance sinks for these gases. Achieving the lowest possible stabilization of GHGs in the atmosphere requires an emphasis on early action to reduce emissions (IPCC 2007a). Thus mitigation efforts over the next two to three decades will have a great impact on opportunities to achieve lower stabilization levels. The IPCC has pointed out the need to avoid locking in old technologies in developing countries. This applies to a number of issues, including renewable energy, energy efficiency and agricultural technologies that are climate-sensitive. Means to enhance action on mitigation through agriculture, forestry and other land-use activities (AFOLU) are currently being explored. Agriculture can reduce GHG emissions by promoting energy efficiency and clean energy; reducing deforestation or changing land use; and promoting sustainable agricultural practices such as rehabilitation of degraded lands, water conservation and management, and increase in biomass. The UNFCCC emphasizes the roles of land use, land-use change and forestry (LULUCF) as a means of protecting carbon stocks and reducing GHG emissions.

While mitigation of climate change has not been a major IFAD focus to date, the organization is currently reflecting on how to optimize mitigation programmes so that they become beneficial to poor rural people. A number of activities traditionally supported by IFAD are likely to have already contributed to mitigation actions. For example, afforestation and reforestation, better land management practices such as conservation tillage and agroforestry, rehabilitation of degraded crop and pasture land, rangeland rehabilitation to further improve productivity, and livestock management practices can all contribute significantly to improving soil cover and reducing carbon emissions. Other relevant IFAD activities are regeneration of medicinal and aromatic plants and improved soil water infiltration.[97] IFAD's experience with indigenous peoples and natural resource management will be of relevance as well: given the strong correspondence between the location of indigenous peoples and areas with the highest biodiversity and relatively intact natural resources, indigenous peoples have a role to play in designing and implementing mitigation measures, especially those related to preventing deforestation.

> *The World Bank estimates that agriculture and deforestation account for 26 to 35 per cent of greenhouse gas emissions. Yet agriculture and forestry can play a key role in tackling climate change. Afforestation and reforestation, better land management practices such as conservation tillage and agroforestry, rehabilitation of degraded crop and pasture land, and better livestock management practices can all contribute significantly to reducing carbon emissions.*
>
> – www.ifad.org/climate/index.htm

Specific possible interventions for mitigation in the agricultural sector include: switching to 'no-tillage' or 'low-tillage' techniques to preserve carbon stored in soil; reducing methane emissions from rice production through better tillage practices, water management and crop rotation; using nitrogen fertilizer more efficiently to reduce nitrous oxide; improving LULUCF; and promoting sustainable coastal management and fisheries.

[97] It may also be that some of the agricultural technologies promoted over the years have exacerbated emissions.

5.7.2 Options for linking mitigation and rural poverty reduction

CDM and REDD initiatives

Currently, financial flows for mitigation activities under the Clean Development Mechanism do not benefit developing countries as much as they could, particularly in Africa, mainly because of the CDM's limited coverage of afforestation and reforestation. The majority of the 'win-win' mitigation instruments that can be identified at the field level – and could benefit small farmers in developing countries – are currently not eligible under the existing mechanisms. A key aspect of bringing mitigation instruments to small farmers and rural communities is the development of financial and institutional means to provide appropriate incentives for mitigation. IFAD's experience with smallholder farmers and rural communities constitutes a valuable basis for the design and implementation of systems to reduce emissions from deforestation and forest degradation (REDD) and other, related systems that will be included in the post-Kyoto climate regime. Such systems could contribute significantly to tackling climate change, while benefiting poor people in rural areas and conferring other environmental benefits. REDD initiatives can also complement forest-related measures included in the CDM and offsets through the Voluntary Carbon Market. The United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (UN-REDD) was included in the Bali Action Plan and was launched on 24 September 2008. The REDD mechanism will need to include a reliable framework for monitoring and verification; third-party verification; ownership and commitments from national governments; and the support of civil society and indigenous peoples.

Of all terrestrial ecosystems, peatlands are the most important carbon stocks globally and store twice as much as the biomass of all the world's forests combined. Peatland forest carbon stocks in South-East Asia contain more than 60 billion tons of carbon (200 billion tons of CO_2). Despite this huge carbon stock value, tropical peat swamp forests in the region are degrading rapidly. This is a critical area for mitigation, and one in which IFAD is taking action. A project of IFAD and the Association of Southeast Asian Nation (ASEAN) – Rehabilitation and Sustainable Use of Peatland Forests in South-East Asia – and cofinanced by the GEF, supports the implementation of the ASEAN Management Initiative on Sustainable Use of Peatlands (APMI) in four South-East Asian countries (Indonesia, Malaysia, the Philippines and Viet Nam).

Given the strong correspondence between the location of indigenous territories and areas with the highest biodiversity and relatively intact natural resources, indigenous peoples have the potential to be key players in designing and implementing mitigation measures such as those mentioned above. However, as IFAD has pointed out, concerns about the rights of local people living on forest lands remain in the background of mitigation discussions. Such concerns include the distribution of benefits from REDD, and how to ensure robust coordination and interaction between national forestry agencies and local government authorities in implementing such an innovative scheme (IFAD 2008b).

> *Poor rural people manage vast areas of land and forest, and can be important players in natural resource management and carbon sequestration. They are often the custodians of the natural resource base and can provide important environmental services. Carbon trading schemes need to include a way to compensate poor rural people for carbon sequestration. Support for soil conservation, incentives for sustainable production practices and payment for carbon sequestration and avoided deforestation are all part of the solution.*
>
> – www.ifad.org/climate/index.htm

Payments for ecosystem services

Payments for ecosystem services (PES), also termed compensation and rewards for ecosystem services (CRES), is a relatively new approach to achieving resource conservation and restoration through different kinds of contingent contracts between stewards of ecosystems and beneficiaries of ecosystem services. These approaches are being encouraged and shaped by several global trends, including a growing demand for ecosystem services, the pursuit of new sources of finance for conservation, and supportive changes in resource governance at local, national and international levels (Scherr, Milder and Bracer 2007). PES also become important because, given that natural barriers are cost-effective insurance against many types of natural disasters, it costs less to prevent disasters than it does to fix the damage they cause (Sudmeier-Rieux et al. 2006). Investing in ecosystems such as sand dunes, mangrove belts, coral reefs and wetlands and in the use of forested slopes as barriers are important prevention measures. If local communities are managing their natural resources in a way that maintains this function, then there is a case to be made for payment for this service.

IFAD is progressively gaining experience in PES projects. A study commissioned by IFAD and carried out by ICRAF in 1998 concluded that there is considerable scope to design PES schemes so that they maximize positive benefits to poor rural people, though they often lack the prerequisites for participation in PES (insecure or no land tenure, rewards easily usurped by the elite, lack of assets such as human capital, etc.). IFAD has subsequently pursued the development of innovative approaches that can tailor such payments to its specific target groups through its grant programme and through strategic alliances with, for example, ICRAF, the Center for International Forestry Research (CIFOR), Forest Trends and World Soil Information (ISRIC).

A desk review of IFAD's Latin America and the Caribbean portfolio revealed that no projects were implementing PES activities. The Strengthening Project for the National Micro-Watershed Programme in Mexico had taken some preliminary steps, but it was unclear whether this would be pursued. However, PES are expected to be developed by the Semi-Arid North-West project in Mexico, the Patagonia Rural Development Project (PRODERPA) in Argentina and PROCORREDOR in Ecuador (IFAD 2007b).

The Programme for Developing Mechanisms to Reward the Upland Poor of Asia for the Environment Services They Provide (RUPES-I) achieved significant impacts. These include increased awareness at the grass-roots level of the RUPES concept; tens of thousands of farmers achieving greater land access security; strengthening of local institutions and multi-stakeholder networks, including the on-site technical working/advisory groups; and generating awareness and knowledge of environmental services as global public goods.[98] Under the RUPES-II framework (Programme on Rewards for, Use of and Shared Investment in Pro-poor Environmental Services), the rapid carbon-stock appraisal methodology has been developed. This is an early-phase diagnostic tool that introduces a scientifically sound methodology to assess landscape carbon stocks. It is designed to provide a basic level of locally relevant knowledge to assist in discussions on this issue among stakeholders.

The RUPES-II methodology: (i) provides reliable data on carbon stocks in a defined landscape, its historical changes and the impact of ongoing land-use change on projected emissions, with or without specific interventions to increase or retain carbon stocks; (ii) identifies primary issues in the local trade-off between carbon stocks and livelihoods and the opportunities to achieve more-sustainable development pathways; and (iii) enhances shared understanding among stakeholders as a step towards 'free, prior and informed consent' in contracts to increase or retain carbon stocks.

Other PES projects are currently under implementation in Africa, such as the Programme for Pro-poor Rewards for Environmental Services in Africa (PRESA), which introduces carbon storage

[98] For additional information, see www.worldagroforestrycentre.org/sea/Networks/RUPES/index.asp.

together with hydrological services and biodiversity conservation.[99] PES schemes under RUPES and PRESA mainly target such hydrological services and biodiversity conservation. There are a number of challenges related to the application of PES schemes to carbon sequestration, including: identifying the appropriate market; establishing appropriate policies; addressing transaction costs; building the capacities of farmers to use the approved methodologies and to understand and follow existing regulations; and developing a system to effectively measure the amount of carbon sequestered (IFAD 2009b).

PES schemes have also recently been introduced in four IFAD loan programmes. The Trees for Global Benefits Programme (box 14) is an example of a carbon sequestration programme targeting low-income farmers in marginal areas of Uganda. PRESA is providing support and scaling up for these activities. Further grants with components on carbon sequestration are currently under development. IFAD and the International Food Policy Research Institute (IFPRI) are discussing ways to help poor rural people benefit economically from storing carbon on their lands, in the context of the IFAD/IFPRI strategic partnership.

Box 15. Trees for Global Benefits Programme

A group of donors and investors[100] are currently supporting the Trees for Global Benefits Programme, which involves the development of voluntary carbon sequestration programmes through the Plan Vivo system. It was conceived and developed in 1994 as part of a DFID-funded research project in southern Mexico. Implementation was subsequently expanded to Uganda in 2003 with the Trees for Global Benefits Programme. The Plan Vivo system supports rural communities in developing long-term sustainable land-use systems that incorporate carbon sequestration activities. The approach targets low-income farmers, who often live in marginal areas, bringing them together to plan activities that reflect their own needs, priorities and capabilities, and that result in long-term carbon storage. Eligible carbon sequestration activities include agroforestry, small-scale timber production, restoration of degraded or damaged ecosystems such as woodland, and conservation of forest and woodland under threat from deforestation. Multiple risk-management measures are taken to provide a reasonable level of assurance that carbon benefits will be fulfilled, such as the definition of reserves of unsold carbon sequestered to cover unforeseen losses in carbon stocks.

Plan Vivo carbon offset certificates are issued by an independently administered entity (the Plan Vivo Foundation) following a standard process based on annual review cycles. The carbon benefits of each plan are evaluated with reference to technical specifications developed by internationally recognized research institutions, such as the University of Edinburgh, ICRAF and the Edinburgh Centre for Carbon Management (ECCM). The emissions reductions are sold on behalf of the farmers or community in the form of Plan Vivo Certificates that represent the long-term sequestration of one ton CO_2 equivalent. The cost per ton of CO_2 sequestered ranges from US$6 to US$20, and includes the transaction costs for certification, verification and international support, local technical assistance, administration and monitoring, staged payments to farmers, and a community carbon fund. This ensures that an average of 60 per cent of the carbon offset purchase goes directly to communities through instalments disbursed over many years. The current projects range from a carbon offset potential of 10,000 tons of CO_2 per year in Uganda to 1,000,000 tons per year in Mexico. An important replicability factor is the standardization of methodologies, systems and indicators for project design, validation, monitoring and evaluation. The main constraint on scaling up the project in Uganda is the lack of buyers, while the main limitation to replication in other countries and different agroecological and socio-economic conditions is the initial investment needed for baseline and feasibility studies, as well as for development of technical specifications (see case study 7 in annex 5).

Key issues, as in many PES projects, are to reduce transaction costs and ensure security of tenure and sustainability.

[99] http://presa.worldagroforestry.org.

[100] The group includes DFID, Tetra Pak UK Ltd., the Carbon Neutral Company, the International Network for the Availability of Scientific Publications (INASP), the Katoomba Group, and others.

Contribution of reforestation and agroforestry projects to mitigation

Discussion at COP 14 stressed that climate change adaptation and mitigation objectives will be impossible to meet if forests are not included in climate mitigation and adaptation mechanisms and strategies. Forest mitigation and adaptation activities are closely related to IFAD's mandate and objectives. These activities could both benefit the global environment and improve local conditions in deprived areas. In particular, REDD systems could offer several benefits to poor rural people, in terms of increased, stable and long-term financial and non-financial flows to rural areas, while preserving natural resources and environmental services.

IFAD has supported reforestation projects in the Himalayas and Yemen, including a livelihoods improvement project in the Himalayas[101] that focuses on gender inequalities and indigenous households. The grant to ICRAF for Tree Domestication in West and Central Africa has resulted in a gradual reduction in the practice of slash-and-burn agriculture in these humid tropics areas. Small-scale farmers now do not burn fields that have been left to lie fallow for several years, owing to the presence of trees. The greater number of trees also increases the chances of sequestering carbon.

Energy-related actions

Through its role as executing agency of the GEF, IFAD has the marked possibility of promoting further expansion of the use of clean energy by developing countries, and reduction of the consumption of fossil fuels. In addition to supporting mitigation in other areas, the GEF is the largest funder of renewable energy in the developing world, supporting solar, wind, geothermal, biomass and small hydropower energy (IFAD 2008e). A new investment in China, the Xinjiang Uygur Autonomous Region Modular Rural Development Programme (2008-2014), is installing solar power systems for poor rural households. It also includes agricultural development through technology transfer and organic production and marketing, targeting of women's groups and a microfinance component. It will adopt a flexible, modular approach to planning and implementation. Also in China, the West Guangxi Poverty Alleviation Project (2002-2008) has been turning human and animal waste into a mixture of methane and carbon dioxide gases for lighting and cooking to help address the energy needs of poor households. Outputs include the provision of nearly 23,000 'biodigester' tanks for biogas production to approximately 30,000 poor households. Outcomes and impacts include a reduction in methane emissions, an increase in incomes, and improvements in household sanitation and health.[102]

Notwithstanding the foregoing, IFAD's comparative advantage in climate change mitigation for the GEF is in LULUCF and biomass production. Thus one of the thematic drivers of IFAD/GEF involvement in the area of climate change is exploration of the links between sustainable land management operations and climate change activities.[103]

5.7.3 Integrated adaptation/mitigation responses

Discussions at COP 14 in Poznan, Poland, stressed that both the setting of ambitious emission reduction targets by developed countries and consideration of mitigation as an integral part of development objectives by developing countries have to be pursued simultaneously within a vision of sustainable development, recognizing the adaptation needs of poor countries.

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[101] Programme on Livelihoods and Ecosystem Services in the Himalayas: Enhancing Adaptation Capacity and Resilience of the Poor to Climate and Socio-economic Changes.

[102] http://operations.ifad.org/web/ifad/operations/country/project/tags/china/1153/documents;jsessionid=F68813013C8845DDCA87270E33328A9A.

[103] www.ifad.org/operations/gef/climate/ifad_adaption.pdf.

Given the fact that a number of traditional activities supported by IFAD have the potential to address both adaptation and mitigation, a further area to consider is integrated approaches to adaptation and mitigation, and their integration in turn into sustainable development approaches. Grants along these lines are currently being developed, such as the scaling up of innovative local strategies that can proactively respond to and mitigate the negative effects of climate change on the livelihoods of poor rural communities in the West African Sahel through a systemic approach (agro-forestry-pastoral). An existing example is the TAG to ICRAF for the three phases of Tree Domestication in West and Central Africa. As discussed above, apart from the adaptive benefit of enhanced soil conservation and fertility, the greater number of trees resulting from project activities also increases the chances of sequestering carbon for mitigation purposes.

A further important example of resource management for an integrated adaptation/mitigation approach is zero tillage, which minimizes or eliminates tillage and maintains crop residues as ground cover. It has many advantages over conventional tillage, including savings in labour and energy; conserving and even improving soil fertility and productivity; increasing soil moisture and tolerance to drought; and reducing GHG emissions (IFAD 2009b). However, a number of constraints on this and other conservation agriculture approaches will need to be addressed before they can be scaled up as integrated adaptation/mitigation approaches. For example, conservation tillage approaches can be very effective, but they may also reduce the availability of crop residues, often a critical source of fodder in mixed crop/livestock systems; and zero tillage requires some use of herbicides, which makes it unaffordable for poorer farmers.

5.7.4 Summary: mitigation

A number of activities traditionally supported by IFAD are important for mitigation: afforestation and reforestation; better land management practices such as conservation tillage and agroforestry; rehabilitation of degraded crop and pasture land; rangeland rehabilitation to improve productivity; and livestock management practices. All of these activities can contribute significantly to improving soil cover and reducing carbon emissions as a mitigation strategy. IFAD's experience with smallholder farmers and rural communities constitutes a valuable basis for the design of financial and institutional mechanisms to provide appropriate incentives to reduce emissions from deforestation and forest degradation that will be included in the post-Kyoto climate regime. IFAD is progressively gaining experience on payments for ecosystem services (PES) projects and clean energy projects. More recently, it is designing grants for integrated mitigation/adaptation approaches – for example, grants to the World Agroforestry Centre (ICRAF) for scaling up innovative local strategies in the West African Sahel that can respond to and mitigate the negative effects of climate change on livelihoods of poor rural communities.

6. Lessons learned from the review of IFAD experience

This report has highlighted a number of lessons arising from the review of IFAD's experiences in activities that support adaptation to climate change, mitigation and scaling up of the organization's response in these areas. These lessons are summarized here, together with a gap analysis of important areas to cover in the future, based on IFAD's core mandate and comparative advantage.

A point of departure for this study was the assertion that even if project design has not specifically included climate change, development activities targeting poor people can nevertheless support adaptation in three main ways (Eriksen et al. 2007):

- Reducing climate risks to projects;
- Strengthening participants' coping and adaptive capacity in the face of short-term climate variability and long-term climate change;
- Targeting the causes of vulnerability to climate variability and climate change.

Based on the above, the following lessons may be identified:

- **Principles of engagement are conducive to adaptation planning.** IFAD's principles of engagement, such as participation, gender mainstreaming, vulnerability assessment and capacity building, position the organization well to increase its focus on planning and implementation of activities that respond to climate change.

- **Activities that address climate risks and variability are supportive of adaptation to climate change.** Many IFAD projects have been designed to promote synergies between climate change and desertification, through interventions such as soil and water conservation, agroforestry and economic diversification. These activities are strongly linked to climate change adaptation. There are also important synergies between responses to desertification and climate change adaptation. IFAD's significant experience with the former provides a good platform for enhancing its response to climate change.

- **Support to indigenous peoples can strengthen their adaptive capacity.** Such support includes strengthening the land titling process and access rights of indigenous peoples to their natural resources, and improvements to indigenous productions systems adapted to climate stress through greater access to marketing, infrastructure, research and development, and technology transfer.

- **Rewards for ecosystem goods and services are key for pro-poor mitigation.** Promoting integrated ecosystem management and rewarding mechanisms for ecosystem services provided by poor rural people are key for pro-poor mitigation, especially in view of the post-Kyoto agreement and of the importance that innovative mechanisms such as the Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) Programme is gaining on the international scene.

- **Knowledge management to transform experience into knowledge and to share this with partners is a key element of improving development effectiveness for IFAD.** Systematic documentation and dissemination of best practices and lessons learned in the context of responding to climate change are important knowledge management approaches to be emphasized by the organization. Participatory research and design, and merging traditional with scientific knowledge, are strategies for building local knowledge and harnessing synergies between different types of knowledge, in order to help poor rural people to adapt to the adverse effects of climate change.

- **IFAD grants for climate change adaptation hold great potential for scaling up.** An important recent development for IFAD investments is the use of the grant mechanism to promote activities targeted at adaptation to climate change. In many cases, these are linked to

implementation through an action learning approach, which holds value for scaling up adaptation to climate change, given the associated urgency for action and uncertainty regarding impacts and effects on resilience.

In addition to the lessons learned, the study revealed a number of gaps in IFAD's response to climate change:

- **Data collection, sharing and use in planning processes:** Given its long-term collaboration with and support to farmers and resource users in rural areas, there is scope for IFAD to make a greater contribution to improving the collection, management, exchange, access to and use of observational data and other relevant information on climate variability and change.
- **Appropriate technologies:** While poor rural people are frequently aware of climate change-related trends such as increased rainfall variability and late onset of rain, IFAD projects have generally not included approaches to help local resource users better track climate trends, such as community monitoring of rainfall and temperature. Appropriate technologies for farmer-based or resource-user based systematic observation and monitoring of climate variability and climate change should be developed as an important way to make livelihoods more climate-resilient.

- **Research activities to support decision-making and mainstreaming:** IFAD has supported the testing, adaptation and dissemination of technology to address climate variability. This support could provide valuable lessons for mainstreaming adaptation to climate change. However, research has not been specifically focused on adaptation to climate change. Given the likely acceleration in climate impacts in the near future, research activities to support decision-making about climate change adaptation, environmental risk management and integration of with sustainable development will be necessary to close this gap.

- **Emphasis on risk mitigation and management:** As recently recognized by the organization, IFAD needs to increase its emphasis on risk preparedness and management work, with a particular focus on early warning systems and crop/livestock insurance guarantee schemes that have great potential to allow farmers (not landlords) to recover from their losses and stabilize their income.
- **Climate change linkages in vulnerability assessments:** Linking causes of vulnerability to climate variability and climate change has been carried out to a greater degree in regions where climatic extremes, droughts and flooding have long been the norm. There is scope for improvement in making the climate linkages in vulnerability assessments.
- **Integrating adaptation and mitigation measures for maximum impact:** There has been little experience in integrating adaptation and mitigation measures for maximized impact on strengthening resilience of poor rural communities. IFAD's experience could be better exploited. IFAD provides substantial support to pro-poor research to increase resilience of smallholders to climate variability. This support is a further valuable element to be increased in the organization's response to climate change.
- **Possibilities for maladaptation**: This study has highlighted potential adaptation opportunities, as well as possible risks, in IFAD's operations. A significant risk for the organization concerns the possibility for maladaptation through the kind of activities it supports. It cannot be taken for granted that positive aspects of IFAD's existing response would automatically lead to the best options for adaptation, which will require a concerted focus in that regard.

7. Strategic recommendations for strengthening IFAD's capacity to mainstream climate change adaptation

Remarkably little has been said or written about the people who will feel the impact most – the poor rural people of developing countries – and even less attention has been given to how they can contribute to slowing its advance. Global efforts will be more effective if the role of poor rural people as custodians of the natural resource base is recognized, and they are enabled to become key players in designing and implementing mitigation measures (IFAD 2008b).

7.1 Towards a new approach

Rural people have coped over the ages with extremes of flood and drought by cultivating a multiplicity of vigorous, indigenous crop types capable of surviving a range of conditions, and by collaboratively managing shared natural resources. However, there is no doubt now that IFAD's target group – poor rural people, who often live on fragile lands and eke out tenuous livelihoods – are faced with a new and urgent reality – the need to cope with increasing climate variability and to adapt to climate change. Poor rural people in marginal and often degraded lands are particularly vulnerable to climate change impacts. This has recently been reconfirmed by analyses in Africa, Asia and Latin America showing that marginalized groups dependent on primary resources for their livelihoods are especially vulnerable to climate change impacts if their natural resource bases and governance systems are heavily stressed and thus not capable of responding well (Leary et al. 2006, cited in Adger et al. 2007).

As the IPCC has pointed out, the capacity to adapt is dynamic and is influenced by many factors, including economic and natural resources, social networks, entitlements, institutions and systems of governance, human resources and technology (Adger et al. 2007). This highlights the need for adaptation to be undertaken as part of broader social and development initiatives, and not in a stand-alone fashion. Adaptation strategies must also be developed locally, and must respond to the needs and vulnerabilities of local people.

IFAD has stated that one aspect of a possible new approach under future modification of the new operating model is a greater focus on climate change and environmental issues as an entry for development. The effects of climate change threaten IFAD operations: they pose additional risks to projects and will increase the vulnerability of participating communities and the ecosystems on which they depend. What is clear is that IFAD's approach to climate change must be firmly rooted in its core competencies, embedded in its operational processes and linked tightly to its main products. In that regard, IFAD is the only international development institution established exclusively to contribute to reducing poverty and food insecurity in the rural areas of developing countries. Thus IFAD has a strong focus on the alleviation of rural poverty and agricultural development, and a broad livelihood-based approach in most of its activities.

7.2 Strategic recommendations to enhance mainstreaming of climate change adaptation

7.2.1 Ensure that the proposed climate change strategy, to be formulated as a follow-up to the Eight Replenishment of IFAD, is linked to enhanced roll-out of the new environmental and social assessment procedures that were presented to the board in April 2009.

While it is important for the organization to develop a climate change strategy, this needs to be linked to the updated environmental and social assessment (ESA) procedures. Attention needs to be

given to ways to enhance the rolling out of the ESA procedures, how to effectively raise awareness on climate change, and ways to implement the strategy. Defining a clear adaptation strategy for IFAD would also enhance IFAD's access to financial resources, including the Least Developed Countries Fund, the Special Climate Change Fund and the Adaptation Fund. To this end, the following specific recommendations are made:

- *Develop an IFAD Guidance Note and supporting tool* that provides simple information and a consistent approach for project development teams and other staff on climate change, including clear indications of countries and eco-regions most vulnerable to climate change.
- *Allocate sufficient resources for undertaking selective strategic environmental assessment to inform the design of RB-COSOPs,* with a strong emphasis on climate change considerations.

> *Far more than any guideline or strategy, I really like the checklists – like the gender and the targeting checklists. This helps us a lot, forces us to include these issues in project design.*
>
> – IFAD Country Programme Manager, Indian Ocean region

7.2.2 Sharpen the connection between project activities and climate variability and change

As this review has revealed that many IFAD-funded activities are unconsciously supporting adaptation-related activities, performance will be improved by encouraging projects to consciously make the connection between normal project activities and climate change or increased climate variability. This would be the first step to projects beginning to factor in some of the climate projections and scenarios now being scaled down in more useful ways. This is less the case in the Sahel, where many activities have been rooted in response to drought and famine since the inception of IFAD, and farmers and other resource users have much experience in adapting to climate variability. Evidence is growing that certain sustainable livelihoods measures operate as climate-change adaptation options and that such measures, which have many co-benefits, should be integrated into the planning of national adaptation strategies. Specific recommendations follow:

- **Raise awareness about climate change through effective dissemination mechanisms,** such as learning platforms, training interventions and seminars (for example, the CLIMTRAIN training offered by IFAD's Global Environment and Climate Change Unit). Given that changes in the quality enhancement process mean that Country Programme Managers (CPMs) now have direct supervision responsibility for projects, the CPMs are an important target group. However, recent training experiences have highlighted the need for more effective means to increase their participation. This can be initiated through the development of a 'basket of options' that would be part of the training for CPMs, and also through other means. It is also important to encourage in-country activities (e.g. training for project staff, consultations and awareness-raising activities with stakeholders) and to collaborate with other partners involved in addressing climate change capacity development to improve overall development effectiveness.
- **Encourage projects to develop linkages with existing or planned climate change interventions in their areas.** In order to build up a critical mass of organizations and actions for climate change adaptation, a starting point would be to look for synergies with any national adaptation programme of action (NAPA) pilot projects being implemented, or with activities being undertaken by international and national organizations with a climate change focus. It would be important to identify organizations carrying out awareness raising on climate change and to develop partnerships with them, and to sensitize project teams as a first step. This linkage

mechanism could be part of a proposed package to be included in training interventions (for example with CPMs).

- **Strengthen the vulnerability assessment process for project design,** ensuring that they make specific links to increasing climate variability and highlight those groups most vulnerable to climate risks. This could be achieved by encouraging the use of sustainable livelihoods approaches, which focus on strengths, vulnerabilities and livelihood strategies in an integrated fashion and thus can provide a platform for developing resilience-building strategies for adaptation to climate change.
- **Integrate climate scenarios into programme operations.** Encourage existing projects that still have significant periods of time to run to do this at the mid-term review or next annual review, and provide discretionary funds to do so. New projects should be designed around the best available downscaled projections, and this should be specified in the IFAD climate change strategy.
- **Strengthen climate input into national policy and planning processes.** Many IFAD projects have valuable lessons about climate change for national policy and planning processes. However, since conscious connections have not been made between relevant activities and climate change, the necessary effective inputs have not been provided to integrate climate change considerations into processes such as poverty reduction strategy papers (PRSPs) and NAPAs. IFAD and other partners need to search for innovative ways to develop national and local capacity. Project coordinators should be actively encouraged to make these links.
- **Pilot a focused climate change mainstreaming programme in a small set of countries.** This could be carried out, for example, in five countries, identified by CPMs on the basis of interest and relevance in terms of climate risks and vulnerability. After initial sensitization of the country programme development teams and a workshop on a basket of adaptation/mitigation options (including those recommended in this report), the pilot could be run as an action learning process, with opportunities for learning between countries and projects. Successful elements could be replicated more broadly. The process should be linked to additional financial resources that participating countries could access in order to implement climate change priorities identified during the initial stages of the pilot process.

We need to have enough funds either to replicate what is going well, or to respond to new challenges. Even in this country, which is very vulnerable to climate change, the investment in environment, and even in agriculture, is very weak. Things like range resting, rangeland reseeding usually have good uptake. But longer-term interventions, like agroforestry, shelter belts – we invested in this 20 years ago, but it has not been replicated.

– IFAD Country Programme Manager, Near East and North Africa region

7.2.3 Enhance support for, and fine-tune, successful actions for adaptation and mitigation

The study identified a number of approaches and sectoral interventions that are supportive of climate change adaptation and mitigation. These interventions need continued support and fine-tuning. Fine-tuning will need to include making stronger connections between poverty and ecosystem services, as well as better integrating climatic variability and downscaled climate projections. Specific recommendations in this regard are:

- **Develop pro-poor innovative financial mechanisms.** Conduct policy research to identify mitigation mechanisms adapted and dedicated to poor rural people, including specific

mechanisms adapted to indigenous peoples, and that reward rural communities for the environmental services they do/could provide. The research should focus on how to support appropriate pro-poor policies to ensure flow of carbon funds, and technologies that enhance, measure and monitor carbon capture and storage.

- **Expand support to pro-poor adaptation research.** Continue and expand support to relevant research activities and fine-tune these so that they support decision-making about climate change adaptation, environmental risk management and integration of environmental risk management with sustainable development.
- **Continue support to economic diversification.** Continue support to activities on economic diversification as a key to enhancing livelihoods and relieving pressure on natural resources, as well as on markets and microfinance, as a crucial link to unlock these opportunities. Such support should have an explicit, rather than unconscious, link to adaptation.
- **Continue to support land tenure rights.** Strengthen the focus on securing territorial rights of indigenous peoples and other marginalized groups, as a key step for both adaptation and mitigation. Again, such support should have an explicit, rather than unconscious, link to adaptation and mitigation.
- **Increase the emphasis on risk preparedness and risk management work.** Such emphasis should focus on micro-insurance schemes, which have great potential for supporting sustainable livelihoods of poor rural people. Explore IFAD's loan and grant instruments as well as its partnership with different foundations to develop and expand micro-insurance schemes to support risk management. Improving incentives in the use of environmental goods and services will have different implications in different cases.

7.2.4 Strengthen monitoring of and reporting on mainstreaming climate change

Adaptive management is critical to successful adaptation to climate change. Given the uncertainties and possibility of rapid changes, planning and implementation of adaptation activities will depend on the ability to close loops quickly and proactively. This means that increased emphasis will have to be placed on having monitoring and feedback mechanisms in place, and linking these to actions and decisions at diverse levels. This study has revealed the need to better capitalize on IFAD's experience, as knowledge on adaptation generated by its operations is often scattered and not systematized, which reduces the possibilities for dissemination of lessons learned and scaling up of activities to support adaptation efforts. Participatory methodologies are needed to achieve better linkage between climate science and local knowledge and practices, so that local communities have the information and resources they need to take effective action to protect their livelihoods and ecosystems from the effects of climate change. Participatory M&E and an action-learning approach are essential to the kind of rapid responses and learning-by-doing that will be required to address climate change impacts proactively.

- **Strengthen monitoring and evaluation (M&E) of climate-related outcomes.** Within overall operational M&E systems, specify that programmes and projects should develop indicators that monitor outcomes related to climate change. This may need to be taken up in the revised Quality Enhancement system. The system should include participatory M&E, which feeds back into an action learning approach at different levels – sub-nationally, nationally and at the global institutional level.
- **Strengthen reporting and dissemination of results and outcomes related to climate change.** Reporting on climate-related outcomes of loans and grants should be compiled on a regular basis and disseminated to help provide input from poor rural people and developing

countries into global discussions and negotiations, including the development of socio-economic scenarios and integrated assessment modelling.

7.2.5 Strengthen support to policy and institutional reform interventions related to climate change

A further shift in focus for IFAD in recent years has been a greater emphasis on policy-level interventions, in line with the Paris Declaration on Aid Effectiveness. As the following quote indicates, having an impact on policy is seen as an important way to ensure that interventions have a long-term impact.[104]

> *The problem is not about reaching all these households, the problem is about having a long-term impact. If no policy instrument is included in the programmes, then, at the end, they are finished.*
>
> – IFAD Country Programme Manager, Latin America and the Caribbean

- **Encourage greater country-level policy input on climate change.** Consider providing incentives and developing a support programme (along with appropriate resources) for country-based staff to expand and deepen in-country capacity for policy advocacy on climate change. Ensure that lessons learned are recorded, synthesized regionally and globally, and fed into global discussions and negotiations. The Strategic Environmental Assessment (SEA) would serve as a useful tool to identify areas for policy dialogue.

7.3 Summary of conclusions

> *Regarding mainstreaming climate issues in IFAD's operations ... I have a slightly simple view of this. I think IFAD has, largely unconsciously, been doing this, at least in the Sahel, for two decades. By designing and funding soil and water conservation projects ... they've been supporting farmers to adapt to drought. By funding agroforestry projects ... they've increased the number of on-farm trees ... which has impacted on local climate by reducing wind speed ... which decreased evaporation, lowered soil temperatures ... and reduced damage of sand blast to young crops. What could IFAD do more? Continue to fund SWC projects and in particular put agroforestry higher on its agenda.*
>
> – International development practitioner and academic with long-standing experience of IFAD investments

This study has explored many activities supported by IFAD in order to identify those that build the capacity of rural people to adapt to climate change in a manner that benefits the most vulnerable. The preliminary portfolio screening and analysis contained in this report indicate that long-term climate change risks have rarely been mentioned in IFAD's project documents to date. However, many of IFAD's investments do address climate variability and include activities directed at reducing vulnerability and coping with climate-related risks. These activities may be technology-oriented or of a social development nature, may involve research and include innovative methodologies, and may also support mitigation, such as increasing biomass through agroforestry.

While an increasing number of IFAD-supported projects include elements that address climate-change adaptation issues, a key challenge lies in optimizing all IFAD activities at the country level, so

[104] Considering IFAD's focus, poverty strategies and rural development policies are critical leverage points. In LDCs, PRSPs constitute a primary target for policy reform, and globally it is generally felt that these have made some progress in shifting policymaking towards a more evidence-based approach and in focusing more attention on poverty analysis. However, a detailed analysis of 10 recent poverty reduction strategies indicates that the chronically poor are generally invisible to those who make and implement national policies (Chronic Poverty Research Centre 2008). This highlights a natural role for IFAD, based on its comparative advantage in putting forward the voices of poor rural people at the international level. Given the importance of NAPAs in accessing funding for climate change adaptation in LDCs, a solid case can be made for an emphasis by IFAD on assisting, together with other rural stakeholders, in integrating the relevant issues into NAPAs.

that programmes and projects are designed systematically to build on an understanding of the potential effects of climate change and to take these into account.

An internal review of IFAD-supported projects defined four types of adaptation-related activity: (a) improving agricultural techniques and technologies; (b) promoting community-based natural resource management; (c) strengthening coping mechanisms and risk-preparedness to mitigate disaster impact; and (d) diversifying livelihoods to reduce risk (IFAD 2008a). Other identified aspects of IFAD's comparative advantage in addressing climate change include: some experience with mitigation measures; knowledge generation and management on climate vulnerability issues; support to in-house capacity-building on climate change; and leveraging additional resources for climate-change-related activities – for instance, through its grants and partnerships with the GEF and other organizations. An earlier analysis indicated that IFAD has a comparative advantage in working on combating land degradation, rural sustainable development and integrated natural resource management (Bouzar 2007). This analysis indicated that IFAD's engagement in climate change is based mainly on developing activities that nurture linkages between sustainable land management and climate change. Thus, based on its experience, IFAD has a clear comparative advantage in adaptation to climate change, rather than in mitigation. However, the recent broadening of the GEF Climate Change window to LULUCF provides an opening to IFAD for increased future involvement in climate change mitigation (Bouzar 2007).

This study supports and expands on the previously identified four areas for adaptation-related activities. It also highlights more-specific areas of IFAD's comparative advantage that go beyond the broad categories of working on combating land degradation, rural sustainable development and integrated natural resource management.

While all of the above do provide an important basis for addressing climate change, key *additional specific* areas in IFAD's experience as identified by this study include:

- IFAD's mode of engagement, based on its principles of engagement and its emphasis on indigenous and local knowledge, local empowerment and capacity building;
- support to interventions that blend traditional and scientific knowledge;
- increasing adoption of an action research and action learning approach;
- funding agricultural research of high relevance for climate change; and
- a number of relevant integrated planning and implementation modes, such as promoting integrated agricultural approaches, addressing conflict and supporting displaced people.

The latter will be important in areas where migration is the most important coping strategy, or becomes unavoidable due to, for example, sea-level rise. IFAD's approaches to capacity building and institutional strengthening, such as extension and advisory services, also form part of its comparative advantage and should be maximized in a comprehensive approach to adaptation.

While delivering on adaptation, it is critical to build adaptive capacity at local, national and regional levels, at the same time recognizing the low levels of capacity that many developing countries have to absorb additional funding for tackling climate change adaptation. What is important is for the organization to prioritize and support the implementation of practical, effective and high-priority adaptation actions. Furthermore, the extent to which the organization is able to mainstream environmental and sustainable natural resource management practices is important for creating a strong platform from which to launch a climate change mainstreaming process. In this regard, it will be important for IFAD to bring its climate change-related work to a deliberate and systematic level, without which mainstreaming is impossible.

Three priorities have been identified for strengthening IFAD's engagement in climate change. The first is to build on its achievements and to fully integrate climate change adaptation into its operations. A second priority is to develop the proposed strategy on climate change, to be presented to the Executive Board for approval in 2010, which will guide the full integration of climate change issues into its operations and prompt a major increase in its engagement. Key focus areas are likely to include: approaches to promoting adaptation and to enabling poor rural people to participate in mitigation efforts; mainstreaming of adaptation measures in IFAD operations; and strengthening of IFAD's capacity and knowledge base on adaptation and climate risks. They would also include risk analysis and a results framework. The third priority is to seek additional funding to enable IFAD to substantially scale up its engagement in climate change issues, while continuing to draw on its core resources to pursue a climate change agenda.[105] This report represents a contribution to the first two of these priorities, and provides additional detail to deepen the understanding of IFAD's comparative advantage.

Climate change adaptation provides a compelling opportunity to accelerate progress towards a goal often stated, but little realized to date – that of sustainable development – and to meet IFAD's goal as set out in the Strategic Framework: poor rural women and men in developing countries are empowered to achieve higher incomes and improved food security.

> *The best way to address climate change is by achieving tangible impact on the ground.*
>
> – Long-term technical assistance expert and partner to IFAD, Central Africa

[105] Additional resources would make it possible for IFAD to: focus more strongly on climate change issues during the project cycle; assist Member States in developing, financing and implementing adaptation and mitigation projects aimed at poor rural people, and in accessing additional resources; better generate, manage and share knowledge on climate change and on how it affects poor rural people; and further build skills and capacity within IFAD.

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Annex 1. Activities that can support climate change adaptation and mitigation

The following activities can potentially support adaptation and mitigation to climate change, depending on the context. There are many site-specific options for adaptation; this list provides a limited set of examples for indicative purposes.

Adaptation activities for NRM and agricultural development themes

- Rehabilitation of wetlands to reduce flooding, improve groundwater recharge and erosion control
- Measures addressing desertification/land degradation and drought
- Prevention of deforestation
- Changes in land use to maximize sustainable yield under increasing climatic variability
- Changing crop varieties and/or crop calendars to adjust to increasing seasonal variability in rainfall/temperature
- More efficient application of nitrogen fertilizers on cultivated fields
- Making irrigation systems more appropriate (e.g. no salinization), and more efficient use of irrigation water
- Improved integrated water management, including water harvesting, water storage and water-use efficiency
- Improved soil conservation measures, including conservation tillage and organic agriculture
- Diversification of farming systems, including integrated crop/livestock systems, agroforestry, crop/fish systems
- Conservation of genetic resources, for example through seed banks
- Development of climate-adapted strains, e.g. stress-tolerant maize and salt-tolerant forage
- Rehabilitation of natural systems to protect coastal communities against climate risks such as storm surges, for example rehabilitation of mangrove systems and dunes
- Sustainable fisheries activities that assist fishers in coping with and adapting to increasing climate variability
- Energy use, substitution of fuelwood consumption (improved efficiency of stoves, etc.)

Infrastructure-related adaptation activities

- Building/retrofitting rural infrastructure to cope with climate-related risks such as water shortages and extreme weather events
- Strengthening food-security systems by improving storage and marketing facilities
- Preventing water supplies from becoming polluted

Financial adaptation activities

- Financial services in place to address risks due to climatic variability (insurance schemes, etc.)
- Financial incentives to reward producers for sustainable natural resource management, e.g. payments for environmental services
- Incentives for income diversification
- Cofinancing schemes to support risk management (extreme weather events)

Economic diversification activities

- Rural income diversification activities that support vulnerability reduction and reduce people's reliance on climate-sensitive activities
- Sustainable commodification of non-timber forest products

Actions targeting vulnerability and social development

- Participatory vulnerability assessments
- Integrating climate risks into vulnerability assessments
- Assessing and understanding current livelihood systems, indigenous knowledge and adaptive capacities
- Understanding gender-based differences related to vulnerability to climate variability and change

- Social actions to reduce vulnerability, e.g. building social networks
- Empowering civil society in relation to climate change, e.g. by integrating climate change into local institutional support
- Increasing access to health care to reduce vulnerability

Disaster risk reduction

- Strengthening drought preparedness and management
- Setting up a monitoring network to enable early warning of weather-related hazards
- Including climate risk assessment in project design

Policy and institutional activities

- Support to policy dialogue, e.g. to raise the profile of climate change; and to dialogue on security of tenure
- Strengthening the legal system to improve compliance with existing regulations, e.g. on soil conservation
- Improving institutional capabilities on climate change at all levels

Mitigation-related activities

- Actions that increase biomass, such as afforestation
- Use of clean energy sources such as solar energy
- Improved nutrition for ruminant livestock and management of livestock wastes to reduce methane emissions

Linking adaptation and mitigation

A number of actions, including some of those in the above list, may act to both reduce emissions of greenhouse gases such as carbon and methane (mitigation), and promote adaptation to a changing climate. Some specific examples are:

- Rehabilitation of degraded grasslands
- Conservation tillage and appropriate cropping systems
- Afforestation, reforestation and agroforestry

Source: Study questionnaire.

Annex 2. People interviewed for this study

Chris Reij, Centre for International Cooperation, Vrije Universiteit, Amsterdam

Stephen D. Turner, freelance international development expert

Abdullah Al-Dakheel, International Center for Biosaline Agriculture

Ilaria Firmian, Associate Technical Advisor, Environment and Natural Resource Management Desk, IFAD Technical Advisory Division, Rome

Teeluck, National Programme Coordinator, IFAD Rural Diversification Programme, Mauritius

Zac Tchoundjeu, Principal Scientist, ICRAF office in Cameroon; coordinator of a grant to ICRAF for tree domestication

Tessera, Programme Coordinator, IFAD Post-Tsunami Coastal Rehabilitation and Resource Management Programme, Sri Lanka

Ladislao Rubio, IFAD Country Programme Manager for Mexico

Rasha Omar, IFAD Country Programme Manager for the Sudan

Ximena Flores, former IFAD Country Programme Manager for Ecuador

Benoît Thierry, IFAD Country Programme Manager for Madagascar, Comores and Seychelles

Siobhan Harrington, Manager of Oral History Programme, Panos London

Abdu Abbas Al Rafeig, Programme Coordinator, and Aisha Oshiek, Community Development Officer, Gash Sustainable Livelihoods Regeneration Project, the Sudan; and many other IFAD staff and government partners on GSLRP

Amal Bushara, Programme Coordinator Ad Interim, Western Sudan Resource Management Programme; and many other IFAD staff and government partners on WSRMP

Annex 3. Additional information on selected projects

Strengthening tenure and using indigenous systems to protect watersheds in the Philippines

The Second Cordillera Highland Agricultural Resource Management Project is using the *Lapat* indigenous system to protect watersheds. This system calls on all community members and neighbouring communities to observe rules for environmental protection. These include refraining from indiscriminately cutting trees, gathering rattan, hunting animals, and even fishing in the rivers and streams within the *Lapat* area. By adopting the *Lapat* system, indigenous communities take over the responsibility, care and management of forests and natural resources. By the end of 2007, indigenous peoples in eleven highland municipalities were practicing the system. As well as improving tenure rights through issuing 'certificates of ancestral domain title', the project provided funds and technical assistance in the form of information and educational campaigns on the Indigenous Peoples Rights Act. It also helped mobilize the community and assisted in preparing the Ancestral Domain Sustainable Development and Protection Plan, which is a major requirement in the issuance of the certificates. The process was expanded to five other municipalities and is now being concluded. The recognition of tenurial rights of indigenous peoples has strengthened the continuity of the *Lapat* system. It has also served as an incentive for people to participate in community development plans and projects (IFAD 2007c).

Linking biodiversity and development in Mali's inner Niger Delta

The inner Niger Delta, a vast wetland of almost 30,000 km^2, together with its transition zones, is one of the largest inner deltas in the world. Because of its dynamics and particular location in a Sahelian arid and semi-arid zone, it hosts unique biodiversity. The delta's population of about 622,000 inhabitants is 90 per cent rural. Most people depend on natural resources for their food and income. Despite its natural potential, the area is crucially affected by poverty and inadequate access to primary infrastructure. The GEF intervention, which forms part of FODESA, has been designed to complement and enhance the IFAD programme by supporting the formulation and implementation of community-based management plans and targeted investments to restore and conserve the most threatened ecosystems of the delta. A key strategy is to reverse the process of degradation by empowering local communities to identify their own priority needs in order to improve living conditions, education, food security and access to health services. This is accompanied by the development of an environmental information system for the delta. Specific technologies to address climate variability include measures to control soil erosion and improve water penetration and soil conservation; and the excavation of channels to improve the availability of water. The project also includes an approach to economic diversification that is integrated into the agriculture, livestock and fishing sectors, with access to decentralized finance for rural microenterprises. Local institutions or 'dioros' are engaged for improved water and pasture management.

Weather derivative contract covering drought in Malawi

Swiss Re has pioneered weather risk-transfer instruments in developing countries, starting in India in 2004 with a programme reaching over 350,000 smallholder farmers. Under its Climate Adaptation and Public-Sector Business Development Programmes, the company fosters the use of modern risk management instruments, such as weather derivatives and insurance-linked securities, to the benefit of non-OECD countries. Recently Swiss Re entered into a weather derivative contract with the International Development Association (IDA), the arm of the World Bank that provides support to the world's poorest countries. Under the terms of the contract, Swiss Re will pay out up to US$5 million in the event that Malawi's farmers suffer a drought-related shortfall in maize production. This is the first IDA weather derivative contract with the Government of Malawi. The World Bank, working together with the Government of Malawi, structured the contract as an option on a rainfall index. The index

links rainfall and maize production: if precipitation falls below a certain level, the index will reflect the value of the projected loss in maize production. The maximum payout is reached if maize production drops to 10 per cent below the historical average (http://swiss-press.com:80/newsflashartikel.cfm?art=News&key=370075&parm=detail).

Participatory mapping for conflict resolution in western Sudan

The Western Sudan Resource Management Programme (WSRMP) covers the North and South Kordofan States. The overall programme aim is to promote the establishment of a natural resources governance system that is equitable, economically efficient and environmentally sustainable. One of the main activities of WSRMP is the rehabilitation and development of 17 stock routes running through the Kordofan states. Increased pressure on existing scarce resources has led to an escalation of conflicts along these routes, especially between settled communities and nomadic pastoralists. The project is focusing on conflict resolution and has carried out surveys and initiated the process of demarcating the stock routes. Participatory learning and action (PLA) methodologies have been used to support these processes among settled communities and some of the nomadic tribes, although engagement with the nomadic groups has proved extremely difficult. Participatory mapping is one of a series of PLA tools being used by extension officers to demarcate stock routes, using both sketch mapping and global positioning system (GPS) tools. PLA tools are also being used to prepare local community development plans, which identify key development priorities among communities in order to focus programme interventions. One of the areas of concern is the requirement to incorporate the voices of all marginal stakeholders that use or manage a particular natural resource. In WSRMP the PLA tools currently being used are designed for sedentary and, often, literate communities. The methodologies are best suited to geographically well-defined communities, with clear boundaries and with a strong sense of place; they are far less effective among nomadic communities or across an entire stock route. WSRMP was one of the projects visited by researchers under the framework of Development of Decision Tools for Participatory Mapping in Specific Livelihoods Systems, a project of IFAD and the International Land Coalition. The project team developed methodological recommendations to guarantee that nomadic pastoral groups would also be involved in participatory mapping exercises in order to ensure the long-term sustainability of project initiatives. The visit to the project also supported the development of an IFAD approach to participatory mapping that takes into account the needs of more vulnerable groups and is flexible enough to be tailored to different circumstances (IFAD 2008d and 2009b,c).

Lessons from Latin America in building on indigenous knowledge systems

A recent desk study has revealed that in IFAD's Latin America and the Caribbean portfolio, only a small number of projects, mostly the Andean ones, had strengthened or attempted to capitalize on indigenous knowledge systems for natural resource management. In addition, the study found practically no instances (except partially in PROCORREDOR in Ecuador) in which a comprehensive approach was adopted towards integrating traditional knowledge systems and governance into sustainable management of resources. Most projects imported modern technologies that, at best, disregarded indigenous knowledge systems, while others attempted to replace them. In some instances, contradictory approaches were identified between projects implemented at different times, but in the same country. For example, while a former project in Mexico (Yucatan) had supported improvements in the traditional *milpa* system, a current project in the same country was trying to arrest the supposedly negative consequences of the same system. The desk review noted that current research had proven the validity of this system. Moreover, with the exception of the Ngöbe Buglé project in Panama, all projects were found to disregard the role of indigenous women as keepers and transmitters of traditional knowledge in natural resource management (IFAD 2007b).

Annex 4. Overview of mainstreaming methodologies adopted by development agencies

Asian Development Bank (AsDB) efforts to mainstream adaptation have included several initiatives aimed at awareness-raising and capacity-building, such as the organization of joint training courses with the Caribbean Development Bank (CDB) focusing on disaster risk reduction and climate change adaptation (OECD 2007). In 2002 AsDB launched a regional technical assistance programme to support its Climate Change Adaptation Program for the Pacific in integrating adaptation to climate variability and climate change into development planning. The programme promotes the mainstreaming of adaptation both in AsDB operations and at the country level. At the latter level, mainstreaming of adaptation into national development planning, sector programmes and projects is supported by the Climate Change Adaptation through Integrated Risk Reduction (CCAIRR) framework and methodology. Guidelines for Adaptation Mainstreaming (AsDB 2003) were also developed to support the implementation of the methodology. CCAIRR contains six major components: (i) capacity-building, including awareness-raising and institutional strengthening; (ii) data, tools and knowledge related to climatic change variability and extremes and their effects; (iii) risk assessments that translate scientific data and knowledge into information relevant to decision-making on adaptation; and (iv) mainstreaming of climate change and adaptation information into policies, plans and development strategies. CCAIRR requires application at project, local and national levels and has to be well integrated into the planning processes of a wide spectrum of stakeholders in government, the private sector and non-profit organizations.

The **World Bank** has focused on raising awareness through initiatives such as the development of a climate change portal, providing readily accessible climate-related data and containing a mapping visualization tool (webGIS) displaying key climate variables. The Bank has also tried to integrate climate risk management into the project cycle by applying a quick, simple risk-screening tool and following up throughout the design process when deemed necessary. A series of guidance booklets on Mainstreaming Climate Risk Management and Adaptation to Climate Change in Development Projects have been developed, focusing on agricultural, NRM and rural development projects. In addition, the ADAPT computer-based tool (**A**ssessment & **D**esign for **A**daptation to Climate Change: A **P**rototype **T**ool) has been developed to identify, at the planning and design stages, potential climate risk to development projects. The tool can help identify investments in climate-sensitive regions and sectors, and is expected to become a standard risk-screening tool for projects. It provides a summary of the climate trends from global climate model projections at a project site; identifies components of the project that might be subject to climate risk; explains the nature of the risk; and provides guidance to appropriate resources (relevant projects, technical literature and expert lists). Currently, the knowledge areas that the tool covers are: agriculture and irrigation in India and sub-Saharan Africa and, for all regions, various aspects of biodiversity and natural resources. Components on rural roads and coastal planning will be incorporated shortly. ADAPT is specifically tailored to project managers' needs by providing user guidance on risk avoidance and potential adaptation options.

The **Swiss Agency for Development and Cooperation (SDC)** provided funding for the development of a decision-support tool called CRiSTAL (Community-based Risk Screening Tool – Adaptation & Livelihoods), developed in partnership by **IISD, IUCN, SEI** and the **Swiss Foundation for Development and International Cooperation (Intercooperation)**. CRiSTAL is a software tool created to assist local communities, project planners and managers in assessing climate risks in planned or ongoing development projects, and in improving decision-making processes. CRiSTAL enables project planners and managers to: (i) understand the links between local livelihoods and climate; (ii) assess a project's impact on livelihood resources important in climate adaptation; and (iii) devise

adjustments to improve a project's impact on these key livelihood resources. The overall goal is to maximize adaptation opportunities and minimize maladaptation based on a systematic understanding of climate change impacts on livelihoods. CRiSTAL has been field-tested in Bangladesh, Mali, Nicaragua and the United Republic of Tanzania, and the tool is now available for wider applications.

To support the integration of risk reduction and adaptation processes into its programmes, the **Department for International Development (DFID),** together with the international **Institute of Development Studies (IDS)**, has developed and is now piloting the Opportunities and Risks of Climate Change and Disasters (ORCHID) methodology. ORCHID is based on a risk management approach to portfolio screening, and it enables country-based portfolio screening of projects and programmes, as well as a broader strategic assessment that relates donor activities to national priorities and plans. Based on profiles of climate and future hazard and vulnerability, the process prioritizes key planned and ongoing activities that are high risk and present good opportunities for risk and vulnerability reduction. The methodology enables a systematic consideration of climate risks and opportunities in the context of development programmes, highlighting where climate factors can best be taken into account, and seeks to build on existing risk management practices and processes. As a first step, the method compares a strategic overview of the programme portfolio with a profile of current and future climate impacts. A set of simple criteria are used to identify a subset of programmes in regions and sectors that are considered potentially at significant risk from climate impacts, and that at the same time present good opportunities for improving adaptive processes.

The **African Development Bank (AfDB)** has started a number of awareness-raising and in-house training activities. Other activities include a future review of its portfolio – to estimate the extent to which its operations are affected by climate risk – and approval of the Climate Risk Management Strategy (AfDB 2007). The strategy adopts a comprehensive climate risk management and adaptation (CRMA) approach to climate change, with better management of risks related to current climate variability and weather extremes. The strategy will be implemented under two main areas of interventions: climate risk management as part of due diligence in AfDB projects; and country/sector planning. The integration of climate risk management into regular project and country operations may require revision of: (i) AfDB's ESA procedures and its guidelines for ESIAs and strategic environmental and social assessments (SESAs); and (ii) AfDB operational and sector policies, procedures and guidelines, including the operations manual, and project identification, preparation and supervision processes, procedures and document formats/templates.

The **United Nations Development Programme (UNDP)** has raised awareness on adaptation issues through in-house training and through the Adaptation Learning Mechanism, an open knowledge platform that captures and disseminates experiences and good practices in adaptation. The platform also hosts the Country Adaptation Profiles Database, a UNDP-developed tool that provides information on climate change and the national initiatives of developing countries. UNDP aims to support countries by integrating climate change risks into United Nations programming; integrating climate change risks into national development policies, plans and strategies; and identifying financing for adaptation initiatives. To achieve these objectives, UNDP has developed: (i) guidelines and resources for project development, including funding information, application guidelines, programming templates, checklists and more; (ii) resources and support for mainstreaming climate change adaptation into United Nations and UNDP projects, programmes and practice areas at global and national levels; and (iii) background material and a public knowledge exchange platform, including monitoring and evaluation (M&E) tools, best practice notes and lessons learned.

The **United States Agency for International Development (USAID)** has developed a Guidance Manual for Development Planning that aims to ensure effective integration of adaptation. The

manual outlines a six-step approach in which each step is meant to be fully integrated into the typical project development and design process:

Step 1. Screening – staff assess whether a project could be adversely affected by climate variability and change. If so, stakeholders need to be consulted in order to identify and address next steps.

Step 2. Identify adaptations – possible adaptation options (i.e. alternative design or management practices that can reduce vulnerability) should be identified, together with stakeholders and external experts.

Step 3. Conduct analysis – to identify whether the adaptation options identified contribute to reducing vulnerability. The focus is on effectiveness, costs and feasibility of implementing these options.

Step 4. Select course of action – identify, together with key stakeholders, whether and what adaptation options are to be implemented.

Step 5. Develop implementation plan – after agreement on adaptation options is achieved.

Step 6. Evaluate the adaptation – shortly after step 5 has been finalized, a first evaluation can assess whether the identified options have been implemented, what problems were identified during implementation and whether costs were higher than anticipated. A further evaluation of the effectiveness of measures taken can be carried out at a later time.

Annex 5 Case studies

Case study 1: SUDAN – Gash Sustainable Livelihoods Regeneration Project: Spate irrigation, climate variability and rural empowerment

Case study 2: SUDAN – Western Sudan Resources Management Programme: Natural resources governance for conflict management, poverty reduction and environmentally sustainable development

Case study 3: ERITREA – Livestock and agricultural development, spate irrigation and adaptation to climate variability and change

Case study 4: KENYA – Mount Kenya East Pilot Project for Natural Resource Management: Increasing the resilience of the ecosystem to human and natural stresses

Case study 5: MONGOLIA – Fostering pastoralists' resilience and adaptive capacity to climate variability and extremes: IFAD's intervention in the livestock sector

Case study 6: BRAZIL – Adaptation to climate variability in north-eastern Brazil's Sertão Region: Transforming the semi-arid zone and facilitating coexistence with dry conditions

Case study 7: UGANDA – Trees for global benefits, carbon management and rural livelihoods: Development of voluntary carbon sequestration projects

1. Case study from the Sudan[106]

Gash Sustainable Livelihoods Regeneration Project: Spate irrigation, climate variability and rural empowerment

The project in brief

The Gash Sustainable Livelihoods Regeneration Project (GSLRP) aims to re-establish sustainable livelihoods for the predominantly poor population in the project area, located in Kassala State in eastern Sudan. It will do so by combining rehabilitation of the spate irrigation system on the seasonal Gash River with more-equitable land tenure linked to economically viable holdings, as well as developing off-farm income-generating activities. The project seeks to ensure an efficient, equitable and sustainable operation of the Gash Flood Irrigation Scheme and its integration into the local economy. Apart from rehabilitation of the irrigation scheme, other project components are animal production and rangeland management; community development, capacity-building and empowerment; financial services and marketing; and institutional support for water users' associations (WUAs), the Gash Agricultural Scheme (GAS), agricultural service providers and project coordination. The project aims to harness the positive relationship between development and peace, and it is envisaged that improving the living standards of the majority of poor people in the area should reduce social tensions.

Development challenges and environmental context

The Sudan, a country still in the process of settlement, is classified as an LDC. Traditional subsistence agriculture dominates the Sudanese economy, with over 80 per cent of the population dependent on crop production and/or livestock husbandry to support their livelihoods. Small-scale farmers are highly vulnerable to climate variability, as evidenced by the widespread suffering in rural areas during past droughts. Agricultural activities account for nearly half of GDP and the vast majority of employment. Large movements of people have occurred in many regions due to civil strife in the south and east, and drought and environmental degradation.

The most pressing environmental concerns for a sustainable development approach are land degradation, desertification and the spread of deserts southwards – by an average of 100 km over the past four decades, according to UNEP. Causal factors include overgrazing of fragile soils by a livestock population that has risen from some 27 million animals in 1961 to about 135 million in 2004. Deforestation, driven largely by slash-and-burn agriculture and energy needs, has led to a loss of almost 12 per cent of the forest cover in just 15 years.

GSLRP targets the poorest communities in one of the poorest regions in the Sudan. Located in the east along the Eritrean border, the project area is bounded by an area of instability to the north. The project was a response to the severe effects on the economic base of the Gash River Delta of recurrent drought, population pressure and deterioration in the infrastructure of the Gash Flood Irrigation Scheme. At the start of GSLRP in 2004, the total cultivated area had fallen sharply, from 80,000 *feddans*[107] in the 1980s to 30,000-50,000 *feddans* in 2004, while the number of claimants to farmland had increased dramatically, from 8,000 tenants in 1988 to 45,000 in 2002. The average cultivated area of less than one *feddan* and livestock holdings of a small number of ruminants were

[106] This case study was developed in December 2008 by Penny Urquhart, freelance sustainable development consultant, under guidance from Sheila Mwanundu, Senior Technical Advisor, and Ilaria Firmian, Associate Technical Advisor, of IFAD's Environment and Natural Resources technical advisory division. Many thanks are due to all the community members, government partners and project staff who gave so generously of their time in Sudan. Particular thanks are due to Rasha Omar, IFAD Country Programme Manager for Sudan; and to Amal Bushara, Programme Coordinator Ad Interim, Western Sudan Resources Management Programme.

[107] 1 *feddan* = 0.42 ha.

well below basic livelihood requirements. At present, malnutrition among children and women in reproductive age is rampant, and it is estimated that approximately 90 per cent of the people in the project area are poor.

The ephemeral Gash River, which rises in the Eritrean highlands, responds rapidly to storm rainfall in the catchment area, and is characterized by intense flood flows extending over an effective period of 60-70 days from July to September, with high silt loads. Downstream from the town of Kassala, its flood waters are used to irrigate the GAS before dissipating in the terminal fan some 100 km north of Kassala, where it provides moisture for natural forests, pasture and subsistence crop production, and recharges the aquifers that support stock water points. Mesquite (*Prosopsis chilensis*) has become an aggressive, invasive shrub along the Gash riverbanks and over flood plains on areas that are public lands or underutilized, especially on well-drained soils where its root system can reach the water table. Recurrent drought has meant that the rangelands near population centres have come under pressure from overstocking. According to the National Forestry Corporation, desertification in the northern parts of the delta is taking place at an alarming rate, in the region of more than two metres per year.

Climate-related risks

Throughout much of the Sudan, water resources are limited, soil fertility is low, drought is common, and rainfall is erratic and concentrated in short growing seasons. Chronic drought is one of the most important climate risks facing the Sudan, with recurring series of dry years having become the norm in the Sudano-Sahel region. According to the NAPA, there is a national trend of greater rainfall variability in the Sudan, increasing at a rate of about 0.2 per cent per year. These factors heighten the vulnerability of rainfed agricultural systems. Land degradation and desertification, brought on by human land-use pressures, unsustainable practices and recurrent drought, have degraded large areas of the country. Extreme flooding events occur in some parts. Other, less-frequent climate-related phenomena are dust storms, thunderstorms and heat waves. An assessment carried out by UNEP in 2007 indicates that among the root causes of decades of social strife and conflict are the rapidly eroding environmental services in several key parts of the country.

The Sudan faces high risks from climate change, and is expected to see the intensification of these hazards. Climate scenarios project significant increases in average temperatures relative to baseline expectations, with projected warming by 2060 ranging from 1.5°C to 3.1°C during August.[108] Results from some climate models show an average rainfall decrease of about 6 mm/month during the rainy season. According to UNEP, there is mounting evidence of long-term regional climate change in several parts of the country. This is witnessed by a very irregular, but marked decline in rainfall, for which the clearest indications are found in North and South Kordofan and Darfur States. The three highest priority sectors for adaptation, as identified through the NAPA consultation process, are agriculture, water and public health.

Concerning agriculture and rainfall, areas on the fringes of the Sahara will be acutely vulnerable – including conflict- and drought-stricken parts of Darfur, North Kordofan, Khartoum and Kassala States. Marginal areas for rainfed irrigation and grazing could tip towards desert conditions, possibly through only a slight increase in temperature and a small decrease in precipitation.

Combined with growing socio-economic pressures, the imposition of climate variability and climate change is likely to intensify the ongoing process of desertification of arable areas. Humid agro-climatic zones will shift southward, rendering areas of the north increasingly unsuitable for agriculture. Crop production is predicted to decline substantially for both millet and sorghum. The area of arable land, as well as the important gum arabic belt (formed of *Acacia senegal* trees, known as *hashab*) is likely to decrease as well, with attendant impacts on local incomes and food security.

[108] Climate projections in this case study are drawn from Republic of the Sudan (2007), UNEP (2007) and a number of studies summarized in van Steenbergen et al. (2008).

Reduced groundwater recharge – either through decreased precipitation or increased temperature and evaporation – has grave repercussions for the Sudan. A projection for arid and semi-arid regions of Africa is that if the temperature increases by 2-3°C and rain is reduced by 10 per cent, there could be a 40-70 per cent drop in mean annual runoff. This would have dramatic effects on agriculture, water supplies and hydroelectricity. Specifically for the Sudan, national studies have shown that soil moisture would decline under future climate change. When coupled with increased water consumption, population growth, high variation in rainfall and the high rate of evaporation, a national water crisis may be impending.

The semi-arid to arid and hot Gash River Delta and adjacent areas suffer from recurrent drought. Severe drought in the mid-1980s led to widespread displacement and loss of livelihoods. The average annual rainfall ranges from 260 mm in the south-east to less than 100 mm in the north-west. It is highly seasonal, occurring from July to October, and is extremely variable in amount, intensity and distribution. Since the 1940s, there has been a declining rainfall trend in the area. Agriculture consequently relies on harvesting seasonal flood waters for irrigation.

Records kept for the flood levels of the Gash River indicate high levels of variability from year to year.

> *The trend for the hydrograph in the last 30 years will show high fluctuations, there are no smooth trends.*
>
> – Hydrological engineer of the Ministry of Irrigation and Water Resources

The frequency of high floods has increased noticeably since 1983, and now a high flood occurs once in four years. It is not clear whether this is due to climate change trends. While no climate projections specific to the Gash area could be accessed, local perceptions noted below indicate trends in line with the general national trends identified above.

Local perceptions of climatic changes

The groups most vulnerable to climate risks in the Sudan are traditional rainfed farmers and pastoralists. As GSLRP includes the entire command area of the Gash irrigation scheme, as well as the east bank of the Gash River and the rangelands north and west of the scheme, many of the participants in the project fall into this highly climate-vulnerable group. A number of comments were made by farmers in villages visited concerning the increasing variability of rainfall.

> *We had a good rainy season in 2007, but there was no dam then, so we could not grow these crops. But 2007 was only good compared with 2008, not with 20 years ago.*
>
> – Farmer growing sorghum and some vegetables, Baryai

Participants in a focus-group meeting for women indicated that they had heard of climate change, and related this to declines in production of both crops and livestock.

> *Yes, we have heard of climate change. It changes the rainfall, and that affects crop production and even the livestock. This year was the poorest rain. The temperature is higher, especially in summer. What would we do about the impacts? We would wait for God, there is nothing to do.*
>
> – Leader of women's group in a village on the east bank of the Gash River

These changes were confirmed by a men's group, which noted that over the past 10-15 years, rainfall had decreased and winters were less cold. This group also mentioned an increase in dust storms. Interestingly, there are indications that traditional systems for predicting seasonal weather are no longer so effective.

> *The system for predicting rain is that when there are stronger windstorms in summer, we usually expect more rain. We thought that 2008 would be a good year, but actually it was a bad one.*
>
> – Community leader, village on the east bank of the Gash River

Adaptation activities that have been observed in the area include water-harvesting techniques and diversification of livelihoods. More as a coping strategy, many men work as casual labourers in the GAS. However, this complicates their crop-growing livelihood component, as they are not able to protect their fields from animals. Among pastoralists, strategies to deal with climate variability include planning herd movements according to their own forecasts; culling if unfavourable climatic conditions are expected; breeding synchronizations (keeping males away from females until the beginning of the rainy season in June/July); responding to veterinary indicators; changes in animal behaviour; and diversification of the herd to spread risk.

> *The pastoralists also have some veterinary indicators: they know that some diseases appear in the weak rainy season, like vitamin A deficiency (night blindness). If such cases occur among their herds, they feel that they should leave this pasture to another, green one. The phenomenon is known locally as* jahar*. Some diseases disappear during the weak rainy season, like the blood parasites that are transmitted by vectors needing wet weather.*
>
> – State official dealing with animal production

Further local adaptation activities include construction of terraces and earth dykes (known locally as *lebah*) for water harvesting.

Assessing vulnerability and socio-economic aspects

Understanding the socio-economic aspects of vulnerability, especially to climate risks, is an important step in adaptation processes. Project design for GSLRP was based on an SLA that seeks to understand the multiple risks and stresses impacting the various assets or capital (human, social, physical, natural and financial) of rural people, and the differentiated and shifting way in which they compose their livelihoods in response to this. An SLA begins with the strengths of people, explores their vulnerabilities and strategies to deal with them, identifies the links with and impacts of the policy and institutional environment, and encompasses people's own aspirations. With their focus on strengths, vulnerabilities and livelihood strategies, SLAs are helpful in developing resilience-building strategies that can be effective in increasing capacity to cope with and adapt to climate-related impacts. These strategies can be built on for climate change adaptation.

Adopting this holistic approach during the project inception mission led to a significant reorientation of the project design – from an irrigation rehabilitation project to a livelihood development project, with an equal focus on irrigated and rainfed agriculture. The SLA used during inception was helpful in highlighting peoples' priorities, which included increased incomes and access to basic social services, including water supply, education and health. The livelihoods assessment highlighted the need for a balance between agriculture, livestock and forestry, and the need to define the right to land.

However, a lesson learned was that the project should have been implemented at the same time as government interventions to deliver basic services. This would have reduced unrealistic expectations from the project and provided some immediate benefits in the interim period before incomes increased through agricultural production.

Planning approaches

GSLRP has put livelihoods, instead of infrastructure, at the core of its development approach. By shifting the project approach from a focus on the rehabilitation of the irrigation scheme to a focus on addressing the policy and management causes that led to the degradation of the scheme, and the reform of the existing institutional framework, GSLRP aims to address the root causes of dysfunction. Promoting an equitable, transparent, stable and sustainable system for resource allocation and management will tackle some of the root causes of poverty. GSLRP adopts an integrated approach that aims to address the multiple livelihood challenges of poor rural people, thus allowing for a broad-based approach to reducing vulnerability. This approach was enabled by the use of SLA during the design phase. An important element of this integrated approach, from a climate adaptation perspective, is the inclusion of environmental remediation and conservation

approaches, and the linking of these to economic centres. Thus community forestry in GSLRP is linked to the primary economic generator in the area, the GAS.

The participatory approach adopted by GSLRP is central in ensuring overall acceptance at the state and target-group levels of new land-tenure arrangements for greater equity. The livelihoods analysis highlighted complex relationships of solidarity among people within villages and their dependence on each other, the tribal system and the state, and the increasing need for surplus cash. Villagers are heavily dependent on traditional representation, and the power vested in local leaders as their link to external institutions. Thus the participatory approach needs to encompass the processes of representation, arbitration and implementation of the criteria for selection of farmers in the GAS as demonstrably as possible.

As an additional issue, the project falls within an area of conflict referred to as the 'eastern front'. While a peace agreement was signed in 2006, the area to the north of the project zone is still subject to instability,[109] and there have been instances of this conflict affecting project activities. With the important water resources of the Atbara River (which irrigates the New Halfa Irrigation Scheme) and the seasonal Gash River captured through flood control, Kassala State serves as a refuge area at times of crisis. Drawn by drought and civil unrest, some 20 per cent of the refugee population in the Sudan is found in Kassala State, increasing pressure on the well-endowed, but fragile resource base. In the Gash area, the population is estimated to have increased sevenfold over the past 20 years; tenants have increased fourfold in the Gash scheme, whereas the production base had decreased by 50 per cent prior to project implementation. The crucial area of land tenancy reform in the Gash scheme is included under the institutional support component. Inadequate rural land tenure is an underlying cause of many environmental problems in rural areas, and a major obstacle to sustainable land use and adaptation to climate change – as farmers have little incentive to invest in and protect natural resources.

A further important aspect of the project approach is the strong mainstreaming of gender. The project is implementing a number of activities for empowering women, in terms of their decision-making roles and income-generating potential.

Infrastructural elements

The Gash basin, which is a closed basin in north-eastern Sudan, is one of the smallest of the seven major watersheds in the country, covering 8,825 km² or 0.4 per cent of the country's surface area. The seasonal Gash River covers 121 km after its entry into the Sudan from the Eritrean highlands, flowing fast, wide and shallow, and transporting a considerable amount of fine sand and silt. The quantity, timing and quality of the Gash river waters flowing through the Sudan depend mainly on the upstream watershed conditions in Eritrea, where average annual rainfall is 600 mm. The Gash irrigation scheme of 100,000 ha, based on what is termed spate irrigation (see Box 1), was set up in the 1920s to settle poor nomadic people into a cash-economy area growing cotton. The scheme went into serious decline in the 1970s for a number of reasons, including lack of effective management.

Box 1. Spate irrigation

Spate irrigation is a type of water management unique to arid regions bordering highlands. It is a largely neglected and forgotten form of resource management, in spite of its potential to contribute to poverty reduction, adaptation to climate change and local food security. Spate irrigation can be found in West Asia (Afghanistan, Iran, Pakistan), the Middle East (Saudi Arabia, Yemen), North Africa (Algeria, Morocco, Tunisia) and the Horn of Africa (Eritrea, Ethiopia, Somalia, the Sudan), and more sporadically in other parts of Africa, Central Asia and South America. Floods originate from episodic rainfall in macrocatchments. They are diverted from

[109] The region bordering Eritrea in Kassala State was a stronghold of the Beja people, who were allied with the Sudan People's Liberation Army. Conflict flared up in the 1990s, but a separate peace agreement between the central Government and eastern forces – known as the Eastern Sudan Peace Agreement – was concluded in October 2006 (UNEP 2007).

ephemeral rivers and spread over agricultural land. After the land is inundated, crops are sown, sometimes immediately, but often the moisture is stored in the soil profile and used later. Spate irrigation supports low-value farming systems, usually cereals (sorghum, millet, wheat, barley), oilseeds (mustard, castor, rapeseed) and pulses (chickpea, cluster bean), but also cotton, cucurbits, tomatoes and other vegetables. Besides providing irrigation, spates recharge shallow aquifers (especially in riverbeds), fill ponds and in some areas are used to spread water for pasture or forest land. These water management systems are among the most spectacular and complicated social organizations existing. They require the local construction of diversion structures able to withstand floods and guide flash water over large areas, dissipating its erosive power. This requires strong local cooperation, and agreement on how to distribute a common good that is unpredictable and uneven (van Steenbergen et al. 2008).

The irrigation scheme rehabilitation component of GSLRP includes enhancing the capture of flood waters through river control and stream regulation, reconstruction of the canals and access roads of the water reticulation network, and improvement of field layouts. The two main implementation divisions are the river control or river training activities being undertaken by the Gash River Training Unit (GRTU), and the rehabilitation of the irrigation scheme itself, being undertaken by the GAS. The 2008 mid-term review found that the river training component had achieved its objectives, but that the rehabilitation of the GAS has not yet done so.

Regarding the agricultural scheme, operational functions at block and lower levels are the responsibility of WUAs, while the GAS has responsibility for assuring the supply of water to the main canals and *masga* (the unit within an irrigation block) outlets. The GAS operates as an autonomous entity under the federal Government. A repeated problem hindering rehabilitation of the scheme has been the limited window available for works, due to late release of funds. Security issues in the area have prevented competitive contracting, and financial constraints include increases in the prices of fuel and construction materials, as well as the effects of changes in the exchange rate. Design problems have also prevented the attainment of objectives. For example, the scheme was rehabilitated without taking into account the change from a three- to a two-year rotation and the participatory management with WUAs, thus leaving further work to be completed. These and other challenges have provided valuable lessons concerning the complex range of issues to be considered in the rehabilitation of spate irrigation schemes.

> *The variability of spate irrigation creates a challenging context, with floods in some years allowing for tenants to irrigate the three* feddans*, and in other years this is not possible, resulting in insufficient production.*
>
> – Project coordination staff member

The high levels of the 2003 Gash River flood provided an early kick-start to river training activities, which were urgently needed to deal with the effects of a flood that resulted in 91 casualties and US$168 million worth of damage to or loss of property. River training activities since 2004 have included riverbed excavations, construction of masonry and tie-bank works, riverbank earthworks, and spurs and spur reconstruction. Five gauge stations have been developed to measure stage, velocities and suspended sediment, and data collection has improved. Since 2004, technical observations made by GRTU engineers have been documented by survey measurements, photographs, sketches and notes to promote understanding of river behaviour. This is extremely important, given the dynamic nature of the system. For instance, the Kassala flood protection system, which consists of spurs and dikes, was originally started in the 1930s, when most of the river characteristics were totally different (it had a deep defined channel and fine sediment loads). Thus it is important to monitor how rehabilitation contributes to the efficiency of the system, and the effectiveness of flood protection.

The “drastic changes in river morphology” of the Gash River have provided a challenging context for flood protection, and have also resulted in a reduction in irrigated agriculture due to changes in the river course. Such changes often isolate intake structures of irrigation canals from the river channel, thus precluding irrigation of the areas under the command of these channels unless expensive works are carried out.

While the actions of the GRTU for protection of the main towns and for irrigation of the GAS have been carried out systematically, the works do require constant maintenance. The late release of finances has hampered the works on a regular basis. The effectiveness of the control activities is currently being constrained by a blockage caused by the downstream bridge over the Kassala reach, which will receive attention in the next implementation period. Using spurs and protection banks, river training has been carried out to store part of the flow during passage of the high waves for a period long enough to infiltrate a considerable amount of water and recharge the groundwater through the permeable bed. Approximately 26-33 per cent of the river flow is infiltrated between Algera and Kassala bridge. Along the river, highly fertile lands within the spurs spacing have been reclaimed for agriculture.

There is an urgent need for a flood early warning system, as there is currently only a three-hour period between sighting of the flood at the upstream Gera gauging station and its arrival at Kassala. The entire flood protection system for the town has been raised by one metre since the 2007 flood, which was the most extreme experienced. However, climate change projections are generally for more extreme floods, or at least greater variability, and thus it cannot be assumed that this will remain the highest flood level. Understanding the rainfall projections for the source of the floods in the Eritrean highlands will allow for more specific planning.

Technologies for adaptation

Rainfed farmers and pastoralists in the Kassala region have employed a range of coping strategies to maintain their livelihoods in the face of climatic variability. GSLRP supports a number of different technological approaches, many of which respond to climate variability and, as such, will assist with adaptation to climate change – for example soil and water conservation technologies. A key aspect of GSLRP is to apply a technical package to achieve an increase in yields of food crops, with close coordination among extension, plant protection, forestry and range and pasture administrations. Fuelwood and charcoal are essential forest products in the livelihoods of the Gash inhabitants. The livelihoods analysis had indicated that the depletion of forest resources had been reversed 10 years prior to the inception missions by the spread of mesquite, which had become an essential part of coping strategies for poorer members of the population (i.e. collection and sale for fuelwood, and production and sale of charcoal). However, this was contradicted by responses indicating that bare areas of rangeland had been well-covered with trees only three years earlier.

> *You ask me if there were more trees in this area 10 years ago? This was a forest – even three years ago.*
>
> – Pastoral leader in rangeland west of the Gash River

The animal production and rangeland management component aims to: improve animal health services; restock with improved animal breeds; and develop a sound land-use policy through the rehabilitation of community stock water facilities, construction of water containment and spreading structures, and control of mesquite invasion. Project actions carried out to date include construction of *hafirs* (excavated earth tanks) and *hods* (excavated underground earth tanks); terraces for water harvesting; water containment and spreading structures; veterinary treatment for cattle, sheep, goats and camel; training of paraveterinarians; establishment of a veterinary revolving fund; and some areas of mesquite controlled and reforested. Traditional water governance practices of the local Hadendowa people (since 1840) would direct the first flood of the river to the extremes of the scheme, so as to stock drinking water for the livestock (in *hafirs*) and grow some grass, which in turn would help keep cattle away from crops. This approach is included in the agreed operational procedures of the GAS, although it has not been followed of late.

Community forestry and eradication of mesquite

> *My biggest problem is the mesquite, which needs to be cut down. And terraces, and ploughing. And the animals that eat crops – that is a big problem.*

– Rainfed farmer on the eastern plain between the Gash River and the Taka Mountains

Together with the alarming rates of desertification in the northern parts of the delta, valuable indigenous vegetation is disappearing in a southwards direction. This includes different species of Acacia; the lalob fruit *Balanities aegyptiaca* – which is used for medicinal purposes and can provide oil, cake and molasses; *Ziziphus spina-christi,* which has high nutritional value; and some grasses and legumes that were once part of grazing resources. Mesquite eradication and replacement with indigenous vegetation is an important forestry component. This approach has been successful along part of the Gash River in the Gera area, where reforestation with the indigenous *Acacia nilotica* has been impressive.

Eradication of mesquite has also been carried out in and around the Garadaib and Tambi *hafirs,* followed by reseeding and planting of seedlings. Due to low rainfall, additional water-harvesting interventions will be needed to ensure that reforestation is achieved. The National Forestry Corporation feels strongly that reforestation should accompany any eradication of vegetation, and this is a sound approach for climate change mitigation as well. Project funds for mesquite eradication and reforestation, as well as for the rangeland activities discussed below, are not considered sufficient to meet the need. Many indigenous species, including those mentioned above, are valuable sources of non-timber forest products (NTFPs), which play a decisive role in livelihoods and food security, particularly for the elderly, women and children, who cannot migrate to seek employment elsewhere or engage in more labour-demanding activities.

Community forestry approaches become increasingly important considering that, if the people of the Sudan are to be able to meet their forest product needs, forestry must reorient itself beyond the boundaries of the forest reserves. This means that forest product users should be involved and encouraged to take responsibility for the forest resource. The project has strong expertise in community forestry and can play a strong role in this regard, if the necessary resources can be found.

Rangeland management and livestock interventions

You can see how this eastern plain is very degraded, with lots of mesquite. There used to be Acacia tortilis here, lots of them, but that has been gone for 20 years. And there was the dom *tree – Hyphenae.*

– Community forestry expert

The establishment of rangeland users' associations (RUAs) is important to enhanced local-level management of resources. While their functionality is still being developed, RUAs may maintain *hafirs,* participate in distribution of seed for rangeland reseeding, liaise with service providers such as veterinary services, and prevent illegal agriculture in the rangeland.

Rangeland management interventions include water harvesting for reseeding degraded areas with forage crops; collection of rainfall and flood drinking water for animals; and efforts to control fire outbreaks in the natural rangelands, through construction of fire breaks and awareness-raising among pastoralists. Project partners have identified the need for enhanced storage of crop residues for fodder for the dry period. The proposed hydrogeological survey to determine where to position *hafirs* and *hods* has not yet been carried out, but will be done shortly.

The sustainable livelihoods analysis completed during the design phase indicated increasing pressure on the Gash agricultural area from herds associated with registered farmers in the surrounding rangeland and from people who have no land within the scheme. Livestock and crops are considered equally important by many people in the area. There is a general move by pastoralists not associated with the area to hold livestock in surrounding grazing areas while waiting to take advantage of crop residue on the scheme, and then moving animals towards Port Sudan for export sales to the Gulf. Project partners have further identified the need for demarcation of corridors for movement of animals to water points and through cultivated areas to markets, to reduce conflict between farmers

and herders. Currently, 15 per cent of the pastoralists in the area are transhumant and 20 per cent are nomads. The total number of pastoralists is 45,000, which is higher than the project target of 37,000. GSLRP has noted an increase in cattle, sheep, goats and camels being moved into the area to obtain the benefits of project services (rangelands, drinking water, vaccination, treatment, tick control and veterinary services). Nevertheless, the veterinary awareness of mobile pastoralists is a challenge for the project. Veterinary interventions for disease control are especially important in times of climate crisis, when large numbers of animals gather in small areas and epidemics are likely.

A further area of challenges for GSLRP lies in desert control. Creeping sand dunes in the far north and north-west edges of the Gash scheme are worsening, while large sand dunes exist around the villages on the east bank of the river. Proposals to establish irrigated shelter belts and wind breaks in the Gash Die area are important.

Community development and extension approaches

The community development, capacity-building and empowerment component seeks to increase drinking water supply and quality by refurbishing existing facilities, building the capacity of and empowering communities through training of both men and women, forming groups, and providing community initiative funds for social services support. Community development activities carried out to date include local extension teams using a participatory and gender mainstreaming approach; management training; group mobilization and awareness-raising; preparations and some progress in installing the water pipeline for drinking water; nutrition, health and first aid training; training in food preservation and processing, and vegetable gardening; high-efficiency stoves to reduce wood consumption; and small-enterprise management training for women.

Demonstration plots and field days have been undertaken for agricultural extension. Two extension officers have been posted to each GAS irrigation block. Their duties include monitoring crop production, conducting regular farmers' schools, communication campaigns and field visits. A number of varieties have been introduced for testing with promising results, including sesame as a cash crop in the Gash River Delta. Preliminary results indicate that the yield per unit area is almost triple the national average. Low levels of rainfall have constrained improvements in rainfed agriculture, which nonetheless has improved since the start of the project.

> *This year 700 farmers planted sorghum in the area, because of the water-harvesting project, and the project provided seed. But the crops did not grow, because of lack of rainfall.*
>
> – Rainfed farmer, east bank of the Gash area

Institutional development

The lead agency for GSLRP is the federal Ministry of Agriculture and Forestry, while the implementing agencies are the federal Ministry of Irrigation and Water Resources, the state Ministry of Agriculture, Animal Wealth and Irrigation, and the GAS. Given that managerial, institutional and policy factors were found to be the root causes of the former deterioration of the Gash Irrigation Scheme, which had disrupted livelihoods in the delta, institutional development to address these causes is a critical project component. Important constraining factors identified during project formulation were the absence of a coherent vision and development plan for the area; unpredictable local and extra-local resource allocation, including inequitable patronage systems; lack of transparency in the management of Gash area resources and investments; erratic support services; frequent exemption from or non-payment of service charges, such as water rates; and weakening of traditional solidarity and social support mechanisms. The relatively harsh and fragile agroecological context and the cumulative degradation of natural resources in the area were further exacerbating factors. GSLRP is focusing on strengthening the institutions at state and local levels that are best able to ensure the sustained, effective and efficient management of the rehabilitated infrastructures and to provide the social and economic services needed.

Apart from equitable redistribution of assets across the population, GSLRP also seeks gradual devolution of land and water management to users' and community-based associations. A number of local organizations have been established by the project, including 92 WUAs and one apex WUA, RUAs, community development committees and women's groups. While these require additional support and training to develop into effective organizations, project activities have nevertheless resulted in a process of social transformation in the area, reflected in increasing demand for services and increased production initiatives on the part of farmers. Empowerment has increased, as has a greater acceptance of women's participation in social and economic development activities, with land being registered in women's names.

It is particularly important, for the sustainability of the scheme, that the WUAs become functionally effective. Important areas for improvement are management and maintenance capacity, and improving the collection of water rates. Currently this varies from 0 to 70 per cent of the area irrigated by the first flush, while the target is 100 per cent. It is also important to ensure that the WUAs are not reproducing elite capture of land.

Land tenancy reform

Land tenancy reform is included under the institutional support component. During the livelihoods analysis, it became clear that there were many vested interests concerning the Gash River, its water, the surrounding land and the people who use it and rely on it. Some of these interests are complementary, while others are conflictual. During the sustainable livelihoods mission, villagers communicated their frustration with the land allocation system in the Gash and asked that it be fairer and more regular. Appraisal documents noted that agreement in principle of acceptable land-tenure arrangements and the distribution of firm long-term tenancy rights to the poorest farmers must be the first step on which all further project activities would depend. It is clear that it is extremely difficult to develop and apply a practical, just and stable system of rural land tenure in general in the Sudan's ethnically complex society of intermingled sedentary farmers and transhumants/nomads. In the GAS, coping mechanisms had been put in place to address the deterioration in total land cultivated that used a seemingly equitable system, but that appeared to keep poor households poor and enabled the better-off to accumulate land.

These issues were taken up in project design, which called for developing equitable land-tenure arrangements as a first step. While there have been significant project actions in this regard – including the establishment of a Legal Committee for Land Reform (LCLR) to set the procedures for equitable allocation of fixed and viable landholdings, and the completion of registry books for a number of blocks of the GAS – this remains an area of complexity, with imbalances in access to land as a result of the reluctance of groups of powerful farmers to reduce the large pieces of land under their control. While a number of farmers who previously lacked secure access to land now have it, there are concerns regarding 'ghost names' on lists, and the opportunity to reduce poverty through access to land and water has not been optimized. Farmers who lack secure access to land round out their livelihoods with casual labour, which is insecure and provides low (but important) financial returns.

GSLRP embodies the symbiotic relationship between effective land and water governance: without security of land tenure, farmers are unlikely to invest in the land; but land without water is of little benefit.

Financial services and marketing

The financial services and marketing component aims to allow the target group the resources to increase their productivity through the provision of credit lines for crop inputs, acquisition of agricultural machinery and livestock, food processing and other off-farm enterprises, and prefinancing to enhance opportunities to market their produce.

The 2008 mid-term review found that progress in this component had been slow due to limited absorptive capacity and weak repayment rates. Rather than using the WUAs as financial intermediaries, women's groups may be more effective in this regard. Microfinance services will now target rural women as a priority, and new services may be developed as necessary.

Summary of adaptation activities

While GSLRP was not designed as a climate-change adaptation project, its focus on rehabilitating the spate irrigation system and associated livelihoods has a strong focus on climate variability. While spate irrigation is inherently risky, it stores water in the soil profile and in shallow aquifers at a much lower cost than storing water in a surface reservoir. Spate irrigation is also able to make use of one of the variables that may increase with climate change: floods. Thus it could become increasingly significant for local and regional food security, provided that the increased amounts of sand, which reduce land available for agriculture, can be managed.

Actions that link livelihood enhancement with increased resilience of the inhabitants of the Gash area, and assist people in coping with the increasing variability that is very likely to result from climate change, are adaptive in nature. This will, however, necessitate simultaneous steps to increase the resilience of the ecosystems on which the majority of the target group very much depend. Thus, as with all sustainable development interventions, the strength of a project lies in the extent to which it is based on a coherent and sustainable system of natural resource management.

In summary, GSLRP activities that address climate variability, or reduce vulnerability and thus indirectly lessen the risks associated with climate change, are the following:

- The *elements of the planning and implementation approach that are relevant to adaptation planning* put livelihoods instead of infrastructure at the core of the development approach; focus strongly on gender mainstreaming, because climate change could exacerbate gender inequalities; employ a participatory approach, including in negotiations on land tenancy reform (still to be fully resolved); and link environmental remediation with economic loci.
- The *sustainable livelihoods approach (SLA)* in project design focuses on strengths, vulnerabilities and livelihood strategies, and provides a platform for developing resilience-building strategies for adaptation to climate change.
- A strong *role for spate irrigation* in climate change adaptation in fragile areas is risk prone, but is capable of dealing with variability and contributing significantly to food security.
- *River training activities are highly likely to play a strong role in climate change adaptation* through: flood damage mitigation; water conservation, by minimizing water losses through breaches and evaporation; maximizing the use of river water flow, for irrigation and other uses; and preventing the adverse effects of river flow, such as erosion of the riverbed and banks.
- *Sustainable methods* such as: introduction of more-resilient crop varieties; rangeland regeneration and water harvesting; mesquite eradication and reforestation with indigenous species; and improvements in livestock productivity that also seek to reduce the currently unsustainable numbers of livestock *will address the pressures on natural resources*.
- The *financial services and marketing component is a critical link* to add value, unlock alternative income-generating enterprises and develop market chains for more diversified livelihood strategies and enhanced incomes. This requires additional effort to optimize uptake.

While the primary focus of this case study is on adaptation, project actions leading to an increase in vegetation cover, such as rangeland regeneration and community forestry, are also likely to increase the capture of carbon, which is important in the mitigation of climate change.

Contribution to improving rural livelihoods

Since 2002, IFAD investments have been concentrated in rainfed areas. As well as being characterized by higher levels of poverty, the livelihoods of poor people in these areas are highly vulnerable to the increasing variability of rainfall that is expected as a result of climate change. Many among the target group of GSLRP depend directly on local rainfall, while the rest are directly dependent on rainfall in the catchment areas of the Gash River. Thus the target groups are highly vulnerable to climate change, and it is essential to link adaptation actions to enhancing livelihoods. This will result in *sustainable adaptation measures:* that is, adaptation that reduces both vulnerability and poverty (Eriksen et al. 2007).

Key project outcomes to enhance livelihoods include equitable access to tenancy rights in the scheme, diversification of the livelihood base among non-tenant households, and improved water supply, social services and community development initiatives. According to the mid-term review, GSLRP has had positive impacts on improved household nutrition, food security and household assets. This is extremely important, given persistent food insecurity in the area. Two main factors contributing to the positive trend are:

- The results of support to rainfed agriculture, which led to crop productivity increasing by 8 per cent, with a 60 per cent increase in range fodder production, through activities that support adaptation, such as water harvesting;
- An increase in cultivated area under spate irrigation from an average of 49,000 *feddan* in 1990-2003 to an average of 76,000 *feddan* in 2004-2007.

Both of these factors contributing to the positive trends have been enabled by actions that support adaptation to climate change, such as water harvesting and rangeland revegetation activities, as well as the rehabilitation of the spate irrigation system. The third major factor contributing to the positive livelihoods trend, according to the mid-term review, involved an increase in livestock herd size. This is more ambiguous from an adaptation perspective, given the degraded nature of much of the rangeland in the area.

Options for enhancing the climate-sensitivity of the project

> *Speaking of climate information and climate adaptation, we do need more activities in this project that address this very important area.*
>
> – State official dealing with rangeland and pasture management

It is clear that the nature of the development pathway can have a significant impact on the level of climate change impacts. Thus, as pointed out by the IPCC, as much as climate change can affect sustainable development and constrain achievement of the MDGs, so sustainable development can reduce vulnerability. Awareness-raising on the nature of climate change and the kinds of approaches that can promote adaptation is one general area that GSLRP could emphasize, as well as better integration of climate information. With increased awareness, the risks posed by climate change can be used to leverage increased commitment to sustainable natural resource management and poverty reduction actions. While there is no NAPA pilot project for the Gash area, eastern Kassala has been identified in a recent UNEP assessment as one of the areas facing significant rates of desertification and land degradation, and thus highly vulnerable to climate change.

Specific steps to strengthen the climate-sensitivity of GSLRP include the following:

- **Strengthen linkages among project components** to optimize synergistic effects, particularly between livelihoods enhancement and ecosystem resilience. For example, it is critical to ensure that community forestry interventions receive the agreed allocations of flood water. This will entail both increased sensitization for the GAS and effective management to implement commitments.

- **Develop an early warning system (EWS) for the Gash flood**. Given the trend of increased frequency of high floods, this is urgently needed to protect life and property and to provide some warning for agriculture. Currently, it is difficult to predict the time and amount of the high flows, as the catchment area lies over the border, there is no exchange of information with Eritrea, and the retention time is very short. An EWS based on satellite imagery of cloud cover, which would be recorded and analysed, could present a pattern flow for the next 10 days. Communication of direct observations from the high catchment, which would necessitate developing an information-sharing relationship with the relevant institutions in Eritrea, would provide a three-day warning period, as opposed to the current three-hour one.
- **Integrate scaled-down climate scenarios into project operations**. For GSLRP, it will be necessary to obtain scaled-down scenarios for both the project area and the Gash catchment in Eritrea. A first step is to pursue possibilities for obtaining scaled-down climate projections through the NAPA process, and integrate this information into project operations.
- **Include seasonal weather forecasts in extension services and targeted pilot projects for farmer-to-farmer learning and monitoring on adaptation**. Seasonal forecasts could be provided in collaboration with the meteorological agency for all extension areas. Selected locations could be involved in pilot projects in which farmers develop their own capacities for applying on-farm adaptive strategies. The projects would promote integration of scientific knowledge, climate information and local practices in a farmer-led approach. These pilot projects could be structured around quarterly farmer-to-farmer workshops to assist farmers in developing their own capacities to apply on-farm adaptive strategies in the face of changing climate conditions.[110] This would result in an empowering process in which farmers could critically reflect on scientific forecasts and make informed land-use decisions based on an integrated interpretation of the data, on presentation of a range of possible technological options provided by the research stations, and on their own knowledge.[111] Such a process would allow for support to and scaling up of locally developed adaptation options. Monitoring could be carried out by the local meteorological station and other research stations, with some community monitoring of variables such as rainfall and temperature, in order to understand microclimates.
- **Greatly expand forestry and rangeland regeneration components**, accompanied by water harvesting, to address the alarming southward loss of important vegetation resources, enhance flood protection along riverbanks, and contribute to mitigation of climate change. While the latter is an important objective, there will be many short-term benefits for livelihoods and ecosystems of expanded forestry and rangeland reseeding, as well as important climate adaptation effects and beneficial microclimate impacts. Establishment of shelter belts and wind breaks has the positive impact of trees acting as a physical barrier to high-speed gusts of dust-laden winds, which are common in the Gash area, thus improving microclimate and desert control. If expansion of forestry and rangeland regeneration components is not possible within the project's budget, partner institutions or small grant mechanisms should be approached for funding.

[110] Seasonal forecasts could be presented to farmers, who could then retrospectively discuss the forecasts of the previous quarter and verify these with their own experience of climate in the area.

[111] This proposal for pilot projects is based directly on the approach adopted in the joint project of WWF, Environmental Monitoring Group (EMG) and Indigo Development implemented in a marginal rainfed farming area in South Africa, as set out in Malgas et al. 2007.

- **Strengthen efforts for land tenancy reform in the GAS**, as equitable tenure underpins investment in environmental regeneration and sustainable agronomic practices, as well as enhanced livelihoods.
- **Continue support to fine-tuning the river training works**, including sufficient and timely allocations for works and maintenance; replace conventional material with higher performance or 'smart' materials such as gabion construction and plastic membrane sheeting, where applicable; upgrade the monitoring system, including through satellite imagery and GIS, as identified by the GRTU; and document river behaviour to promote understanding.
- **Make better use of animal waste**, for example for enhancing soil fertility, and us methane generated from animal waste as a source of biogas for cooking fuel. The latter will both reduce GHG emissions (mitigation) and reduce the demand for fuelwood, thus slowing deforestation.

In conclusion, a range of actions should be supported that help people deal better with increasing uncertainty, and that will constitute *no-regrets adaptation*: that is, adaptation activities that are beneficial under any climate change scenario.

> *The climate change situation, if things could still get worse – these are big things you are talking about. We haven't known until now about this, but we will have to think what to do. Maybe plant trees. And plant shrubs to keep the topsoil from wind and erosion.*
>
> – Community leader, village on the east bank of the Gash River

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PROJECT SUMMARY TITLE OF PROJECT: Gash Sustainable Livelihoods Regeneration Project (GSLRP)		
TOTAL PROJECT COST:US$39 m	**IFAD CONTRIBUTION: US24.9m**	**YEAR OF APPROVAL: 2004**
EXPECTED COMPLETION: 2012	**STATUS: Ongoing**	**DIRECTLY BENEFITING: 67 000 HOUSEHOLDS**

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2. Case study from the Sudan[112]

Western Sudan Resources Management Programme:

Natural resources governance for conflict management, poverty reduction and environmentally sustainable development

The programme in brief

The Western Sudan Resources Management Programme (WSRMP) seeks to establish a governance system for natural resources in the Kordofan region, western Sudan. The objective is to build up traditional rainfed agriculture and improve economic conditions for the poor or extremely poor small-scale farmers and herders who predominate in the area, and whose supply of food and water is limited. The programme is adopting an area-based integrated development approach, and builds on former IFAD investments in the 380,000 km² area. Central programme activities involve developing a governance structure for natural resources that is efficient, equitable and environmentally sustainable, and mapping traditional stock routes in order to increase access to services and reduce conflict along these routes, particularly between pastoralists and agriculturalists. Other NRM actions include developing and disseminating appropriate agricultural technologies, such as agroforestry systems and drip irrigation for home gardens, rangeland restoration activities such as reseeding, and raising environmental awareness. In the poorest areas, the programme will invest in livestock restocking, vocational training and introduction of alternative income-generating enterprises. Supporting programme components include rural microfinance and marketing, institution-building, community development and extension activities, and construction of a road to link remote areas with markets.

Development challenges and environmental context

The Sudan, a country still in the process of settlement, is classified as a least developed country (LDC). Traditional subsistence agriculture dominates the Sudanese economy, with over 80 per cent of the population dependent on crop production and/or livestock husbandry to support their livelihoods. Small-scale farmers are highly vulnerable to climate variability, as evidenced by the widespread suffering in rural areas during past droughts. Agricultural activities account for nearly half of GDP and the vast majority of employment.

WSRMP operates within a challenging context of extremely high levels of poverty, lack of basic services, particularly for pastoralists, remoteness and lack of communications and transport infrastructure, environmental degradation and desertification. Parts of the programme area – the Kordofan region – were at the epicentre of the last civil war, leading to a breakdown in systems of governance in some areas. Severe degradation of natural resources, particularly in the north-east, while related to repeated droughts, is also caused to a significant degree by unsustainable practices. The consequences of instability and war in Kordofan include displacement of populations, inaccessibility of farm and pastureland in certain areas, inability or unwillingness on the part of various groups to respect stock routes, and deterioration of social capital. Parts of South Kordofan host a sizeable population of IDPs. Expansion of farmland, owing to population increases, and market-driven increases in animal stocks also drive competition between resource users. Human

[112] This case study was developed in December 2008 by Penny Urquhart, freelance sustainable development consultant, under guidance from Sheila Mwanundu, Senior Technical Advisor, and Ilaria Firmian, Associate Technical Advisor, of IFAD's Environment and Natural Resources technical advisory division. Many thanks are due to all the community members, government partners and project staff who gave so generously of their time in Sudan. Particular thanks are due to Rasha Omar, IFAD Country Programme Manager for Sudan; and to Amal Bushara, Programme Coordinator Ad Interim, Western Sudan Resources Management Programme.

development indicators relating to literacy, healthcare and life expectancy in Kordofan compare unfavourably with averages for the Sudan. For instance, in 1993 only about 29 per cent of women and 52 per cent of men in the region were literate (against 41 and 66 per cent respectively at the national level).

The programme is operational in an area where mainly agropastoralist and settled farmers are engaged in extensive livestock production, rainfed cropping and range product utilization – principally fuelwood and gum arabic. Transhumance is practiced along well-defined customary stock routes in South Kordofan and along negotiated itineraries in North Kordofan.

The programme area contains ecological zones ranging from desert in the north, through semi-arid sahel-savannah transition, to dry savannah and, finally, to wet savannah in the south. Severe climatic conditions in North Kordofan (drought frequency and rainfall variability) and land mismanagement (overgrazing, overcropping, deforestation) have caused deterioration of the vegetation cover and the loss of many endemic woody and rangeland species. Rainfall is higher in South Kordofan, with savannah there transitioning from low through moderate rainfall to wet savannah. Livelihoods have been affected by frequent drought cycles throughout Kordofan. Bush fire is becoming an increasing problem. Multiple causes include increased dryness of vegetation, burning of crop residue, burning to access wild honey, and starting fires to keep pastoralists out of areas. Apart from negative environmental impacts, burning has direct consequences for climate change: release of carbon into the atmosphere and removal of vegetation that acts as a carbon sink.

Climate-related risks

Throughout much of the Sudan, water resources are limited, soil fertility is low, drought is common, and rainfall is erratic and concentrated in short growing seasons. Chronic drought is one of the most important climate risks facing the Sudan, with recurring series of dry years having become the norm in the Sudano-Sahel region. According to the NAPA, there is a national trend of greater rainfall variability in the Sudan, increasing at a rate of about 0.2 per cent per year. These factors heighten the vulnerability of rainfed agricultural systems. Land degradation and desertification, brought on by human land-use pressures, unsustainable practices and recurrent drought, have degraded large areas of the country. Extreme flooding events occur in some parts. Other, less-frequent climate-related phenomena are dust storms, thunderstorms and heat waves. An assessment carried out by UNEP in 2007 indicates that among the root causes of decades of social strife and conflict are the rapidly eroding environmental services in several key parts of the country.

> *Previously, thirteen states in the Sudan were considered desertified. Now all of the northern part of the Sudan is considered desertified.*
>
> – Technical focal point on climate change

The Sudan faces great risks from climate change, which is expected to see the intensification of these climatic hazards. Climate scenarios project significant increases in average temperatures relative to baseline expectations, with projected warming by 2060 ranging from 1.5°C to 3.1°C during August.[113] Results from some climate models show an average rainfall decrease of about 6 mm/month during the rainy season. According to UNEP, there is mounting evidence of long-term regional climate change in several parts of the country. This is evidenced by a very irregular but marked decline in rainfall, for which the clearest indications are found in North and South Kordofan and Darfur States.

The three highest priority sectors for adaptation, as identified through the NAPA consultation process, are agriculture, water and public health. Combined with growing socio-economic pressures, the imposition of climate variability and climate change is likely to intensify the ongoing process of

[113] Climate projections in this case study are drawn from the 2007 NAPA, as well as from a number of studies summarized in van Steenbergen et al. (2008).

desertification of arable areas. Humid agroclimatic zones will shift southward, rendering areas of the north increasingly unsuitable for agriculture. Crop production is predicted to decline substantially for both millet and sorghum. The area of arable land, as well as the important gum arabic belt (formed of *Acacia senegal* trees, known as *hashab)* that runs through the programme area, are also likely to decrease, with attendant impacts on local incomes and food security. Reduced groundwater recharge – either through decreased precipitation or increased temperature and evaporation – has grave repercussions for the Sudan. National studies have shown that soil moisture would decline under future climate change. When coupled with increased water consumption, population growth, high variation in rainfall and the high rate of evaporation, a water crisis may be impending.

Regarding agriculture and rainfall, areas on the fringes of the Sahara will be acutely vulnerable, including conflict- and drought-stricken parts of Darfur, North Kordofan, and Khartoum and Kassala States. Marginal areas for rainfed irrigation and grazing could tip towards desert conditions, possibly through only a slight increase in temperature and a small decrease in precipitation. Combined with growing socio-economic pressures, the imposition of climate variability and climate change is likely to intensify the ongoing process of desertification of arable areas. Humid agroclimatic zones will shift southward, rendering areas of the north increasingly unsuitable for agriculture.

Most of these projected changes are highly relevant to the programme area, a large part of which has been designated as particularly vulnerable by the NAPA. In the arid and semi-arid zones of North Kordofan, frequent droughts exacerbate baseline vulnerability to declining soil fertility, low agricultural productivity, and persistent food insecurity. Frequent drought also afflicts the savannah areas of South Kordofan, where it compounds problems of overgrazing, soil erosion and outbreaks of public health epidemics such as malaria. In the centre of the country, where Kordofan is situated, average rainfall variability ranges from 20 to 60 per cent. According to a 2007 UNEP study, crop models have shown a major and possibly disastrous drop in crop production for the northern parts of the region, and significant declines further south. In the El Obeid region, modelled sorghum production is predicted to drop by 70 per cent, from 495 kg/ha to 150 kg/ha. While droughts in the Sahel have decreased the incidence of malaria, with more floods there is an increased chance of a malaria epidemic in some areas. While there is a need for improved climate analysis, the projections for the Sudan and for the Kordofan region are sufficiently severe to warrant urgent precautionary action.

> *We cannot just talk about climate change. We see fires, overgrazing, removal of forests – hashab trees and others. Unless we mitigate such activities, we cannot mitigate climate change.*
>
> – Technical officer involved in land use and desertification, State Ministry of Agriculture

Local perceptions of climatic changes

The groups most vulnerable to climate risks in the Sudan are traditional rainfed farmers and pastoralists. During past climatic shocks such as drought, there has been large-scale human suffering from hunger among these groups, including forced out-migration from rural areas and the death of livestock herds. Flooding has also caused widespread damage through destruction of property and livestock mortality. In July 2007 a flood caused serious damage to infrastructure and to parts of the spate irrigation network , although it is not clear whether this is part of an increasing trend.

Due to high levels of climate variability and associated severe impacts on livelihoods, programme participants such as small-scale farmers and pastoralists are receptive to discussions on climate change and have strong ideas on how the climate is changing. While it is not yet clear whether all of the observed changes can be linked to long-term climate change, heightened variability is increasingly being linked to such global change.

> *In Kordofan in general, nobody can deny that there is climate change. More than 50 per cent of the state is desertified. Nonetheless, when you consider the last rainy season in the north, you see floods*

> *in dry areas – it's very strange. It is very important to quantify to what extent the climate is changing.*
>
> – Technical officer involved in land use and desertification, State Ministry of Agriculture

Discussions with village committees in Gangil village, located on the western stock route 53 km from El Obeid in North Kordofan, indicated that farmers and local resource users were aware of the concept of climate change, which extension teams have discussed with them. Changes observed include rainfall variability and late onset of rain, which have resulted in reduced agricultural productivity and insufficient grass for livestock. Villagers also traced degradation and desertification to the cutting of trees for income, and noted that there were now two seasons for malaria – autumn and winter – but were not clear on the cause of this.

> *In the past, the rain came in May and we finished sowing in May. In June we did weeding, because the rain stopped for a little bit. But this year, the rain came on 20 July and it stopped after August. Agricultural production has dropped and we don't have enough grass for our livestock. Due to successive droughts, households have lost livestock – some lost 10 head. Our incomes drop and we cannot educate our children.*
>
> – Small-scale farmer, North Kordofan

Adaptation activities observed in the Kordofan region include off-farm activities, migration to cities, indigenous risk-aversion practices such as widening the area of cultivation for drought-adapted field watermelon, which also covers soil for a long period and is useful in stopping desert encroachment. In some areas, melon is substituted for millet, which is no longer grown. The melon is also used as a source of water for humans and livestock, and the seeds are used as a cash crop and exported, for example to Egypt. Another local adaptation in North Kordofan is dry sowing, where farmers merely scratch the soil to sow the seed, knowing that if they sow deeper than this, the winds and sand creep will bury the seed too deep. Some communities have also changed from fuelwood to gas, and others are beginning to make use of different building materials. The latter is an approach that is being promoted through the government drought-control programme for North Kordofan, which is encouraging the use of cement blocks for houses, instead of wood and mud.

> *We used to say that rainfall in this area varied between 75 and 250 mm per annum. But now we see it dropping lower than 75 mm.*
>
> – Representative of a state agricultural department

Managing conflict through natural resources governance

While the Comprehensive Peace Agreement of 2005 ended 20 years of civil war in the Sudan, smaller-scale conflicts are still widespread in the Kordofan region. Many of these centre on access to and control of natural resources: indeed, large-scale movements of livestock in response to drought precipitated the last civil war. A variety of factors contribute to these conflicts, in particular the combination of resource scarcity with a governance crisis. Two main areas of conflict involve farmers and herders over stock routes, gum arabic forests, gardens, watering points and the use of *dars* (tribal homelands); and conflicts between herders and small farmers and government agents or large private investors over mechanized farming areas, oil infrastructure and other private investments. The band of cultivation of gum arabic has shifted south, most likely in response to climatic factors, causing increased incidences of camel herders pushing further south than was usual and thus increasing conflict.

In the past, customary land-tenure systems were able to manage conflicts between farmers and herders relatively successfully. However, effectiveness of these systems has been reduced owing to larger herds, reduced water and pasture, and a large number of firearms among herders. In addition, the politics of patron/client relationships, weak natural resource management and development policies, and top-down government institutions have encouraged social divisions, already activated

by the war. WSRMP was designed with full awareness of the resultant broad-scale instability. Its overall strategy is to build a participatory regulatory system for natural resources, and to support local empowerment and strengthen traditional systems of land tenure, towards redefining sustainable property rights for farmland and for mobile resources.

WSRMP illustrates conflict resulting both from movement – for example, the impact of nomads' livestock on croplands – and from settlement – for example, settlement of nomadic people on the peripheries of villages, which encroaches on village grazing land. Mechanisms to address conflict include mapping out traditional stock routes, identifying services needed along these, and placing services so as to minimize conflict. For example, water points along the stock routes are being located to reduce competition between nomadic pastoralists and settled villagers over this critical resource. Local empowerment will be pursued through encouraging local dialogue and negotiations. Apart from informal conflict management mechanisms, the programme aims to encourage effective use of the native administration (traditional leaders)[114] and local courts. The influence of traditional leaders is very much needed when it comes to issues involving rational natural resources use and management and resolution of conflicts. The programme is also working on the broader policy environment and harmonization of relevant state laws. Conflicts along the stock routes and political unrest in South Kordofan State have resulted in some programme delays and loss of equipment.[115]

Planning approach

WSRMP is adopting a practical approach to planning that is relevant to and could be fine-tuned for adaptation planning. This includes an overall orientation towards dealing with conflict over natural resources, and supporting local and indigenous knowledge and conflict-resolution systems. Thus an important component is enhancing local capacities to manage conflict. WSRMP also builds on the achievements of previous projects in the area that pursued conflict reduction goals.

An important strength of WSRMP is its focus on surveying and understanding the state of the natural resources in the area, and using this to develop an NRM strategy. Thus, crucially, WSRMP has adopted an approach that recognizes the fundamental nature of ecological integrity for sustainable development. As mentioned, the programme is also supporting harmonization of state laws on natural resource issues. The idea is to develop the NRM governance system both to promote more sustainable land use and to assist in resolving land- and water-based conflicts. In this way, WSRMP is targeting some of the root causes of poverty and vulnerability. The preparatory work for the formulation of the NRM strategy is nearly completed, but the programme still has some way to go to achieve the aim of devolution of natural resource management to user communities, for stock routes, water points and forest land. At the time of the 2008 mid-term review, the natural resources survey, the wildlife survey and disease maps in both North and South Kordofan, and other mapping activities were completed. Policy and legislation related to natural resource management were being compiled with a view to harmonizing these; detailed participatory GIS mapping by the Remote Sensing Authority has been completed; and a presentation workshop was held in September 2009.".

The natural resources strategy will result in an agreed land-use plan; proposals for reformed mandates of the relevant state agencies; necessary legal amendments and modalities; a communication process; and monitoring procedures. One of the main NRM-related outputs of WSRMP is that harmonized natural resources legislation be voted and implemented with clear access and use rights, and appeal and arbitration mechanisms, for farmland, grazing land, forests and water sources. Mobility and displacement of people has led to encroachment and land grabbing,

[114] The native administration has by tradition advanced tribal interests, resolved conflicts and enforced traditional (or *urf*) law and order. It collects livestock taxes, settles land tenure problems and allocates land under customary rights. While the authority of the native administration has been eroded since 1970, when it was abolished under the Numeiri regime, it was reinstated under the present regime, with tribal leaders (or *nazirs*) appointed from the historic leading families within the tribe; it has regained some of its former importance and is now recognized under legislation.

[115] On 2 September 2007 a vehicle of the extension team of Abyei Locality was set afire by rebels in the area.

with many incidents and constant conflict in the programme area. Mapping of and providing services to *marheel* (the traditional stock routes) is a central locus for WSRMP, and the main instrument for dealing with the mobility of nomadic pastoralists. Programme actions are currently concentrated along two main stock routes. At the time of the mid-term review, approximately 3,300 km had been surveyed in North and South Kordofan, and 865 km demarcated. The demarcation takes place after consultation by pastoral and settled community leaders on the boundary of the stock route. Mobile teams have surveyed these routes, and socio-economic surveys as well as technical surveys have been completed. Demarcation of the stock routes to date has involved the tribal leaders and local authorities in determining the length and width of routes. The next step is further implementation through delivery of services at *massaif* (places where nomads spend the dry season, towards the south) and *makharif* (wet season grazing areas for nomads, towards the north, used for a stay of approximately 45 days during August-September), as well as water management strategies. Provision of water, veterinary services and reseeding of resting points along the stock routes were started during 2008. Based on the feedback of local authorities, the demarcation of the western stock route has decreased disputes between nomads and settled communities.

Apart from reforming the process of natural resource management, land-use planning needs to be made more comprehensive. WSRMP will have a GIS system and will develop resource maps for North and South Kordofan. Regular monitoring is planned as part of the programme, including using remote sensing in collaboration with the Remote Sensing Authority (RSA).

Given the need for an integrated approach to development that recognizes the fundamental role ecosystem services play in rural livelihoods, WSRMP has been designed to specifically integrate biodiversity into programme actions. Apart from developing a wildlife reserve in an important catchment area, the programme will measure increased biodiversity by the forage value of the range, by an increase in the wildlife count, and through afforestation achievements.

An important issue identified in programme inception was the need to recognize pastoral and farming usufruct rights. The 2005 peace accord makes provision for settlement of land claims in South Kordofan. Early programme steps towards clarifying access and use rights for natural resources include the establishment of the Regional Land Policy Committee (RLPC), which would make recommendations for organizing land allocation, land use and water management for the two states. It is hoped that through this and other programme actions, sustainable property rights for farmland and for mobile resources can be redefined, and informal conflict management mechanisms restored as much as possible. This will entail recognizing and regularizing customary law and rights, as well as traditional systems for conflict management.[116] Challenges for the programme relate to the need to build a shared vision for the region; and to increase the involvement of community participants and the native administration in planning, management and monitoring of the NRM activities, which to date have been more government-led.

Assessing vulnerability and socio-economic aspects

Understanding the socio-economic aspects of vulnerability, especially to climate risks, is an important step in adaptation processes. While not specifically targeted at adaptation, WSRMP has employed a number of participatory techniques to gain an understanding of the livelihoods of its target groups, and to assist these groups in developing strategies to meet identified needs. Participatory learning and action (PLA) is being used by extension teams to identify the problems and needs in villages. Employing PLA methods has revealed the climate-related risks considered important by local resource users in the development of problem trees. For example, climate risks in Gangil village in North Kordofan, near El Obeid, included reduced rainfall and drought as contributing causes to the reduction of livestock in the village.

[116] It is important that WSRMP maintain its focus on clarifying and regularizing customary land tenure issues, to prevent loss of effectiveness of project actions – for example, before pasture rehabilitation actions such as reseeding, it is necessary to be clear on management and protection regimes.

Attempts to involve nomadic groups in participatory mapping of the stock routes have revealed that the PLA tools currently used are designed for sedentary and, often, literate communities. They have been far less effective among nomadic communities or across an entire stock route. In general, participatory maps have been produced only of the immediate village areas. A recent study suggested that extension officers needed to expand the geographical range of the maps, to depict the entire village territory. This would be important in the identification of flashpoints of past or perceived conflicts and in creating a clearer profile of conflict along the entire stock route.

WSRMP has included socio-economic research related to water points along the routes, in order to highlight areas where a new *hafir* (excavated earth tank) is needed or where rehabilitation of an old one is required. The programme has a strong focus on gender mainstreaming, and programme staff have participated in some training in this regard.

Apart from considering how participatory approaches have been used, assessing the socio-economic aspects of vulnerability also concerns social targeting methods. The mid-term review indicated that targeting of poor households has not been applied to the selection of participants in programme activities, and recommended that the criteria for vulnerability of these communities should be redefined. This offers an opportunity to include variables relating to climate and vulnerability in the targeting process.

Technologies that support adaptation

Over the years, rainfed farmers and pastoralists in the Kordofan region have devised numerous kinds of coping strategies to deal with agricultural production in the face of climatic variability. WSRMP is supporting the livelihoods of resource-poor farmers through a range of technologies and some support for research, in areas that include soil and water conservation technologies, rangeland regeneration, appropriate irrigation technologies and various sustainable agronomic practices. The programme has a clear conception of the linkages between environmental degradation and poverty in its challenging environmental context. Institutional and technical interventions aim to address environmental degradation – such as deforestation, land degradation and depletion of water resources – while at the same time enhancing livelihoods. Significantly, increased biodiversity is included as one of the key outputs of the programme.

> *Adaptation is now a core issue people should concentrate on. In the area of agricultural productivity, this area is very fragile. Productivity is very low compared with the national level, despite extension activities. Even at the research station, we are talking about just a few kilograms per* feddan*. We have to start our strategy from zero. All packages should be revisited. We also need to consider the socio-economic aspects of the communities.*
>
> – Technical officer involved in land use and desertification, State Ministry of Agriculture

Apart from the central WSRMP activities of development of the NRM strategy, mapping of stock routes and provision of veterinary services and water points along these, other natural resource activities include construction of quarantines, forestry development, water investments in underserved areas and improved water harvesting. Measures are being implemented to build on local livelihood systems in activities such as rangeland regeneration through reseeding, enclosure, community protection of rangeland, community forestry, live fences and soil conservation measures. For example, as part of WSRMP, the El Obeid research station of the Agricultural Research Corporation (ARC) is promoting intercropping with legumes through farmer-to-farmer dissemination and farmer field schools.

Programme activities further include: rehabilitation of nurseries for forestry and pasture species; seed production units, which have produced 22 tons of seed over the past three years; baling of grasses from pasture areas not used due to lack of water; and sand dune fixation with *Acacia senegal* – to date, more than 15,000 seedlings have been produced. Local extension agents have been trained in integrated pest management (IPM) and provided with basic equipment in 40

communities. To counter the effects of a trend of increasing fires, due to the dryness of the vegetation, the programme has established 15,000 km of fire lines in nine localities in North Kordofan. Reseeding is carried out to combat the effects of overgrazing. Currently, the programme is considering the best means of protecting reseeded areas in the *makharif*. Debates centre on the villagers' difficulty in protecting reseeded areas from the livestock of nomads, and the desire of villagers that WSRMP provide guards to protect these areas, as opposed to suggestions by programme stakeholders to fence off areas and protect them on a rotational basis.

Farmers and researchers have identified recent trends towards a shorter rainy season (from 90 to 75 days), with a dry spell in the middle of the rainy season. In response to this, the El Obeid research station is now developing crop varieties that can tolerate loss of rain for 20 days in the middle of the season, as well as early maturing varieties of groundnuts and sorghum that can mature in 80 days, and some that can mature in 55 days. As part of WSRMP, the research station is developing an agroforestry system that involves planting gum arabic intercropped with food and cash crops – millet, sorghum, hibiscus (*karkaday*), groundnuts, cowpea, and sesame (*simsim*). Experimental and on-farm trials are currently being carried out. The station is also testing range and forage species to replace species that have disappeared as a result of drought and climatic changes. Some of these varieties are being used in demonstration plots under WSRMP.[117] Programme activities also seek to reduce the number of animals through improved markets and marketing information, and improving breeds. An animal disease survey has been carried out, which will aid planning for vaccination campaigns and veterinary services.

> *We are not talking about demarcated commercial stock routes, like in Australia. These are traditional stock corridors. Selling livestock is not the object of these pastoralists. So the links with the markets will be problematic. But developing markets along the stock routes will help.*
>
> – State government official in the agricultural sector

Programme activities to improve access to water include employment of a water management advisor; water containment and spreading structures; promotion of appropriate irrigation – for example, through cost-effective technologies for drip irrigation in some areas – and development of home gardens for women, associated with the establishment of *hafirs*. Demonstration plots have been developed to show the impact of water harvesting on production, and the El Obeid research station is working on water-harvesting technologies that include terraces and chiselling to increase water penetration. Water supply in the homelands is being improved to reduce movement in search of water, and small demonstration ranches are being established in South Kordofan as an additional encouragement to reduce movement.

The transboundary catchment area of Khor Abu Habil has been a source of dispute between the states of North and South Kordofan. As part of WSRMP, the states have agreed on a joint planning and development mechanism that includes rehabilitation of the irrigation canal of Semeih, downstream from the catchment, and establishment of a nature reserve on Jebel ed Dair, a principal watershed. On the subject of biodiversity, wildlife surveys have been carried out for North and South

[117] Further technological development activities of the El Obeid research station that have potential synergies with WSRMP include: cultural practices to use limited resources effectively, such as intercropping and seed priming (soaking seeds in water for a few hours before sowing, which helps speed up germination and contributes to increased vigour); affordable microfertilization techniques, in which small doses of fertilizer (less than 1 gram per hole) stimulate the root system and increase the health of plants, at a cost of approximately US$2 per hectare; technologies to improve the nutrition and reproduction of the desert sheep that predominate in north Kordofan, including the use of inexpensive mineral blocks for livestock; and establishment of a tree seed centre covering species for the entire Kordofan region and a gene bank for crops, with collections of indigenous species. The research station also has a joint programme with Lund University in Sweden on carbon sequestration. Known as Carbo-Africa, the programme has developed a well-equipped meteorological station 30 km from El Obeid.

Kordofan and for the Jebel ed Dair reserve, and WSRMP has been involved in a workshop held in Kadugli on agrobiodiversity, the recommendations of which will feed into the programme.

Community development and extension activities include community mobilization and organization, specific asset-building activities in favour of poor people, including women (such as vocational training, restocking, and agricultural starter packs), community social services provided on a matching grant basis, and conformation of the locality and village extension services to state norms. Literacy and nutrition classes for selected communities form part of the community development and extension component. Environmental awareness workshops have been held in a number of communities, and these have included some discussion of global climate change. However, it appears that while WSRMP will work in 280 localities, only five workshops are planned for the entire programme. One innovation has been the deployment of two mobile multidisciplinary extension teams along the stock routes. In these teams, the state ministries of agriculture and concerned localities pool staff and resources to carry out joint survey and planning for the demarcation and development of the stock routes. A further 11 teams are posted at the locality level, with women's participation in extension teams currently at 35 per cent. According to the mid-term review, all extension teams require additional training and capacity-building, as well as improved working conditions.

WSRMP is including a number of technical packages in pasture regeneration, investment in water facilities, introduction of small- and large-scale water-harvesting techniques and the construction of quarantine facilities. In South Kordofan, extension officers only use packages tailored to local agroecological conditions. The mid-term review found that extension activities for animal draught implements and drip irrigation systems have been successful, with good demand and readiness to purchase these at cost. However, most of the other technological packages are still inconclusive at this stage, owing to delayed delivery of inputs and problems in setting up demonstrations of the proposed technologies.

Forestry nurseries have been rehabilitated and community forests registered. While reforestation is an important activity, the programme is currently considering how best to proceed, given that this activity depends on participatory activities carried out with communities. Previous projects have found these not very effective, because pay-backs occur only in the long term. The recently completed mid-term review of the programme advised working through local traditional leaders to maximize mobilization.

> *Desertification and sand dunes are making the Bara area more vulnerable. In North Kordofan, people are aware of climate change and able to accept this project [the NAPA pilot project for North Kordofan], because they lost everything in the drought. But in South Kordofan, it is less so, because the resources still seem healthy. But there is lots of tree cutting, as well as the harmful effects of the oil companies – like the black water.*
>
> – Technical focal point on climate change

Extension officers are regularly presented with proposals drawn up by villagers, such as one for an 'environmental rehabilitation project' that would involve cultivation of *Acacia senegal,* handed to extension staff during the site visit for this case study.[118] These proactive approaches on the part of community organizations indicate potential entry points for improving the community-driven nature of the programme.

Institutional development

The main implementing agency of WSRMP is the federal Ministry of Agriculture and Forestry. The institutional development component aims to strengthen states' capacities for equitable economic

[118] This proposal involved one of the committees paying people to look after seedlings of economically valuable trees, such as *Acacia Senegal*, in areas that would be protected by fire lines. The fund would be recovered after five years from the yield of the trees. This project was proposed to involve 56 villages in the locality.

planning and management, and to establish a mechanism to support effective interstate collaboration and decision-making. This will involve building the capacity of the implementing agencies to address technical as well as institutional aspects of natural resource management. Of importance for critical land-use and land-tenure issues is the establishment of a regional land policy committee, as the consultative forum for development of the natural resource management strategy.

At the village level, a number of institutions have been targeted for either strengthening or creation. In one village, this could include a committee for nomads and semi-nomads, a women's group, an agricultural committee and special-interest groups. WSRMP also aims to strengthen existing conflict-resolution mechanisms, including through conflict committees chaired by the sheikhs. In the case of damage to crops by livestock, the committee will inspect the damage and then meet with the owners of the livestock to obtain compensation. If this is not forthcoming, formal legal institutions are approached.

Marketing and rural finance

The Kordofan region is a main livestock producer for national and export markets. El Obeid has an important livestock terminal market, which is the main trade point for herds from North and South Kordofan and Darfur States. However, one of the biggest bottlenecks in the Kordofan region is marketing. Main activities of the rural finance and marketing component will include conducting a policy dialogue on bank restructuring, rehabilitation of selected markets and organization of their management to include representatives of producers' associations, piloting market prefinancing operations, and setting up a market information network. For rural finance, WSRMP will: adopt a microfinance approach; focus on formation and strengthening of savings and credit groups in WSRMP communities; provide technical assistance to banks to expand their rural portfolios based on business plan submission; and monitor the sustainability of *sanduqs* (gender-specific community-based savings groups) formed under the previous IFAD/government North Kordofan Rural Development Project.

The marketing component of WSRMP now includes two main activities: market rehabilitation and market information systems. Market information centres will provide producers and traders with information on market prices and the volume of transactions in neighbouring and terminal markets.

A activity related to market development is the planned upgrading and construction of the road from Semeih (on the highway from Khartoum to El Obeid) to Kurgul in the south-west, thus connecting traditional and rainfed agriculture with regional, national and export markets. Cofinancing for this component was confirmed in October 2008 and rehabilitation of markets and information centres began late in that year. Designs are being developed for markets and related infrastructure – stores, sheds and loading areas. An important related activity, critical to food security and to coping with uncertainty, is post-harvest storage. A study commissioned by WSRMP to explore the status of household storage strategies throughout the region revealed that major improvements are necessary. The study highlighted the importance of integrating the approaches to storage structure, commodity management and pest management (using non-chemical control). It will be important for the programme to pursue this area, to ensure that hard-won production is not lost through inadequate storage. Training is planned for extension staff on storage at all levels.

Summary of adaptation activities

> *In North Kordofan, we have had no specific focus on climate change in the agricultural sector. But we know that carbon sequestration, biodiversity, control of desertification and managing conflict are very strongly linked. We believe that demarcation of stock routes and rehabilitation of degraded rangeland will address all four of these things, as well as the marginalization of pastoralists.*
>
> – State government official in the agricultural sector

WSRMP was not conceived of as a climate-change adaptation programme when it was designed four years ago. However, many of the activities being implemented directly address climate risk and variability – for example, the development and dissemination of early maturing crop varieties, and demonstration plots showing the impact on production of water-harvesting technologies. Moreover, conflict in the Kordofan region has been closely linked to resource scarcity and environmental degradation, which in turn has been causally linked to recurrent droughts, combined with the effects of unsustainable practices. The programme directly addresses these conflict/climate/resource degradation linkages through its focus on NRM strategy development and on mapping and providing services to stock routes. In this way it seeks both to reduce conflict between pastoralists and settled agriculturalists and to remediate the negative environmental impacts of overgrazing.

In summary, WSRMP activities that address climate variability, or reduce vulnerability and thus indirectly lessen the risks associated with climate change, are the following:

- *The systematic approach to developing an NRM strategy*, which underpins the programme in a fundamental and very positive way;
- *Strategies for resolving land- and water-based conflicts* through: demarcation of stock routes; strengthening of traditional conflict-resolution mechanisms; activities to increase security of tenure through registration of customary rights; and land-use planning and control to protect routes and associated pasture and water for transhumants;
- *A focus on nomadic pastoralists*, which keeps a livelihood strategy open that may become increasingly important as the effects of climate change are felt;
- *Methods to build up traditional rainfed agriculture* in a sustainable and climate-sensitive way, such as early maturing varieties, agroforestry as a risk reduction strategy and water-harvesting technologies;
- *Activities to enhance the resilience of ecosystems*, and also of the livelihoods of people who depend on them, such as rangeland reseeding, integrating biodiversity and specifying improvement of this as a programme outcome, and a focus on agrobiodiversity, which can lead to the identification and development of additional climate-resilient varieties;
- *Rural finance and market components as a critical link* to add value and unlock alternative income-generating enterprises and developing market chains, for more diversified livelihood strategies and enhanced incomes;
- *Approaches to participation and empowerment*, community organizational development and integrating gender aspects, which help strengthen resilience in general, and environmental awareness workshops that specifically include climate change.

While the primary focus of this case study is on adaptation, programme actions have implications for mitigation too. Thus all programme actions that increase vegetation cover, reduce degradation of rangelands and encourage development of community forestry are also likely to increase the capture of carbon.

Contribution to improving rural livelihoods

> *To adapt to climate change, we must plant trees. IFAD has given us awareness of this. The programme also gave us seedlings and improved seeds – short-maturing varieties of sesame and groundnuts. The most beneficial thing has been the improved seeds – the seasons using these have been the best.*
>
> – Small-scale farmer, Gangil village, North Kordofan

Since 2002, IFAD investments have been concentrated in rainfed areas. As well as being characterized by higher levels of poverty, the livelihoods of poor people in these areas are highly vulnerable to the increasing variability of rainfall expected as a result of climate change. The 2008

mid-term review concluded that economic activities of WSRMP were too limited to trigger the projected increases in food self-sufficiency and cash earnings of poor households. However, implementation of programme activities only really started in early 2007, thus it was still early in the implementation of WSRMP. While the design of the programme is complex, its integrated approach positions the programme well for achieving synergies between its two goals of livelihood improvement and sustainable natural resource management. Inasmuch as many of the programme activities can be seen to be acting as adaptation measures, this will confer a link between these more unconscious adaptation activities and rural livelihoods. Examples of programme activities that also function as proxy adaptation measures, and can already be seen to have conferred some benefits (albeit on a limited basis), are the provision of early maturing crop varieties and the positive uptake of drip irrigation systems for home gardens. All programme activities that aim to build up traditional rainfed agriculture in an environmentally sensitive manner would ultimately contribute to improving rural livelihoods. It is a strength of the programme that it is designed with a strong understanding of the poverty/environment linkages in the region.

Community development and extension activities seek improvements in the productive asset base of poor households, as well as improved coverage of extension and social services. The marketing initiatives piloted by the programme have the ultimate aim of providing market-based incentives to both producers and state governments for efficient allocation and management of natural resources. Improved access to markets can be expected to unlock further livelihood diversification, and also reduce pressure on fragile rangelands.

With its emphasis on biodiversity and on monitoring improvements in biodiversity, WSRMP has the potential to highlight the role of agricultural biodiversity conservation for adaptation, as well as the role of enhanced ecosystem resilience for human livelihoods, and to promote the ability to cope with increasing climatic variability.

While climate change could have serious impacts on pastoralists, it may also be that pastoral livelihoods become increasingly important. They are shaped to deal with scarce and variable natural resources and to tackle difficult and uncertain agroecological conditions. Climate change could conceivably lead to the extension of territories in which pastoralism could show comparative advantages. This would require policy support. In the Sudan, while national policy may view settlement as the main mechanism for enhancing the livelihoods of currently nomadic and semi-nomadic populations, it may become increasingly important, as climate change impacts are felt more strongly and perhaps over short time periods, to not foreclose options on the nomadic way of life. As the Sudan NAPA indicates, humid agroclimatic zones will shift southward, rendering areas of the north increasingly unsuitable for agriculture. Apart from conflict reduction goals, programme actions can thus also be seen as ways to support coping strategies for pastoralists, as well as to promote a more equitable approach to development for groups that are often marginalized. The importance of this is clear if one considers that in the El Obeid region, rainfed agricultural land increased by 57.6 per cent between 1973 and 1999, while rangeland decreased by 33.8 per cent and wooded pasture by 27 per cent, as noted in a recent UNEP assessment.

The support to pastoralism provided by WSRMP may translate into both livelihood gains and increased climate change adaptation in some parts of Kordofan. A study to explore the pros and cons for rural livelihoods and ecosystems of support to the nomadic way of life under different climate change scenarios, including the opportunity costs of not doing so, could be instructive.

> *Yes, the support to pastoralists and demarcating stock routes is probably not a long-term thing. But previous attempts at cooperative farming in this area have failed 100 per cent, because they did not take into account socio-economic factors. There is an idea to set aside a large area, with a shallow underground reservoir, in the area where the borders of Sudan, Chad, Libya and Egypt meet, for pastoral groups to settle. This is possible I think, but it needs funding.*
>
> – Natural resources expert

Options for enhancing the climate-sensitivity of the programme

It is becoming increasingly accepted that development based on a stronger ecological understanding at the outset – and more-robust use of ecological knowledge linked to traditional practices – is an important step in developing effective local adaptation strategies. The overall approach of WSRMP is thus quite consistent with an adaptation planning approach. This can be relatively easily strengthened through a systematic inclusion of specific climate information and scaled-down projections for climate change.

A key realignment to be implemented after the mid-term review is that of increased involvement of the native administration in natural resource management, in order to promote co-management and user-management of resources. This will help shift the focus from government-driven service delivery to community-managed delivery, and it is also expected to increase cost efficiency and effectiveness. This could be a further important step in promoting community-based adaptation-related activities, assuming that climate change is further prioritized in the programme.

The Sudan NAPA highlights changes in climatic patterns in recent decades, and makes the point that many of the traditional coping strategies are proving to be no longer effective, emphasizing the need for concerted action to support community adaptation. This highlights the need for actions to strengthen people's coping and adaptive capacity to both short-term climate variability and long-term climate change. Activities of WSRMP in community empowerment and capacity-building, and in providing microfinance and improved marketing facilities, are aimed at reducing vulnerability and enhancing livelihoods in general. As such, they will serve to increase the resilience of poor rural people, which will enable them to better withstand the additional shocks and stresses of climate change.

Specific steps to strengthen the climate-sensitivity of WSRMP include the following:

- **Integrate scaled-down climate scenarios into programme operations**. Pursue possibilities for obtaining scaled-down climate projections through the NAPA process, and integrate this information into programme operations.
- **Increase collaboration with local research stations on appropriate integrated, multidisciplinary agroecological technologies**. There are existing programme activities in this regard. However, given the wealth of appropriate technology developed, for example, by the El Obeid research station, and the programme's objective of collecting indigenous knowledge of farmers, there is room for additional collaboration. This could include further exploration of the integration of crops and livestock as a vital tool for risk aversion; increased involvement of farmers in technological development;[119] increased support for agroforestry as a risk reduction mechanism; and further steps to protect and enhance *hashab* cultivation.
- **Include seasonal weather forecasts in extension services and targeted pilot projects for farmer-to-farmer learning and monitoring**. Seasonal forecasts could be provided in collaboration with the meteorological agency, and selected locations could be involved in pilot projects in which farmers develop their own capacities for applying on-farm adaptive strategies. The projects would promote integration of scientific knowledge, climate information and local practices in a farmer-led approach. These pilot projects could be structured around quarterly farmer-to-farmer workshops, which would assist farmers in developing their own capacities to apply on-farm adaptive strategies in the face of changing

[119] This would also help address some of the weaknesses of the extension approach adopted, such as the lack of community participation in the selection of technological packages and weak follow-up from the extension team, as identified by the mid-term review.

climate conditions.[120] In the resultant empowering process, farmers could critically reflect on scientific forecasts and make informed land-use decisions based on an integrated interpretation of the data, on presentation of a range of technological options by the research stations, and on their own knowledge.[121] Such a process would support locally developed adaptation options and their scaling up. Monitoring could be carried out by the El Obeid[122] and other research stations, with some community monitoring of variables such as rainfall and temperature, to understand microclimates.

- **Develop drought early warning systems for disaster preparedness**. It is not clear to what extent the programme area is included in FAO early warning systems for drought, but this is an area that should be explored and enhanced.
- **Develop linkages with existing or planned climate change interventions in the area**. To build up a critical mass of organizations and actions for climate change adaptation, a starting point is to look for synergies with the NAPA pilot project being implemented in North Kordofan.
- **Strengthen linkages between the strategic approach to natural resource management and other programme activities**. A first step would be to strengthen the understanding of programme staff and implementing partners of the programme's conceptualization and rationale underpinning. And, second, to ensure that the NRM strategy and associated land-use planning inform all other activity areas.

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[120] Seasonal forecasts could be presented to farmers, who could then retrospectively discuss the forecasts of the previous quarter and verify these with their own experience of climate in the area.

[121] This proposal for pilot projects is based directly on the approach adopted in the joint project of WWF, Environmental Monitoring Group (EMG) and Indigo Development implemented in a marginal rainfed farming area in South Africa, as set out in Malgas et al. (2007).

[122] The meteorological station of the El Obeid research station collects climatic data on temperature, rainfall and humidity, and for the Carbo-Africa project, on vegetation cover and carbon balance.

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PROJECT SUMMARY TITLE OF PROJECT: Western Sudan Resources Management Programme (WSRMP)		
TOTAL PROJECT COST:US$49 m	**IFAD CONTRIBUTION: US25.5m**	**YEAR OF APPROVAL: 2004**
EXPECTED COMPLETION: 2012	**STATUS: Ongoing**	**DIRECTLY BENEFITING: 65 000 households**

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3. Case study from Eritrea[123]

Livestock and agricultural development, spate irrigation and adaptation to climate variability and change

The project in brief

The Gash Barka project supports investments in livestock and crop production enterprises benefiting 16,000 households. The region has been adversely affected by the recent conflict between Ethiopia and Eritrea. Households lost many assets, including tools and cattle, infrastructure was destroyed and seasonal migration of livestock has been disrupted. Under the project, improvements in grazing and farming include establishment of exclusion areas and communal management of rangeland. The project supports infrastructure works such as the building of water points, diversion of rivers and small streams and water harvesting for supplementary irrigation.
The project also improves people's access to drinking water and medical services, including measures to combat malaria and tuberculosis and to improve health care for mothers and children.

General context and country main development challenges

Eritrea is one of the poorest countries in the world, with an average annual per capita income of US$200. The population is estimated to be about 4.5 million, of whom two thirds normally live in rural areas. Population density is high in the highlands, 200 people per km^2, and low in the arid lowlands, where average densities rarely reach 20 people per km^2. Agriculture provides only 16 per cent of GDP, while services account for 56 per cent. Economic conditions have not improved and real GDP growth averaged 1 per cent between 2005 and 2007. In the longer term, sustained real economic growth of 7 per cent or more will be required for Eritrea to reach the MDG of halving the proportion of people living in extreme poverty. Rainfed agriculture, the predominant economic activity for more than half the population, is a very risky enterprise, and food security remains one of the Government's main concerns. Even in times of good rainfall, domestic food production is estimated to be 60-70 per cent of the population's needs. Malnutrition is of particular concern among women and children. Some 46 per cent of the population was estimated as undernourished in 2002, and 40 per cent of the children were found to be underweight for their age (World Bank 2009; IFAD 2002b).

Country vulnerability to observed and anticipated threats and impacts of climate variability and change

Eritrea is among the countries most vulnerable to the adverse effects of climate change (UNFCCC 2002; State of Eritrea 2007). The country is situated in an arid/semi-arid region of the Sahelian belt, which is characterized by frequent and prolonged droughts. It has special needs regarding adaptation to climate change, because of low-lying coastal regions, arid and semi-arid areas, zones liable to drought and desertification, and areas with fragile ecosystems such as mountainous regions. Particularly vulnerable groups are subsistence farmers, pastoralists, rural dwellers and fishers. The most limiting factor is rainfall, which is erratic and torrential, and quickly forms heavy floods with little chance of absorption into the soil. Rainfall is also very variable, which greatly affects agricultural systems. Impacts are further aggravated by the early stage of development of meteorological and hydrological information.

[123] This case study was written by Elisa Distefano, Environment and NRM Consultant at IFAD, with inputs from A. Benhammouche, CPM for Eritrea.

Current local climate risks

Eritrea has a mostly arid climate, with about 70 per cent of its land area classified as hot and arid, and receiving average annual rainfall of less than 350 mm. A main feature of rainfall patterns is the extreme variability within and between years, and spatial variation over very short distances. The country is divided into six agroecological zones representing two rainfall regimes: the summer rains, which affect the central highland and the western lowland areas, and the winter rains, which affect coastal areas and the eastern and southern escarpments. Current major climate hazards are increased climatic variability, recurring drought, flash flooding and sea-level rise. Increasing climate variability is already affecting various sectors. The light rains that usually occurred during April/May have all but disappeared. In recent years, the main rainy season starts later and finishes earlier than in the historical pattern, resulting in rainfed crop failures. New crop pests are appearing that were previously unknown or uncommon. Irrigated crops are also adversely affected, owing to depletion and drying of water wells, as well as to unusually heavy flooding during the rainy season. This is accompanied by recurrent drought, warmer temperatures and high evaporation patterns that are resulting in smaller stream flows, lower groundwater levels, deterioration in water quality and disappearance of the base flows that are the sources of water supply.

Most of Eritrea's land areas are characterized by shrub coverage, with limited areas of trees. Climate variability impacts soil moisture and adversely affects the growth of the shrubs and trees. As temperature increases, there are increasing shortages of biomass, both for energy and local home construction, as well as declines in non-timber harvesting products such as wild fruit and fodder.

In addition, frequent droughts between 1992 and 2004 led to the deaths of thousands of cattle and camels. Thermal stress is leading to decreased feed intake, interference with animal productive and reproductive functions, and increasing exposure to pathogens. Pastoralists in the eastern lowlands and north-western rangelands are the most vulnerable to these patterns.

Government prioritized adaptation interventions and coping strategies

Eritrea has low adaptive capacity relative to constraints on wealth, technology, institutions, information, infrastructure and social capital. The Government has identified high-priority adaptation activities for diverse sectors. Major adaptation needs and actions for **crop production** are: (i) improve soil fertility and moisture retention using conservation and alternative cropping techniques; (ii) increase water supply through irrigation, water diversion structures, ponds and wells; (iii) control pests and plant diseases through regular weeding, crop rotation and planting of appropriate crops; (iv) adjust timing of crop cultivation in direct response to changing patterns of rainfall; and (v) breed drought- and disease-resistant high-yield crops to maintain and/or improve crop production levels. Proposed adaptation measures for the **livestock sector** are: (i) implement community-based development and/or rehabilitation of rangelands in specific areas; (ii) select animal species and breeds more able to cope with climatic variability; (iii) increase job opportunities in order to diversify household incomes; and (iv) reduce overall livestock numbers, while simultaneously improving animal productivity. Major adaptation interventions in the **forestry sector** are: (i) encourage afforestation of degraded landscape/watersheds: (ii) promote agroforestry practices; (iii) encourage natural regeneration through enclosures; and (iv) encourage alternatives to wood in traditional home energy provision and construction. Important adaptation measures for **water resource management** are: (i) improve water-use efficiency by introducing water-saving irrigation systems; (ii) enhance groundwater recharging mechanisms; (iii) develop effective soil and water conservation projects; (iv) introduce or expand irrigated agriculture, especially spate irrigation for crop and livestock production; and (v) increase awareness, education and training in water resource management for farmers, government staff and administrative officers.

Project background

The project area is the Gash Barka administrative region, which is part of the Sudano-Sahelian agroclimatic zone and covers 27 per cent of the country's total land area. Rainfall occurs between May and October, and varies from less than 200 mm per annum in the north-western lowlands to 700 mm on the fringes of the highlands in the south-east. The dependable cropping period is only 50-90 days. Two seasonal rivers, the Gash and the Barka, cross the region and supply essential dry season grazing and access to underground water. The target population depends on low-productivity crop and livestock enterprises, has limited access to social services and relies on few alternative opportunities for generating income. Smallholder agricultural production systems vary greatly in the region. In the arid lowlands, semi-sedentary pastoralists rely almost exclusively on livestock. On the fringes of the highlands, where rainfall is higher and more reliable, sedentary agropastoralists rely equally on crop and livestock production. The majority of households produce sufficient food for 8-10 months in years of good rainfall, and 5-7 months in years of poorer rainfall. Partial or complete crop failure occurs as frequently as one year in three, on average, and more often in arid areas. In years of crop failure, nine of ten households are food insecure and must sell livestock to ensure household survival. Households with few or no livestock must rely on food donations for survival, and many such households are headed by women and have particularly poor access to other means of income generation. The greatest livelihood risks are low and unreliable rainfall and serious health risk problems, including malaria, tuberculosis and diarrhoea linked to unsafe drinking water and poor sanitation (IFAD 2002a).

Description of project activities and key practices enhancing adaptation

The overall project goal is to reduce poverty through local demand-driven investments in livestock, agriculture and social services. The project has four components: (i) project facilitation to strengthen the capacity of rural households to plan, implement and monitor development activities; (ii) livestock and agricultural development to promote increased productivity and food security while conserving the environment; (iii) social services to provide improved rural infrastructure, with particular regard to rural water supply, sanitation and health facilities; and (iv) coordination of planning, implementation, monitoring and evaluation. The project design describes investments and technologies that communities may choose and adapt to local conditions and priorities during a participatory planning process. Thus investments and activities in a specific locality are identified by the target group and government staff during an initial assessment of possible solutions, prioritization and agreement on an action plan. This case study focuses on the livestock and agronomy component, which comprises four subcomponents:

Rangeland development. Mapping, satellite and aerial photo imagery, equipment and staff training were initially provided to enable interpretation of map resources, and ultimately to identify the best locations for livestock watering points and drinking-water supplies. Where water was available for livestock and humans, storage ponds (10,000-15,000 m^3) or boreholes, mainly with windmill-driven pumps, were constructed in strategic sites. Storage ponds were preferred, as they support no more livestock than the surrounding rangeland capacity. Voluntary livestock exclusion areas (VLEAs) were established, with temporary or permanent closures, to improve the quality and quantity of forage and pasture produced from the rangelands, as well as to prevent overgrazing. As the rainy season is short, rainfall is low and soils are often shallow, the location of the VLEAs was carefully selected to ensure proper conditions for regeneration of the vegetation. They were located near the lower-lying valleys or depressions. The management of VLEAs, of up to 1,000 ha, was assigned to pasture guards employed by grazing management groups, which were formed by the communities with assistance from government staff. The objective of producing feed while increasing the annual grazing period was achieved through planting of forage trees and purchase and distribution of native grass seed (*Urochloa trichopus*), to be sown in the summer. Supplementary feed production using locally available materials contributed to shortening the critical dry season period. These activities were undertaken in conjunction with feed conservation and distribution to farmers during the dry season

or drought. The effectiveness of the approach is demonstrated by the fact that pastoralists adopted the practices spontaneously, and by a reduction of two months in the migration period in 2007/2008, owing to the improved feed situation.

Animal health and production. The animal health services have been strengthened through rehabilitation and construction of veterinary clinics, supply of equipment, medications and vaccines. The animal-health-services unit now has a good field network, which is functioning effectively. Significant vaccination and disease treatments have been carried out: in one year almost 600,000 animals were treated for various diseases and approximately 150,000 were vaccinated. The communities in areas where VLEAs were established selected village livestock workers (VLWs), who were provided with basic equipment. Training in disease diagnosis and animal nutrition has been given to veterinarians and laboratory and animal health technicians, as well as to VLWs. In addition, livestock marketing opportunities were identified, with the aim of improving returns on livestock production. Finally, woman-headed poor households were provided with goats, sheep and poultry, as livestock-raising can be an important strategy to diversify the household economy and cope with occasional crop failure.

Crop production. The project financed soil and water conservation structures, such as earth or brushwood bunds and terracing, to halt land degradation and increase the availability of water to improve crop productivity. Microcatchment interventions were also carried out to reduce run-off and increase infiltration. In addition, the project embarked on the construction of two medium-scale spate irrigation schemes, covering about 1,100 ha and benefiting 1,000 farmers. A land-tenure or ownership map was created prior to construction of the spate irrigation system. People's rights to land were assessed and recorded in a land registration document, and land-use rights issued for the irrigated land benefiting from the spate irrigation system. These interventions have been accompanied by capacity-building and training of water users' groups (WUAs) and Ministry of Agriculture staff. WUAs were also established in every spate irrigation scheme to transfer the operation and maintenance costs to the participants. The spate-irrigated area is mainly cultivated with sorghum, although small quantities of sesame and common bean are also grown. Yields of sorghum vary widely, depending on the completion status of the scheme, management capability of operators, type of seed used, and water availability: from an average of 300 kg to 2,480 kg.

Crop technology transfer. This component aimed to increase food production for household consumption and local sales through trials and demonstrations of crop production techniques. The target groups live mainly in the drylands. Farmers received training in pump operation and maintenance, and in soil and water conservation techniques through field-based crop demonstrations and extension activities. Radio and video broadcasts were released to support the extension services (IFAD 2002a, 2006, 2008a).

Support to local adaptive capacity through spate irrigation

Spate irrigation is a type of water management unique to arid regions bordering highlands. It is a largely neglected and forgotten form of resource management, in spite of its potential to contribute to poverty alleviation, adaptation to climate change and local food security. Spate irrigation has a strong potential to build local adaptive capacity to climate variability, because it not only provides irrigation and limits the damage of flooding, but also stores moisture in the soil, recharges shallow aquifers and fills ponds. It requires the construction of diversion structures that are able to withstand floods and guide flash waters over large areas, dissipating their erosive power. The main principle is exploitation of the floods that originate from episodic rainfall in macrocatchments. Floods are diverted from ephemeral rivers and spread over agricultural land. After the land is inundated, crops are sown. For this reason, spate irrigation depends on the availability of floods and sediment loads related to the rainfall pattern, geology, morphology and vegetation cover of the catchment. Sediments play an important role in fertilizing the soil. Crop productivity is influenced by years with good rains and floods. However, in years with less than normal rainfall, spate irrigation

can sustain highly productive agricultural systems. In the Gash Barka region, for example, the average sorghum yield is reported to be 1,200 to 2,100 kg/ha in spate irrigated areas, while only 450 kg/ha is derived from rainfed land. In the eastern lowlands, sorghum yields are 3,750 kg/ha – three to six times higher than elsewhere.

The existence of a functioning spate irrigation system consolidates an ephemeral river system and prevents it from constant braiding and degrading in extreme weather events. This explains why spate irrigation can enhance the resilience and productivity of small-scale farming systems that are particularly vulnerable to floods and droughts. It makes it possible to grow crops in hot, arid and semi-arid regions where evapotranspiration greatly exceeds annual rainfall. The cropping patterns in spate-irrigated areas are dominated by the cultivation of low-value, drought-resistant subsistence crops, such as sorghum, wheat, millet, pulses and oilseeds, whereas cotton, pumpkin and melons are also grown as cash crops. The production of fodder crops to support livestock is also important in most spate systems. In conclusion, spate irrigation generates important benefits: improved access to water for humans and livestock, better access to water for animal feeding and increased soil moisture, and increased harvesting of forest products (IFAD, Meta and UNESCO Institute of Water Education 2008).

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PROJECT SUMMARY **TITLE OF PROJECT:** Gash Barka Livestock and Agricultural Development Project (GBLADP)		
TOTAL PROJECT COST:US$16.1 m	**IFAD CONTRIBUTION: US$ 10m**	**YEAR OF APPROVAL: 2003**
EXPECTED COMPLETION: 2009	**STATUS: Completed**	**DIRECTLY BENEFITING: 27 500 households**

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4. Case study from Kenya[124]

Mount Kenya East Pilot Project for Natural Resource Management:

Increasing the resilience of the ecosystem to human and natural stresses

The project in brief

The project supports the government's goal of promoting environmental conservation as a means of ensuring sustainable livelihoods for the rural poor. Since the project area is adjacent to the Mount Kenya National Park and Reserve, the project addresses the serious problem of conflict between humans and wildlife, a leading priority for farmers. Project activities focus on supporting sustainable watershed management and development within protected areas; conserving and managing ecosystems, including forest rehabilitation; capacity-building for ecosystem management and for research; and reducing human/wildlife conflicts related to the proximity of the unique Mount Kenya National Park, to improve livelihoods and protect community investments.
The project strengthens community-based organizations. Local groups help formulate regulations for the sustainable management of land and water resources. Improved river basin management is a key feature. The project enables poor people to increase their incomes through food processing or off-farm activities, and it promotes improved market linkages.

General context and main development challenges

Kenya's average annual GDP growth rate declined from 6.5 per cent in the 1960s-1970s to about 1.3 per cent in 1996-2000. Poverty has been increasing, as confirmed by its Human Poverty Index (HPI) rating, which has risen from 26.1 per cent in 1997 to 34.5 per cent in 2001. Kenya's renewable natural resources constitute its main economic asset, with agriculture contributing about 23 per cent to GDP. However, over the past two decades, agricultural productivity has been affected by soil erosion and inappropriate agricultural practices. This is accompanied by degradation of river basins, which is undermining Kenya's overexploited water resource base. River basin degradation is resulting in increased run-off, flash-flooding, erosion and siltation, reduced infiltration and lower flow during dry periods. The main causes of river basin degradation are deforestation, poor farming methods and population pressures. In addition, increasing water demand has intensified competition and conflict among users. At the root of these conflicts are also the lack of an adequate mechanism for water allocation, and poor administration and enforcement of the water-permit system. Illegal withdrawals of water have proliferated and include abstraction without permits, non-compliance with permit conditions and use of expired permits. Moreover, population pressure on high-potential areas is forcing people to move into drier areas, where agricultural production requires supplementary water.

Mount Kenya is one of the five main 'water towers' in the country and a vital source of water for a significant portion of the population. The three main catchment areas, vast underground lakes and large network of rivers that originate from the mountain supply water to more than two million people inhabiting the surrounding rural areas and three million people living in Nairobi. However,

[124] This case study was written by Elisa Distefano, Environment and NRM Consultant at IFAD, with inputs from R. Mutandi, CPM for Kenya, P.M. Njuguna MKEPP PMU Environmental Conservation Officer, Wellingtone Ndaka, MKEPP Mbeere District Coordinator of the Environment Component and target groups.

deforestation and upstream abstraction of water (uncontrolled, inefficient and excessive) in all river basins has led to declines in downstream flows. Farmers and pastoralists in arid/semi-arid areas (ASAL) are particularly at risk, and suffer the most during dry seasons. Moreover, deforestation and inappropriate agricultural practices on fragile soils and sloping lands have led to accelerating soil erosion and the accumulation of an extraordinary silt load in main rivers and their tributaries. These factors are undermining the ecosystem function of water regulation. Thus drought and flooding are becoming more frequent, affecting the agricultural productive potential of the area and leading to food insecurity and poverty (IFAD 2003a).

Country vulnerability to observed and anticipated threats and impacts of climate variability and change

Climate change is likely to impact on ASAL, areas liable to drought and desertification, forested areas, coastal zones and areas with fragile ecosystems, including mountainous zones (UNFCCC 2002). Mountain regions are likely to experience an early and shortened snow-melt period, with rapid water release and downstream floods. Glacier retreat and reduction of melt volume have implications for downstream rivers, as dry season flows are declining. These impacts may be exacerbated by population pressure, land-use changes, ecosystem degradation, deforestation and soil erosion.

In general, the water resources in the country will become scarce by the year 2030. The most vulnerable areas are expected to be the ASAL, with increased frequency and severity of droughts, deterioration of soil and vegetation cover, disruption of the hydrological cycle and reduction of water supply. In these areas subsistence farming and livestock production are dominant, and farmers and pastoralists will be at risk of food insecurity. The social characteristics that increase vulnerability of water resources to climate change include: (i) inadequate water control infrastructures; (ii) inadequate maintenance and deterioration of existing infrastructures; (iii) lack of appropriate institutions for resource-use planning and management; (iv) high population densities; and (v) increasing demand for water. On the other hand, the physical features associated with climate vulnerability of water resources include: (i) high seasonal hydrology due to seasonal precipitation or dependence of snowmelt; (ii) high rates of sedimentation leading to reduction of reservoir storage; and (iii) topography and land-use practices that promote soil erosion and flash-flooding conditions.

Current local climate risks

Mt. Kenya glaciers have lost 92 per cent of their mass in the last century, and their volume and extent show drastic decrease in recent years. Major floods have occurred in the Lower Tana basin, and serious droughts have affected the ASAL in the past 50 years. In 2000, which was the third successive year of drought, some rivers and streams in the middle catchment in parts of Meru Central and Embu completely dried up for the first time in living memory.

Government prioritized adaptation interventions and coping strategies

Kenya's adaptation strategies and policies in the agriculture and forestry sectors emphasize the introduction of flood-control measures in most prone areas, promotion of soil conservation practices, prohibition of cultivation on riverbanks and a ban on clearing catchment and river basin vegetation. Other adaptation options include the development of smallholder irrigation schemes, introduction of drought-tolerant crops and early maturing crops, as well as reforestation and environmental conservation.

Description of project activities and key practices enhancing adaptation

The activities funded jointly by the Government of Kenya and IFAD have been implemented in five river basins within the Tana River catchment on the eastern slopes of Mount Kenya. The basins fall

within eight administrative districts: Embu, Mbeere, Meru Central and South, Maara, Imenti North and South, and Tharaka. The Tana River forms the largest and most important basin in the country; its area accounts for 50 per cent of the total Mount Kenya discharge. The upper catchment area comprises the afro-alpine zone, dominated by broad-leaved evergreen hardwoods and conifers as well as bamboo forest, and is protected by the Mount Kenya National Park (about 700 km^2) and Mount Kenya National Forest Reserve (about 2,000 km^2). This vast zone is more or less uninhabited, and home to biodiversity of national and global significance. The middle catchment of the project area includes high-potential agricultural land, with an annual rainfall between 750 and 2,000 mm. The land has been cleared of its natural vegetation, is densely populated, and is now covered by cultivation, human settlements and farmlands. Here agroforestry is widely practiced and the principal food crops and exports are cultivated (e.g. tea, coffee, cotton and tobacco). The lower catchment comprises the ASAL, bush land dominated by *Acacia* and *Commiphora*, and rangeland, where annual rainfall reaches levels as low as 550 mm. Here farmers depend mostly on livestock, and earn additional income from harvesting and selling fuelwood and honey, and petty trade. The project targets 136,000 poor households and is implemented in 32 focal development areas (FDAs), homogeneously distributed in the five river basins. The project aims to address the main causes of poverty in the area – degradation and overexploitation of natural resources, low productivity, human/wildlife conflict and population pressure – through the following components.

Water resource management

The objective of this component is to enhance sound river basin management and strengthen the capacities of government departments to conserve water and rationalize abstraction. The first important step in monitoring river water abstraction was the installation and rehabilitation of river gauging stations along the main rivers in the basins. A series of assessments of water quality, availability and use were then undertaken at selected sites. The assessments comprise water sample analysis, periodic collection of river flow data, and water abstraction inventories, which entail the estimation of legal and illegal withdrawal points. The project is also facilitating establishment of a data-collection system responsible for monitoring river sediment load and sources of pollution.

River-water users' associations (WRUAs) are formed and prepared to be legally registered. Members of each WRUA receive training in irrigation system management, while leaders are trained in organizational management (e.g. collection of users' fees, accounting and administration) to ensure that WRUAs become self-sustained entities able to enforce regulations. An umbrella organization composed of the WRUAs in a river basin forms the main river users' association (RUA). RUAs are receiving technical and financial support to work in partnership with the district water departments to resolve water conflicts and address specific river basin management challenges. All river-basin management plans have been prepared and finalized through participatory processes. Water and sanitation campaigns are carried out to create awareness of environmental conservation, pollution and health.

Investment in infrastructure for domestic and irrigation water supply is another key strategy to improve water-use efficiency, reduce excess demand and supply an adequate quantity of water to communities. The project facilitated the construction and rehabilitation of gravity-fed irrigation schemes, small earth and concrete dams, and exploitation of groundwater through shallow wells and boreholes. This was combined with the introduction of rainwater-harvesting roofs and storage tanks, as well as development and protection of springs. Overall, thousands of participants are currently being served by these infrastructures.

Environmental conservation

This project component focuses on environmental conservation and rehabilitation of agricultural zones and protected areas, with particular regard to areas adjacent to rivers. The main aim is to reduce sediment load and pollution in rivers to improve water quality and increase season base flow to ASAL. The activities include rehabilitation of degraded areas and hilltops, and replanting in the

Mount Kenya Forest Reserve. This should improve the integrity of the ecosystem and its capacity to provide watershed services, such as water purification, groundwater and surface flow regulation, and erosion control. Woodlots and plantation forests are being established in communal trust lands to reduce vegetation destruction and pressure on forests. The project also supports on-farm forestry, as well as tree-planting on farms, at schools and other public institutions. This is accompanied by protection and restoration of wetlands and riverbanks. Road embankment works are also designed to reduce soil erosion, as roadsides are responsible for 10-20 per cent of the silt load in rivers. To meet the demand for planting material at the local level, commercial woodlots are being established, along with support to community and private-sector tree nurseries. Seedlings of indigenous species and of improved *Eucalyptus* spp. are distributed to communities in all the river basins. Participants receive training in tree nursery management, participatory forest management and environmental governance.

Rural livelihoods

This component is designed to increase food security and reduce poverty at the household level. The project is supporting on-farm integrated soil and water conservation measures, and fodder and pasture management practices, to increase agricultural and livestock productivity. Demonstrations are given in farmer field schools, where farmers test the performance of drought-resistant crops and kitchen gardens, while small livestock-raisers are trained in artificial insemination, and receive support for animal disease control, as well as dairy goats and high-breed chickens for cross-breeding with local breeds. Diversification of farm incomes is achieved through income-generating activities such as honey production, processing of food crops and better access to markets.

Community empowerment

The strengthening of local-level governance will enable the transfer to communities of collective responsibility for natural resource management. Towards this end, the project is organizing, legalizing and training local community institutions such as FDA committees, WRUAs and RUAs, and building the capacity of district technicians for service delivery. Special consideration is given to the full integration of women.

Contribution to adaptation

As climate change is very likely to impact Mount Kenya and the surrounding river catchments, MKEPP has a key role to play in contributing to adaptation and ensuring that the impacts will not be exacerbated by ecosystem degradation, unsustainable use of natural resources and population pressure.

Discussions with target groups revealed that glacier retreat is having a major impact. In the recent past, melting snow contributed to nurturing the rivers and keeping the catchment humid, while moderating the dry seasons. Currently, the early and shortened snow-melt periods have implications for rivers and springs, as dry season flows can no longer be supported and are declining progressively, while the land becomes drier and less productive. Forests are affected by increased occurrence of fires and slower regeneration of vegetation. Lack of melting water is also causing wildlife to migrate downstream in search of water and food, worsening the human-wildlife conflict. Overall, communities reported that the current major climatic hazards are glacier retreat, decreased and erratic rainfall, droughts and higher temperatures. The frequency, duration and intensity of rainfall is said to be unpredictable.

The lower catchment is most at risk, with shortage of rain being the most important driver of vulnerability. In the middle catchment, the major hazard is reported to be drought, while in the upper catchment, the main climatic risks are diminishing ice caps and reduced rainfall. Moreover, low water supply, poor crop and forage production, slow regeneration of vegetation and diminishing water levels in rivers, streams and springs have been experienced with increased frequency in all river catchments. All these effects are having a consistently negative impact on farm families' food

security, income, employment and health. The main coping strategies are to: (i) travel long distances to fetch water; (ii) build water-harvesting and conservation structures (e.g. dams, wells, retention ditches and trenches, intakes, roof catchments); (iii) invest in microirrigation; (iv) plant drought-resistant crops (some farmers); (v) apply manure or fertilizers; (vi) sell assets; (vii) search for casual employment locally; (viii) migrate; and/or (ix) accept donations and food distribution from the Government and other external sources of support. In the upper catchment, the forest plays a crucial role in most of the coping strategies: water flow is regulated by the forest; honey production occurs in the reserve; and farmers access the protected area to harvest NTFPs, cut grass and sell it as fodder. Most communities rely on natural resources, such as water, livestock and vegetation, that are both vulnerable to climatic risks and important for coping with these risks.

Despite these harsh conditions, MKEPP is contributing to strengthening the resilience of natural and farming systems to short-term climate variability, as well as to reducing participants' vulnerability to current climatic risks. It is promoting adaptation through a range of activities such as reforestation, improved water resources management and promotion of appropriate agricultural practices. The most effective practices were reported to be the introduction of infrastructures for water supply, rehabilitation of degraded lands and hilltops, protection of riverbanks through planting, and agroforestry. According to the views of local stakeholders and programme participants, some positive effects are already visible, for example vegetation and tree cover have been increasing; in the upper catchment, forest rehabilitation and protection have resulted in stabilization of the water levels in various rivers and reduced siltation in some areas. In the middle catchment, springs and streams dry for a shorter period. In the lower catchment, where there are no perennial rivers, infrastructures for improved access to water – such as water-harvesting tanks, earth dams and spring development – have enabled farmers to better cope with rainfall shortages.

Other MKEPP activities that can potentially support adaptation are: diversification of income generation activities and introduction of high-efficiency stoves to reduce wood consumption and strengthen the environmental conservation component. MEPP is also raising farmer's awareness and understanding of the significant role played by forests and vegetation in increasing water infiltration, controlling water run-off, protecting rivers and springs, and reducing the velocity of water flow in rivers. As a result of project interventions, trees are also valued for their capacity to decrease evaporation, increase water availability in dams and trenches on farms, and act as wind breaks and protection from storms. In the upper catchment, communities have developed a new sense of ownership of the forest, they feel responsible for its protection, patrol to avoid illegal farming and other unregulated activities, and report to the relevant authorities when necessary.

Even though MKEPP activities are already having a positive impact on the capacity of participants to face current climate variability, overall project impact needs to be consolidated and scaled up to play a significant role in climate change adaptation. It is expected that environmental conservation and rehabilitation will enhance the resilience of natural systems to climatic variations, to extreme events and, by extension, to climate change.

Other positive environmental, social and economic outcomes and results

Spring and shallow well development has reduced the distance travelled to collect water from 4 km to 200 metres, freeing women's time for other activities, and has doubled household water consumption, improving hygiene and health standards. Construction of irrigation schemes is expected to increase food production and improve nutrition and incomes from horticultural crops.

Moreover, as a result of training in tree nursery management, communities have been adopting tree nurseries as a revenue-generating activity. In Meru South, 500 women and 250 men earned more than 1.3 million Kenyan shillings (US$1,800) from the sale of seedlings. Tree planting is becoming a common practice as an environmental conservation strategy and future income-generating activity. Some farmers have established individual commercial woodlots, and women are taking the lead in tree management activities.

General, institutional and technological success factors

- The project introduced an innovative participatory approach to river basin management that is based on empowerment and the involvement of water users in decision-making. This was possible thanks to the new water bill, which gives a legal base and major role to CBOs in water management at the river basin level.
- The practices promoted by the project have been tested widely under field conditions in Kenya and elsewhere, and do not require advanced management skills beyond the capabilities of the farmers.
- Active community participation in and commitment to environmental conservation activities was triggered by the utilization of trees that provide both conservation benefits and immediate household income benefits, such as tamarind (*Tamarindus indica*), *Vitex doniana,* Marula (*Sclerocarya birrea*), or *Acacia senegalensis*, which is used for gum and resin extraction.
- Tree planting was accompanied by training of farmers and communities in indigenous seed collection and handling techniques.

Sustainability dimensions

- Design and approval of water schemes, illustration of the technologies proposed and organization for operation and maintenance are discussed and agreed on with the direct stakeholders. This approach ensures community ownership of the schemes. Moreover, the involvement of communities in mobilizing financial, human and material resources for the construction work is expected to avoid perpetuating dependence on outside support.
- Long-term enforcement of sustainable water use with minimum government involvement depends on the capacity of WRUAs and RUAs. For this reason, the legal registration of WRUAs is accompanied by a comprehensive constitution that clearly identifies membership and responsibilities in the maintenance of infrastructures, sets procedures for payment of water fees, and specifies penalties for none compliance with the rules.
- The long-term ecological effects of eucalypts should not be underestimated, and the short-term economical benefits should be carefully balanced against the ecological impacts. Natural forest regulates the catchment flow, and the degree of regulation depends on the ground cover. There is evidence from the humid tropics that young, rapidly growing eucalypt plantations consume more water and regulate flow less well than natural forests. Thus watershed protection and restoration can be achieved by restoring the original ecosystem and/or planting local and indigenous tree species. For this reason, indigenous fast-growing trees should replace planting of *Eucalyptus grandis* and *camaldulensis* in the project area, because if eucalypts are planted where there have been no trees before, the water yield of catchments is reduced and water tables are drawn down. Moreover, the strong surface roots of eucalypts mean that they compete vigorously with ground vegetation and with neighbouring crops in situations where water is in short supply. Thus eucalypts are not good trees for erosion control, especially under dry conditions, because ground vegetation is suppressed by root competition (FAO 1985).

Lessons learned

Water resources contribute greatly to economic productivity and to the social well-being of poor rural people, as both economic and social activities rely on the quality and quantity of fresh water.

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PROJECT SUMMARY **TITLE OF PROJECT: Mount Kenya East Pilot Project for Natural Resource Management (MKEPP)**		
TOTAL PROJECT COST:US$25.7 m	**IFAD CONTRIBUTION: US16.7m**	**YEAR OF APPROVAL: 2004**
EXPECTED COMPLETION: 2011	**STATUS: Ongoing**	**DIRECTLY BENEFITING: 60 000 households**

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5. Case study from Mongolia[125]

Fostering pastoralists' resilience and adaptive capacity to climate variability and extremes: IFAD's intervention in the livestock sector

The project in brief

The project area covers four of the poorest provinces in the country. Almost all of the rural families are poor or very poor. Families have limited food supply and practically no cash income. The long-term goal of the project is to help reduce poverty sustainably among vulnerable families who live in an environment with increasingly degraded natural resources. The project particularly targets single women with young children who live in rural centres, where they comprise 15 per cent of the population.

The project's overall objectives are to: (i) help herders and farmers increase production in a sustainable manner; (ii) help people increase cash incombe; (iii) offer increased access to economic and social resources such as basic financial services, education and health care.

General context and main development challenges

The average population density is the lowest in the world (1.7 people per km^2), and the total population reached 2.4 million people in 2000. The Mongolian economy depends on agriculture, mainly nomadic livestock production, which accounts for 33 per cent of GDP, industry and construction (27 per cent) and services (40 per cent). The industrial sector includes mineral extraction (e.g. copper, gold and coal), wool, cashmere and food processing. Economic development faces considerable challenges, including having an extreme continental climate, weak infrastructures and increased costs for social services. The country has been going through the difficult transition from a centrally planned to a market-oriented economy in the last decade (UNFCCC National Communication, in AIACC 2006).

Country vulnerability to observed and anticipated threats and impacts of climate variability and change

Mongolia has a semi-arid to arid climate characterized by four distinctive seasons, with a cold winter, dry, hot summer, high annual and diurnal temperature fluctuations, and low precipitation (200-220 mm/year). The climate is already changing, it is getting warmer and slightly dry. During the last 60 years, average spring precipitation has dropped by 17 per cent, the annual mean air temperature has increased by 1,56°C and the winter temperature by 3.6°C, with winter warming more pronounced in the mountain regions and less in the steppe and Gobi regions. Climate change projections for annual mean temperature increases are 1.8-2.8°C for the period 2000-2040, and 2.8-4.6°C by 2070, which will lead to an increase in the warm period and precipitation, a reduction in snow-covered areas and permafrost, and depletion of glaciers and snow sources that feed the rivers and lakes. This is expected to significantly affect the surface water balance, soil moisture and vegetation cover, and to be accompanied by a shift of natural zones northward – with a decrease of tundra and taiga regions and an increase of dry-steppe and desert areas by 2040. The compounding effect of desert expansion and a higher number of livestock is acceleration of desertification of the steppe and desert-steppe zones. Global warming scenarios indicate these areas are more vulnerable to small changes of climate variables than other regions, with disappearance of water sources,

[125] This case study was written by Elisa Distefano, Environment and NRM Consultant at IFAD, with inputs from S. Gun-Uyanga, Monitoring and Evaluation Officer, PSU, RPRP Programme, Erdenebaatar Batargal, Rural Development Expert, Centre for Policy Research, and A. Toda, CPM for Mongolia, as well as target groups.

degradation of pasture, reduction of annual peak-standing biomass up to 23 per cent, and direct influences on livestock production and thus on the entire national economy (UNFCCC 2001).

Current local climate risks

Mongolia's natural ecosystems are highly susceptible to degradation by natural and human impacts, and slow to recover. More than 60 per cent of the country's land has been identified as vulnerable to climate extremes. The peak of pasture biomass has already declined by 20-30 per cent during the past 40 years, with dominance of low nutrient plants (AIACC 2006). Natural disasters of meteorological and hydrological origin, such as sandstorms, snowstorms and flooding, have substantial effects on animal husbandry and crop production, and ultimately rural communities' livelihoods. Devastating weather hazards, such as drought and *dzud* [126], are common afflictions of nomadic pastoralists, with clear indications that their frequency and magnitude are increasing due to global warming (UNFCCC National Communication, in AIACC 2006).

Findings of participatory analysis suggest that current main climatic hazards are drought, *dzud*, black *dzud*, dust and wind storms. Since animals build up the necessary weight, strength and reserve during summer, drought is considered one important driver of vulnerability. Drought occurs from May to early September, its impacts are dryness and lowering of the water table, water shortage, followed by extended desertification, decrease of pasture carrying capacity, pasture degradation, low plant diversity, and increased presence of rodents and other pests. During drought, herders face reduced harvesting of hay and crops, low fattening and pregnancy in animals, and increased poverty. In winter, *dzud* results in reduction of pasture availability because of snow or ice cover, inaccessibility of water sources, higher incidence of livestock diseases and mortality, ultimately leading to increased poverty.

Black *dzud* causes poor water availability, total deterioration of pasture, early exhaustion of livestock and lameness. Long-lasting thick snow cover adversely affects animal-raising by limiting access to pasture. On the other hand, the snow cover provides a water source in a season when all surface water is covered by thick ice and in areas that, due to lack of water, cannot be used for pasture otherwise. In addition, lack of snow precipitation and earlier melting of snow cover limit the spring pasture biomass. Thus, *dzud* results in a reduction of pasture size, while black *dzud* results in shortages of water for wintertime animal watering. In spring, wind and dust storms remove the topsoil, damage the vegetation cover, and lead to acceleration of desertification, with shifting sands covering pasture, small rivers and springs. In this period animals die in large numbers and some become lost. The most affected zone is the semi-steppe, with sandy soils, the most vulnerable are poor herders with less than 200 animals, woman- or single-headed households, who do not have the resources to move or to obtain emergency supplies of hay and fodder.

Government prioritized adaptation interventions and coping strategies

Mongolia developed its National Action Programme on Climate Change in 2000; it includes high-priority adaptation measures for the animal husbandry, rangeland and farming systems. Their focus is to: (i) foster public awareness and education of herdsmen on climate change impacts; (ii) restore natural hay land and improve forage production systems; (iii) apply modern pasture water supply systems; (iv) establish an appropriate risk management system, particularly by establishing security funds in the form of hay, forage and cash reserves at national and community levels; (v) strengthen the early warning system within the National Meteorological and Hydrological Services; (vi) develop an insurance system for livestock and crops with respect to natural disasters; (vii) regulate the number of livestock according to the capacity of the land; (viii) diversify the revenue sources of local people; and (ix) improve the health-care system for people and animals. These objectives should be

[126] *Dzud* is caused by heavy snowfall, extremely low temperatures, or drifting windstorms that reduce or prevent animals from grazing. This phenomenon leads to widespread animal mortality because of hunger, freezing and exhaustion (AIACC 2006). The absence of snow in winter is also a type of *dzud* ('black *dzud*').

accompanied by adaptation measures that prevent soil degradation and desertification in pastureland, namely, (x) improvement of legislative mechanisms for pasture use, with a focus on local communities; and (xi) restoration of forest in degraded areas. On the other hand, some of the prioritized interventions aimed at anticipating adverse effects on crop yields are: (xii) development of new crop varieties that have higher tolerance to pest and disease, and are more resistant to drought; (xiii) cultivation of alternative crop species; and (xiv) sowing and planting dates in accordance with expected precipitation and temperatures (UNFCCC 2001).

Description of project activities and key practices enhancing adaptation

RPRP is designed to address some important issues. The first is the growing imbalance between resources and herd size, which contributes to rangeland degradation; the second is lack of quality social and financial services. Other issues tackled by the project are the limited quality of livestock produce, poor access to markets and unemployment. The programme is implemented in four of the poorest *aimags* (provinces) in the country: Arhangai, Bulgan, Hentii and Huvsgul, where the predominant farming system is semi-nomadic herding on open rangelands. The area of implementation comprises diverse rangeland types: the high mountain zone characterized by meadows and coniferous and deciduous forest slopes; the forest steppe zone characterized by lower hills with forests and large, open grazing areas; and the steppe zone characterized by flat to gently rolling hills with wide-open areas. RPRP intends to benefit primarily the herder households with less than 500 head of livestock, with women being a significant part of the target group, through the following components: (i) livestock and natural resource management; (ii) other economic activities; (iii) rural financial services and (iv) social development activities. This case study focuses on the activities implemented in Bulgan *aimag* under the first component.

Rangeland management systems

IFAD is introducing a promising innovation in Mongolia, in terms of developing local institutions for natural resource management and rural development. Rangeland management and monitoring committees (RMMCs) are being established at *bag* (subdistrict), *soum* (district) and *aimag* levels, composed of herder group representatives, government officials and residents of the local centres. RMMCs are empowered to formulate the local NRM maps and associated development plans. The resource maps represent the distribution of grazing area, hay land, water sources, forest and protected zones, as well as infrastructure such as urbanized areas, roads, schools and hospitals. Maps are drawn up through a participatory process involving the whole community and assisted by relevant staff. On the basis of these approved maps, the *bag* RMMC members identify timing of seasonal migrations, location of winter camps and reserved areas, and allocation of grazing and hay lands according to herd size and composition.

All decisions on land allocation and use are made within the legal framework and the land law. They are made through a participatory process and followed by the issuing of possession licenses to users. As the legal authority, the *bag* governor approves decisions made by the RMMC and presents the proposals to the *soum* parliament, where they are discussed, consolidated and approved. This document is then forwarded to the *aimag* authorities, and in particular to the programme implementation unit (PIU) for approval. At this stage the plan is given legal status and becomes a reference instrument for the herder community and legal authorities. It will form the basis for local area implementation planning and land dispute resolution. This process is currently enhancing community mobilization and local public consultation in decision-making on natural resource management. Moreover, it is promoting customary migration and grazing rotation schemes and the use of remote and often underexploited pastures, and thus has a significant impact on pasture management. RMMCs are becoming the most viable and functioning local institution for bottom-up planning and delivery of information from government to the citizens.

RMMCs are also involved in the rehabilitation and maintenance of wells, and in research on ecologically sound rodent control, two additional factors contributing to the degradation of rangelands. Increased water availability reduces the exhausting travel of livestock to water sources on spring pasture and contributes to the reduction of mortality. Access to water allows the use of otherwise inaccessible rangeland in winter and spring, and the recovery of overgrazed areas. In addition, water from rehabilitated wells reduces the time allocated to fetching water and ameliorates hygienic conditions and household health status.

RMMCs are expected to be an important institution in the event that people need to migrate from *dzud*-affected areas to *dzud*-free ones. These migrations need to be coordinated on a provincial, even national, level and the RMMCs can organize and advise migrating herder families. However, herders are also encouraged to establish their own winter hay/fodder reserves, sufficient to provide emergency feeding to their animals, with the support of training in and demonstrations of appropriate hay-making techniques, land preparation for seeding, use of improved grass/legume seeds and the correct application of natural and mineral fertilizer. Assistance in mechanization of hay-making, such as small tractors, is also strengthening the groups' capacity. Increased winter fodder production reinforces preparedness for harsh climatic conditions, improving the nutritional status of animals during winter and spring, thus substantially raising survival rates and livestock performance. When animals recover well from the harsh winter, they respond with higher outputs, with subsequent higher revenue for the herder household (IFAD 2002b, 2007b).

***Dzud* emergency fund**

In the effort to enhance the resilience of herder households to unusual weather phenomena and to mitigate the worst effects on the poorest people, RPRP established a *dzud* emergency fund. The fund can be used for: (i) acquiring emergency fodder/hay supplies for herders, to be distributed on a grant basis; (ii) livestock re-stocking on a grant basis for herders whose stock losses amount to 50 per cent or more of their initial herd; (iii) redistribution loans for herders whose losses are estimated at from 25 to 50 per cent of their initial herd; and (iv) purchase of fodder. By way of discouragement of careless management practices, emergency assistance levels would be reduced by a predetermined percentage of the claim for applicants that did not have adequate shelter for their herd and, again, if vaccination and parasite control had not been carried out regularly and on their entire herd. In addition, less generous arrangements are applied in *soums* that had allowed their herds to grow faster than the rate agreed under the RMMC resource management plans (IFAD 2002b).

Livestock support services

RPRP also addresses the spread of endemic livestock disease, which harms livestock production and quality, and hence the food security and income of herder households. IFAD is rehabilitating veterinary laboratories, re-establishing mobile units to ensure outreach to remote areas, and supporting the emerging private veterinary sector through training and financial assistance for disease control equipment and medicine. The livestock and breeding extension system is also being revitalized to increase the productivity of the herd without significantly changing the herd size and the impact of grazing on natural resources. These activities are establishing an effective surveillance system for animal diseases, while strengthening the resilience of herders to external shocks, such as major outbreaks of infections. The improved animal health services are having measurable impacts on the quality of livestock production and safety of food products (IFAD 2002b, 2007c).

Contribution to adaptation

The foremost factor influencing the vulnerability of rural people is climate, and poverty is inversely correlated with the capacity to maintain a viable herd size. Animal growth and productivity depend on pasture size and quality. Conserving and restoring natural resources, and fostering a balanced management of human activities, are thus the most effective measures to ensure viable livestock

husbandry (IFAD 2007a). Consultations with pastoralists revealed that they have developed a series of strategies to cope with the different effects of climatic hazards, as illustrated in figures 1, 2 and 3. Herders respond to **drought** through OTOR,[127] perform rotational grazing or suspend grazing in degraded pasture for resting during summer, and protect headwaters of springs and rivers with fences, stones, trees and bushes. They also establish forest management partnerships among local communities and engage in localized reforestation to reduce land dryness and acceleration of desertification. Building additional hand and drilled wells is another common measure.

Herders prepare for ***dzud***, making hay in the summer. During *dzud*, when grazing becomes difficult and water sources inaccessible, they buy prefabricated fodder, integrate animal feeding with the traditional way of making handmade fodder, using different palatable plants mixed with horse liver, cow milk, natural soda and other ingredients. As livestock diseases and mortality increase, herders seek veterinary advice, administer drugs and make use of traditional medicine. OTOR and emergency migration are two strategies adopted to cope with both *dzud* and black *dzud*.

The high mortality rates for livestock that many herder families experienced during three consecutive winters from 1999-2002 demonstrate that the traditional strategy for mitigating the effects of *dzud* has reached its limits. One of the reasons seems to be the rising livestock numbers that have locally resulted in high grazing pressure. This prevents rangelands from recovering completely before the onset of winter. Hence, animals are not able to find sufficient feed. Another reason for the high livestock losses was certainly that many herders were not able to move in time to non *dzud*-affected areas. During **black *dzud***, herders tend to bring animals closer to water sources to reduce the walking distance, and to apply lubricants to hoofs to address livestock lameness, which is caused by extensive wandering in search of water. IFAD's intervention is providing concrete support to some of the most common and effective coping strategies, and thus supporting spontaneous adaptation.

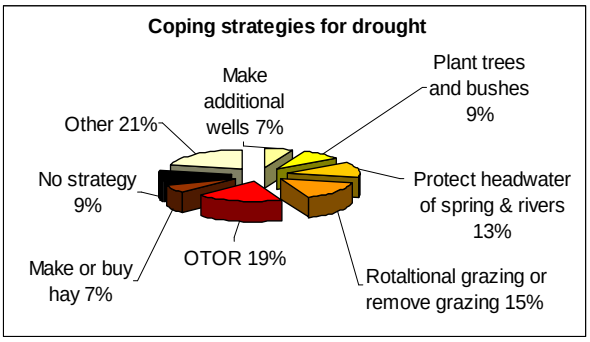

Figure 1: Frequency of different strategies adopted by herders to cope with the impacts of drought. The category 'other' includes: encourage exploitation of unused and underused pasture, adjust the herd size to carrying capacity, embark on non-herding income-generating activities, combat rodents, request help from Government

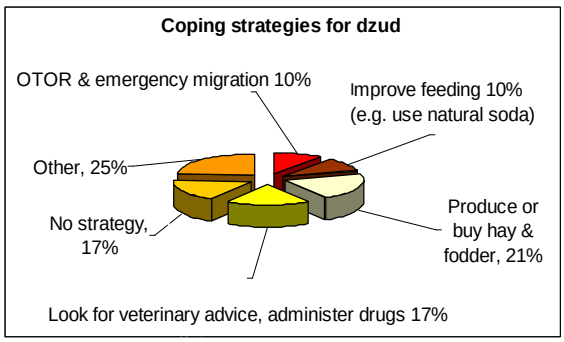

Figure 2: Frequency of different strategies adopted by herders to cope with the impacts of *dzud*. The category 'other' includes: approach Government, donors and RMMC for help, slaughter animals to sell, use of traditional medicine.

[127] 'OTOR' is the pasturing of livestock in groups, seeking good pasture away from regular pastures. Herders can move within a *bag* or *soum* or to other *soums* or *aimags*. The movements are organized and coordinated by the local government.

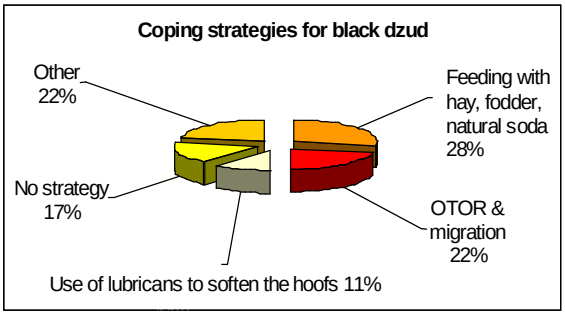

Figure 3: Frequency of different strategies adopted by herders to cope with the impacts of *dzud*. The category 'other' includes: livestock attendance, search for dispersed animals, administer drugs.

Participatory discussions with herder groups and RMMCs demonstrated that they rely on natural resources, such as pasture, land, water and livestock that are both vulnerable to climatic risks and important in coping with these risks. However, herders depend on other physical, financial and social assets, such as financial resources, knowledge and experience, communication and transportation facilities to implement effective adaptation strategies. It is worth noting that RMMCs and herder groups, established and organized by IFAD, scored highest among all the livelihood resources and were considered of pivotal importance by project participants and local government in preparing for and responding to natural calamities (figure 4). Participants acknowledged that group formation allows for division of labour, which facilitates mobility and promotes productivity and the diversification of livelihood strategies. The enhanced capacity for mobility gives the groups important advantages: in the case of *dzud*, strong livestock can be brought to other areas, while enough labour is available to stay with small and weakened livestock. Collective action and labour division allow for more time to engage in activities for value addition. Moreover, herder groups and RMMCs fulfil an important role in improving pastureland and livestock management through joint decision-making and collaborative management (IFAD 2007b).

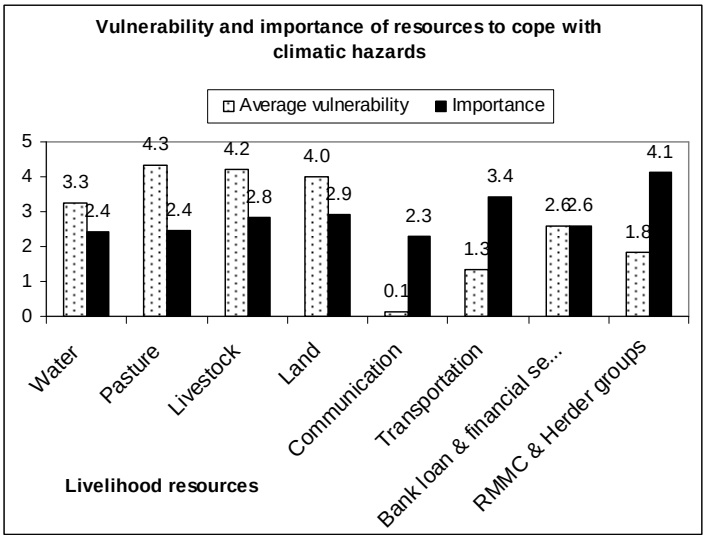

Figure 4: Degree of vulnerability (score from 0 to 5) of resources to climatic variability and degree of importance to coping strategies.

Findings of participatory analysis suggest that RPRP is contributing to reducing stakeholders' vulnerability to current climatic risks and to enhancing the resilience of natural systems to these risks. The programme is promoting proper pasture management and has been effective in revamping traditional practices and introducing new practices through training, research and demonstrations for local administrators, government officials and herders. Decision makers reported that the survey and assessment of pasture conditions performed by the Nomadic Research Centre was pivotal to (i) identify degraded pastureland to be preserved for regeneration; (ii) determine locations for well rehabilitation; and (iii) delineate zones to be fenced for hay production. Remote unused and underused pasture is now accessible owing to the rehabilitation and construction of new wells. This strategy is releasing the pressure on degraded pasture and was reported to be particularly sustainable, as potential grazing land is available but not easily accessible. Resource mapping was also considered essential in improving the use of pastureland, as herders identify the distribution and status of resources through maps, plan and monitor community-based action plans, and are empowered to regulate the use of pasture land and water points. Support for winter preparedness was acknowledged to reduce losses of animals and result in better risk management.

There was also general consensus among participants in group discussions that the establishment and organization of herder groups is building local adaptive capacity of herders to overcome natural disasters with minimum losses. RMMCs are playing an important role in representing herders' interests in the planning and regulation of local land use, and pasture management at *bag, soum* and

aimag levels. RMMCs are acquiring the status of NGOs and are expected to negotiate with the Government and private companies on the use of natural resources, as well as to facilitate liaising and linkages between the herders and the Government. As pasture is a common property and there are no Government regulations to restrict the herd size, coordination of herders' activities to regulate pasture use, monitor compliance of regulations and limit conflicts and overgrazing is crucial.

It can be concluded that IFAD is supporting climate-risk vulnerability reduction through optimization of the use of natural resources, promotion of alternative income-generating activities and improvement of social services such as schools, hospitals and animal health services. RPRP laid the foundations for increasing the resilience of the ecosystem and herder's livelihoods to current climate variability and extreme events. However the measures adopted might not be sufficient to reduce the risks of incoming climate change impacts.

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PROJECT SUMMARY **TITLE OF PROJECT:** Rural Poverty Reduction Programme (RPRP)		
TOTAL PROJECT COST:US$19.1 m	**IFAD CONTRIBUTION: US$ 14.8m**	**YEAR OF APPROVAL: 2003**
EXPECTED COMPLETION: 2010	**STATUS: Ongoing**	**DIRECTLY BENEFITING: 80.000 households**

Contact: Ms Ariko Toda, IFAD Country Programme Manager a.toda@ifad.org

6. Case study from Brazil[128]

Adaptation to climate variability in north-eastern Brazil's Sertão Region:

Transforming the semi-arid zone and facilitating coexistence with dry conditions

The project in brief

The project area is among the most disadvantaged in the country in terms of access to housing, sanitation, education, health services and employment. Poor soils and severe cyclical droughts are major obstacles to agricultural productivity. The overall objective of the project is to introduce sustainable improvements in income and living conditions for poor agrarian reform settlers and neighbouring smallholders. Project activities specifically target groups that are generally discriminated against, particularly women, youth and ethnic groups such as Brazilians of African descent.

Specific goals of the project are to: (i) improve agricultural and small business management skills; (ii) improve market linkages; (iii) improve production technologies adapted for semi-arid climates; (iv) teach water management techniques; (v) provide support for marketing, small agro-industries and rural enterprises; (vi) create a production investment fund.

General context and main development challenges

Brazil's gross national income per capita is US$4,730, which situates it in the upper-middle-income country category according to the *World Development Report 2008* (World Bank 2008). Overall macroeconomic conditions are good, favourable to strong growth.

Agriculture is an important source of exports and employment in Brazil. Exports of agricultural products account for 22 per cent of total exports, while agricultural employment is close to 20 per cent of all employment. The agribusiness complex has grown to almost 30 per cent of GDP, and rural non-agricultural incomes and employment have also expanded. Agriculture has been growing fast in the last two and a half decades, particularly in recent years. With the exception of 2005, when exceptionally bad weather conditions prevailed in the south, agriculture has grown more than GDP. All main crops – sugarcane, soybeans, maize, oranges, rice, cotton, coffee, tobacco and cocoa – have expanded. And so have livestock products, mainly poultry and beef, of which Brazil is a leading world producer. Family agriculture is important in Brazil; it accounts for 85 per cent of farms, 30 per cent of the farming area, and employs some 14 million people in more than 4 million farms. In the north-east, family agriculture is even more prominent, where it accounts for 88 per cent of farms, 44 per cent of the farming area, and employs 7 million people. Rural poverty concentrates mainly in the north-east semi-arid Sertão Region, where the incidence of poverty exceeds 80 per cent (IFAD 2008a,b; World Bank 2008).

Country vulnerability to observed threats of climate variability and anticipated impacts of climate change

Current knowledge of the regional dimensions of global climate change is still very fragmented for a country as vast as Brazil, owing to lack of reliable future climate scenarios (UNFCCC 2004). However,

[128] This case study was written by Elisa Distefano, Environment and NRM Consultant at IFAD, with inputs from Walmar Jucá, Project Planning Coordinator and I. Cossio, CPM for Brazil, and target groups.

a study on climate change vulnerability for the northern states, released in 2008 by Brazil's National Space Research Institute, found that the region will become hotter and drier, with reductions in rainfall of 2-4 mm less per day than current levels by the 2071-2100 period. Average regional temperatures – from the western portion of Pará eastward through to north-eastern Brazil – are expected to rise by 4°C in the optimistic scenario, and by 7°C in the pessimistic one. Precipitation in western Pará and northern Maranhão is projected to drop 20-40 per cent under the optimistic scenario, and 40-60 per cent under the pessimistic one. The study concludes that the region has a very high climatic vulnerability, is expected to have a drier climate, with some areas receiving heavy rains concentrated in short periods, followed by long periods without rain and with high temperatures. Accordingly, the hydrological balance may change, with future periods of water deficit that will affect the native vegetation and regional agriculture.

Brazil is directly affected by the El Niño Southern Oscillation, which brings droughts and reduced rainfall during its warm phase. The Brazilian semi-arid areas, found mainly in the North-East Region, are the most susceptible to drought, and characterized by high evaporation, shallow soils, high salinity, low fertility and reduced water retention capacity, which restrict its productive capacity. Moreover, these areas are prone to desertification, a phenomenon that is intensified by poverty. The potential effects of climate change on the agricultural sectors have been studied using different General Circulation Models. A sensitivity analysis was conducted on different agricultural climate regions (e.g. subtropical, tropical and semi-arid) to assess the effect of increase in temperature, changes in rainfall and in atmospheric concentration levels of CO_2 (550ppm) on the production and physiology of agricultural crops such as wheat, corn and soybean. The results indicated that the North-East Region is especially vulnerable to decreased corn production. Analysis of adaptation strategies based on technologies such as the use of irrigation and new cultivars, changes in planting dates, and nitrogen fertilizers demonstrated that these would help mitigate the impacts of climate change on the productivity of the crops affected, but would not be sufficient to compensate for all the losses projected by the scenarios generated.

Local context and current local climate risks

The project is operational in six states of the North-East Region, where rural workers have been settled in the last ten years. These states are characterized by high incidence of rural poverty and the lowest socio-economic indicators of the country (for housing, sanitation, education and health services). Poverty is also closely related to a restriction of water supply, poor soil and difficult climatic conditions of the semi-arid areas. Limited access to agricultural resources, associated with limited training and experience of agricultural production technologies adapted to semi-arid conditions, have been leading the migration of large numbers of people to urban areas. Smallholder farmers are also critically affected by lack of existing financial resources and few linkages to local and regional markets.

The climate of the Sertão Region is tropical, with local variations from tropical humid to semi-arid. Annual average temperature is 27.4°C, with an average maximum of 32.6°C in October and an average minimum of 22.5°C in July. The region is under constant climatic vulnerability, precipitation is concentrated into three months and varies from 250 to 800 mm/year. The region is subject to cyclical, severe regional droughts. The risk of drought incidence varies within states and municipalities because of the presence of microclimates, river courses and topographical variations. Yearly intervals for drought occurrence range from seven to ten years for most locations (IFAD 2001, 2008a).

Findings of participatory analysis suggest that the current main climatic hazards are: increase of temperature and extremes, irregular distribution and concentration of rains, and dry periods that occur seasonally from February to July. The impacts of temperature increases and prolonged dry periods are: enhanced evapotranspiration and evaporation, reduction of the reproductive potential

of the *caatinga*, [129] and increased fires, accompanied by reduction of water availability and greater water consumption. Higher temperature also has a negative impact on soil fertility, germination and the growth of plants, and on incidence of pests, negatively affecting agricultural production. Moreover, higher temperatures mean that more labour is necessary to maintain a productive agricultural system, while stressing human health and limiting the capacity to undertake heavy work. On the other hand, irregular distribution of rains and prolonged dry periods result in a decreased water supply, reduction of pasture and decline in animal and crop production. Conversely, concentration of rains causes floods and difficulty in accessing the villages, damage to water reservoirs, changes in the course of rivers, soil erosion and river siltation.

Two important environmental issues in the North-East Region are that precipitation is unevenly distributed in time and space and mainly concentrated in three-to-four months in the year, and the groundwater table is not adequately recharged, with high downstream flow and evaporation. The reduction of rainwater infiltration is a process that started in the 1970s as a consequence of deforestation, burning of the natural vegetation, intensive cultivation, mechanization of agriculture and lack of soil protection. The availability of water in the *caatinga* is not homogeneous. For this reason, allocation of land is based on equal and fair distribution of water: the average dimension of properties in the areas in proximity to rivers, streams, springs or underground water is 2-3 ha, while in the more arid areas the dimension can reach 10-15 ha to compensate the reduced land productivity.

Description of project activities and key practices enhancing adaptation

Projeto Dom Helder was designed to contribute to the sustainable improvement of social and economic conditions of poor agrarian reform settlers and neighbouring smallholders. It consists of three components: (i) training and organization, (ii) production and marketing development and (iii) financial services. This case study focuses on the second component and specifically on the introduction of agricultural technologies adapted to semi-arid conditions, as well as promotion of irrigation schemes and technologies to ensure efficient provision of water and the expansion of the area under irrigation. The target group consists principally of families that live in federal or state agrarian reform settlements and have a monthly income of less than two basic salaries (about US$235 equivalent) derived from agriculture, livestock production, small business and rural wages (IFAD 1997 and 1998).

The project is addressing the problems of uneven distribution of rain, aridity of land and reduced infiltration through technical assistance services based on demonstrations and a combination of training and credit to ensure that farmers adopt the technologies appropriate to the weather conditions and availability of natural resources. Diversification of the techniques and practices promoted is essential in the ecosystem of *caatinga*, characterized by ecological heterogeneity and more than 150 different environments. A great emphasis has been given to improved access to water for household consumption, primarily through the construction of tanks. This initiative has also been supported by the Federal Government through the One Million Cisterns Program, which was launched in the semi-arid region by a group of civil society organizations. The tanks have a storage capacity of 16,000 litres, can be filled with only 200 mm of precipitation and supply good quality water sufficient to cover family consumption for a year. Another important achievement in water storage and management is the introduction of small underground dams and different types of wells (*poços amazonas*, *poços artesianos*). The underground dam is a technology that allows the capture and storing of rainwater under the soil, without flooding the best land for planting. It increases the availability of water for cultivation, which can be used for irrigation with little

[129] Within the Sertão, *caatinga* is the predominant vegetation, found only in Brazil. It is composed of xerophilous and prickly species, and in minor proportion grass species. It is characterized by rich biological diversity and high rates of endemism (IFAD 2001).

expenditure of energy and guarantees the production of grain and forage, even in years of drought. These practices are ultimately having positive repercussions on the availability of drinking water for families, preventing health problems associated with unsafe water sources used in the past and reducing the effort to fetch water from distant places. There is also a consistent minimization of climatic risks associated with seasonal dry periods and cyclical droughts, as the water from wells and dams is used in small-scale irrigation.

Projeto Dom Helder is also promoting the diversification of production and consumption of participating families. It has introduced practices such as irrigated organic horticulture, bee-keeping, fish farming, and the raising of *caipira* hens, sheep and goats, to improve productivity and product availability throughout the year. The project is also assisting farmers in improving the quality of products. Access to markets is a pivotal strategy to maximize project impacts, and has included the construction of processing infrastructures, establishment of agroecological markets at the municipal level and support to the marketing of products in local fairs and in Federal Government purchase programmes. The fairs allowed farmers to sell their production directly to final consumers, bypassing middlemen. The sale of produce represented an important source of income for the families (PDHC 2006 and 2007).

In semi-arid areas, raising small animals is the main alternative for generating income within a diversified production system. However, feeding animals during droughts or prolonged dry periods is a serious problem, and farmers often lose their herds or are forced to sell the animals. The process of decimation of the *palma forrageira*, the main feed source in periods of drought, began in 1999 and was caused by a pest that destroyed the plant, leaving farmers without an alternative. In this context, the project is revitalizing cultivation of the *forrageira* and introducing the *palma doce* (*Nopalea cochenillifera*), intercropped with sorgo (*Sorghum bicolor*), guandu (*Cajanus cajan*) and gliricidia (*Gliricidia sepium*). They are grown in a diversified system that ensures feed reserves in time of scarcity. Conservation of fodder is then performed through anaerobic fermentation, after cutting, compacting and sealing in silos. This strategy intends to prepare farmers for the dry season, and help them overcome the negative impacts of lack of fodder on animal health and productivity. Training in agroecological technologies and practices for the production and conservation of fodder is improving the supply of animal feed, and reducing malnutrition and mortality in herds. In addition, improved food availability for livestock based on *caatinga* management techniques, the introduction of forage species compatible with it (mainly leucena (*Leucaena* spp.), palm and *Gliricidia* spp.) and the use of conservation techniques of fodder prevent overgrazing during times of low productivity of natural pastures.

Veterinary assistance leading to improvements in the raising of cattle, goats, sheep and chickens, accompanied by conservation of fodder in low-cost silos, allows livestock to overcome periods of harsh climatic conditions and to continue to produce quality outputs during the dry season. Some farmers are producing more feed than they need and have begun selling it to others. Their example is promoting a behavioural change, as they are gradually followed by other members of the community. Adoption of the practice is facilitated by the fact that farmers can train others, thus visits of farmers from other communities or settlements from the same territory and even other territories have been organized to support scaling up and replication of the practice (PAAF 2003; PDHC 2007).

Contribution to adaptation

Consultations with farmers revealed that the communities are gradually introducing important changes, shifting from their traditional subsistence, rainfed production practices to drought-resistant diversified production systems. IFAD is not only supporting some of the farmers' spontaneous adaptation strategies, but is introducing innovative coping strategies. Farmers respond to the increase in temperature by: (i) diversifying cultures and combining the incomes from crop and livestock-raising; and (ii) performing natural pest control, using organic fertilizer and mulching to

facilitate plant growth and germination. Some of the most common and effective strategies deal with (iii) improved management of water resources, which is strongly supported by IFAD through the introduction of simple techniques for localized irrigation (e.g. drip and sprinkler irrigation). This is accompanied by infrastructures to harvest and store rainwater, such as small superficial and underground dams, wells (the *poços amazonas* and *poços artesianos* mentioned earlier), tanks connected to the roof or a 110 m^2 concrete catchment area (figures 1 and 5).

Project participants stated that the introduction of water management practices allowed production during seasonal dry periods, drastically reducing the need for supplementary employment off-farm. The construction of wells and irrigation systems enabled the community to produce during seasonal dry periods, when other farmers could not produce for lack of water. During this period, regional agricultural production decreased, participants' products gained additional value and could be sold at a higher price. In order to maximize benefits, IFAD established a series of agroecological markets, where farmers can sell their agroecological products at a premium price, creating new employment opportunities for every family member. The agroecological markets, coupled with the possibility of continuing production during dry periods, decreased farmers' vulnerability to climatic hazards through creation of a secure source of income. A spillover effect is that the increased income is partially invested in the protection and restoration of the *caatinga*, which plays a key role in enhancing rain water infiltration and reducing evaporation, as well as in ensuring higher diversity of plants on the farm, and balancing the presence of pests and plagues. Conserving and restoring the *caatinga* and fostering a balanced management of human activities are among the most effective adaptation measures.

Thanks to IFAD's intervention, farmers have realized the importance of (iv) diversifying their livelihoods, and are engaged in bee-keeping, processing of cashew and fruits to produce snacks, sweets and jams, and the production and marketing of organic crops. In this context, the project played an essential role in the establishment of processing units. In the case of cashew, for example, the unit increased its value from 1 Brazilian real (US$0.42) for 1 kg of raw cashew to 4 reais (US$1.68) for 1 kg of processed and packaged cashew (figure 6).

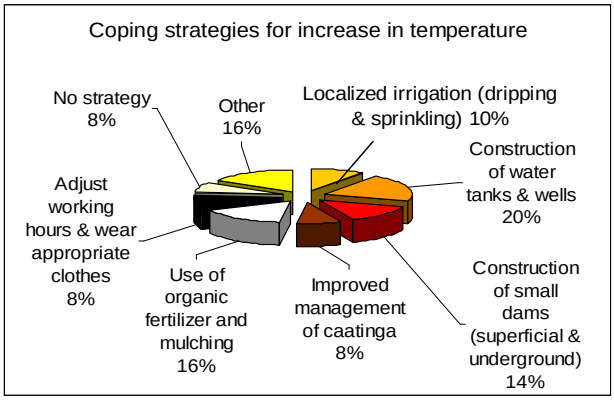

Figure 1: Frequency of different strategies adopted by farmers to cope with the impacts of increase in temperature. The category 'other' includes: diversification of cultures, e.g. cashew, natural control of pests, adjustment of irrigation timing, and adoption of soil and water conservation techniques.

Farmers respond to irregular distribution of rain by: (v) planting more resistant crops and fodder, or early maturing varieties; and (vi) constructing water tanks and small dams. (vii) Use of species from the *caatinga* to feed livestock is another essential strategy (figure 2). Farmers rely on (viii) small-scale irrigation to produce crops during seasonal dry periods; and prepare for prolonged dry periods by (ix) building tanks, wells and small dams (figure 3). Production and storage of fodder (x) is another common measure, which enhances the capacity of livestock to face seasonal dry periods, when this resource is extremely limited. This practice allows the saving of financial resources that were formerly spent for the purchase of fodder, as well as saving time, because farmers do not have to travel long distances to graze the animals. In addition, fodder production involves planting some

species that protect the soil (e.g. *capim elefante* – *Pennisetum purpureum*), and when planted at the margins of rivers stabilize the riverbanks.

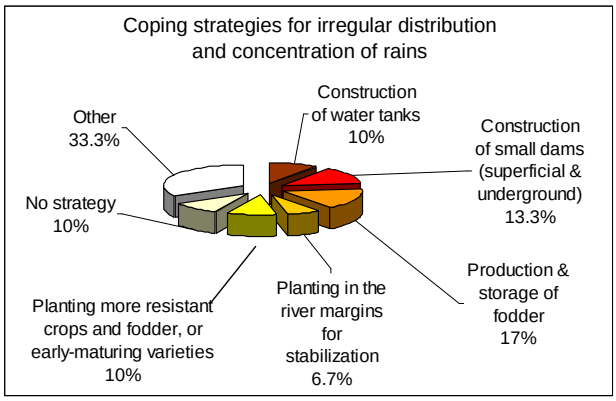

Figure 2: Frequency of different strategies adopted by farmers to cope with the impacts of irregular distribution and concentration of rains. The category 'other' includes: exploitation of plants from the *caatinga*, localized irrigation, natural control of pests, and adoption of soil and water conservation techniques, vegetable production.

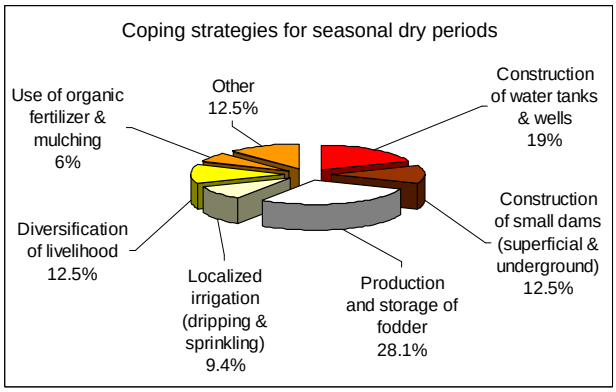

Figure 3: Frequency of different strategies adopted by farmers to cope with the impacts of seasonal dry periods. The category 'other' includes: conservation of fodder seeds in seed banks, improved management of *caatinga*, adjustment of irrigation timing. Diversification of livelihoods includes: cashew processing, bee-keeping, vegetable production and market sales.

Participatory discussions with farmers revealed that they rely on natural resources, such as superficial water, land and labour that are both vulnerable to climatic risks and important in coping with these risks. However, farmers depend on other natural, physical and social assets, such as underground and stored water to implement effective adaptation strategies. Project participants considered knowledge from, and education and technical support by, project staff of pivotal importance in responding to climatic hazards. Infrastructures for food processing are the least vulnerable. Women recognized the value of being engaged in alternative income-generating activities and feel proud to contribute with their labour to the family income (figure 4).

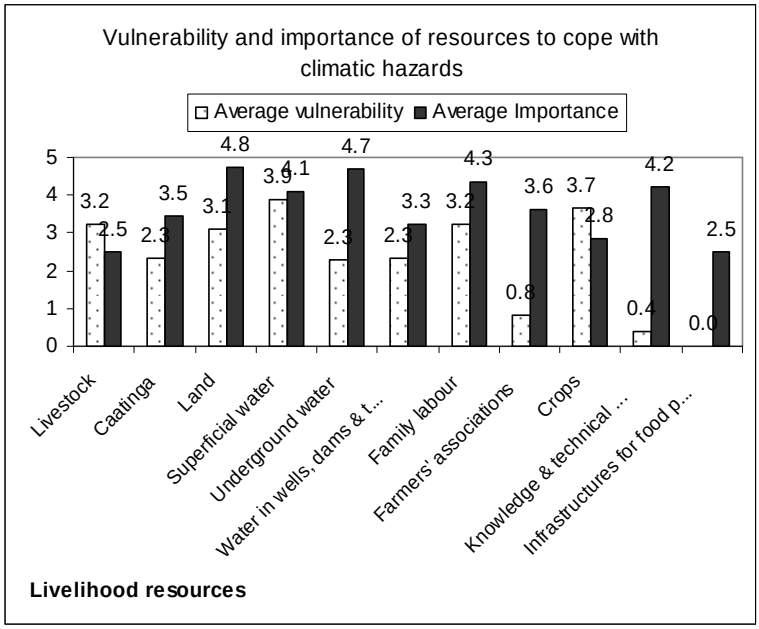

Figure 4: Degree of vulnerability (score from 0 to 5) of resources to climatic variability and degree of importance to coping strategies.

Increased frequency and severity of climatic hazards will have a negative impact on farmers, who depend strictly on natural resources for their survival. However, Projeto Dom Helder is demonstrating that sustainable agricultural production and food security are possible in the Sertâo. The construction of water infrastructures to store and harvest water is contributing to reducing participants' vulnerability to concentration of rains and seasonal dry periods. Small irrigation systems are playing an important role in ensuring agricultural production during prolonged dry periods, and are building the adaptive capacity of farmers to coexist with uneven distribution of rains and arid conditions. Both soil and land are more resistant and resilient to climatic risks as a result of project training in and demonstrations of techniques to increase soil fertility, reduce land aridity and evaporation. Support for production and storage of fodder was acknowledged to reduce animal losses during prolonged dry periods and result in better risk management. The project is also supporting climate risk vulnerability reduction through promotion of alternative income-generating activities, such as cashew and fruit processing. It can be concluded that IFAD's intervention has laid the foundations for increasing the resilience of farmers' livelihoods to current climate variability and extreme events. The techniques and practices fostered are concrete, simple and can be adopted and replicated on a larger scale once incorporated in government and civil society policies.

General, institutional and technological success factors

Some key elements that are contributing to the success and sustainability of the project:

- Administrative functions and decisions regarding project interventions have been largely transferred to stakeholders' organizations and local institutions. The annual work plan and budget is based on the plans proposed by each settlement/community association. The yearly planning process is carried out through intensive consultation with and active participation of participants. Social mobilization agents play an important role in convoking the community and facilitating the process, which also involves permanent technical assistance by local NGOs. The compatibility of these plans at territorial and project level is then analysed in function of project capacity and budget.
- The project is cofinancing activities with NGOs and other local institutions, engaging in an extensive partnership with civil society representatives to support institutional strengthening and to ensure participants' involvement in decision-making. Specific activities were implemented that facilitate the transfer of responsibilities to local institutions and ensure successful implementation of the exit strategy.
- The sustainability of the technical solutions promoted by the project is high. They are very productive and appropriate to the semi-arid ecological conditions and economic conditions of farmers. Most of the practices involve simple technologies, low investment costs and low-cost inputs.

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PROJECT SUMMARY		
TITLE OF PROJECT: Sustainable Development Project for Agrarian Reform Settlements in the Semi-Arid North-East Region of Brazil, PDHC (Dom Helder Camara)		
TOTAL PROJECT COST:US$93.5 m	**IFAD CONTRIBUTION: US$ 25 m**	**YEAR OF APPROVAL: 2000**
EXPECTED COMPLETION: 2009	**STATUS: Ongoing**	**DIRECTLY BENEFITING: 15.000 households**

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7. Case study from Uganda[130]

Trees for global benefits, carbon management and rural livelihoods:

Development of voluntary carbon sequestration projects

The project in brief

The key objective of the project is to enable communities in developing countries to access the emerging voluntary carbon market by combining carbon sequestration with sustainable rural development.

General context and main development challenges

Uganda is one of the poorest countries in the world. Natural resources constitute the primary source of livelihood for the majority of the population, thus their management is critical to long-term development (Republic of Uganda 2007). In 2006, per capita income was about US$300, poverty declined rapidly from 1992 to 2006 as a result of major and broad-based economic growth. In the short term, however, infrastructure gaps, high population growth, exogenous shocks and the recovery cost following a return to peace in the north, will continue to limit prospects for rapid growth. The main development challenges are: instability in agricultural production, energy shortages in industrial production, and high and volatile world oil prices (World Bank 2009).

Forest products and services play a very important role in the Ugandan economy. A conservative estimate of the contribution of forestry to the nation's GDP is 6.1 per cent. Forests are especially pivotal in rural communities' livelihoods, as over 99 per cent of rural people use wood or charcoal as fuel. Today, deforestation is the main environmental issue confronting the country's forests, savannah woodlands and bush land. Deforestation is caused by a number of factors, including population increase, poor agricultural practices, unsustainable exploitation of forest products and encroachment on gazetted forest reserves for expanding agriculture or settlement. Deforestation and degrading of forests exacerbate the severity of some disasters (e.g. floods and windstorm) and trigger a downward spiral of food insecurity (Republic of Uganda 2007).

In this context, carbon offset projects have the potential to provide increased international investments and financial flows for forestry activities. Beyond the sequestration of CO_2, these projects can promote local sustainable development, raise income, and achieve natural resource conservation and protection of valuable biodiversity (Rohit, Swallow and Kerr 2006). In the carbon market, buyers and sellers trade in 'carbon offsets' or 'carbon credits', which are units of CO_2 that have been absorbed from the atmosphere or units of carbon emissions reduced at source, for example by reducing the consumption of fossil fuels. The compliance carbon market is created and regulated by the Kyoto Protocol and its tools, such as Joint Implementation or the CDM. The voluntary carbon market functions outside the compliance market, enabling private companies, organizations and individuals to purchase carbon credits on a voluntary basis. It is a substantial economic force that is growing consistently: its value increased from US$97 million in 2006 to US$331 million in 2007 (Katoomba Group 2008).

[130] This case study was written by Elisa Distefano, Environment and NRM Consultant at IFAD, with inputs from Gerald Kairu and Polycarp from ECOTRUST.

Country vulnerability to observed and anticipated threats and impacts of climate variability and change

Over 80 per cent of the population is rural and depends on rainfed agriculture, which is vulnerable to the adverse effects of climate variability and change (UNFCCC 2002, 2009). The climate of Uganda offers great potential for food production: the average annual rainfall is about 1,318 mm, which is adequate to support agricultural activities. However, prolonged and frequent droughts in many parts of the country, particularly in the north-east, have led to almost perpetual dependency on food aid. Climate change has started manifesting itself through increased frequency of extreme weather events, such as droughts in the dryland areas, heavy rains and landslides in the highlands, and floods in lowland ecosystems. It is posing a serious threat to Uganda's natural resources and to social and economic development. The percentage of people living below the poverty line increased from 35 per cent in 2002 to 38 per cent in 2004, apparently due to climate variability and conflicts. Extreme weather events are seriously affecting the health sector: floods have caused the outbreak of waterborne diseases, while higher temperatures in the highlands have led to malaria invasion.

Government prioritized mitigation options and measures

Land use, land-use change and forestry (LULUCF) collectively accounted for 40 per cent of global GHG emissions increases between 1997 and 2004, and in developing countries, it is accelerating the degradation of local ecosystems and undermining the well-being of rural communities. Thus forest-related mitigation activities can considerably reduce emissions from sources and increase carbon dioxide (CO_2) removals by sinks at low cost – and can be designed to create synergies with adaptation and sustainable development (IPCC 2007).

Uganda does not have legally binding targets to reduce or limit its GHG emissions during the Kyoto Protocol's first commitment period (2008-2012). However the country should, to the extent possible, join the international community in mitigating such emissions. High priority should be given to those mitigation options that bring direct socio-economic benefits and are in line with the national policy on poverty eradication and sustainable development (UNFCCC 2002). According to the Uganda National Forestry Plan (NFP) 2002, one of the proposed strategies to increase investment in the forest sector is the implementation of carbon sequestration projects.

Description of project activities and key practices contributing to mitigation

The Plan Vivo system supports rural communities in developing long-term sustainable land-use systems that incorporate carbon sequestration activities. The approach targets low-income farmers, who often live in marginal areas, bringing them together to plan activities that reflect their own needs, priorities and capabilities, and that result in long-term carbon storage. Eligible carbon sequestration activities are (i) agroforestry and small-scale timber; (ii) restoration of degraded or damaged ecosystems such as woodland; and (iii) conservation of forest and woodland under threat from deforestation. The name of the system comes from the 'living plan' (*plan vivo*) that is drawn by each farmer, showing what activities s/he will implement on his or her piece of land. A plan vivo is basically an annotated map showing what species will be planted, where and how many.

The plans are assessed by the implementing agency for technical feasibility, social and environmental impact and carbon sequestration potential, and are approved if suitable. Then farmers or communities sign a contract or sale agreement for the carbon sequestered as a result of their land management activities. The implementation of a project and development of plan vivos in a country is managed by a local NGO, which provides farmers with financial and technical assistance, and aggregates the carbon benefits of many communities or individual farmers through standard agreements. Private companies, institutions or individuals can purchase carbon offset certificates via the NGO, which also administers carbon payments directly to farmers, based on progress towards carbon targets. Multiple risk-management measures are taken to provide a reasonable level of

assurance that carbon benefits will be fulfilled, such as the definition of reserves of unsold carbon sequestered to cover unforeseen losses in carbon stocks.

Plan vivo carbon offset certificates are issued by an independently administered entity (the Plan Vivo Foundation) following a standard process based on annual review cycles. The carbon benefits of each plan are evaluated with reference to technical specifications developed by internationally recognized research institutions, such as the University of Edinburgh, ICRAF and ECCM. Every certificate has a unique serial number to denote the project and exact producer, which provides buyers with distinct proof of ownership of the verified emission reductions and avoids double-counting of carbon credits. The emissions reductions are sold on behalf of the farmers or community in the form of Plan Vivo Certificates that represent the long-term sequestration of one ton CO_2 equivalent. The cost per ton of CO_2 sequestered ranges from US$6 to US$20, and includes the transaction costs for certification, verification and international support, local technical assistance, administration and monitoring, staged payments to farmers, and a community carbon fund. In the host country, this approach ensures that an average of 60 per cent of the carbon offset purchase goes directly to the communities through instalments disbursed over many years. Payments to farmers are based on monitored results and are invested to improve and diversify farm incomes. Funding for the Plan Vivo Foundation derives from both a levy imposed on the issuance of Plan Vivo Certificates and implementing agency registration fees. The current projects range from a carbon offset potential of 100,000 tons of CO_2 per year in Uganda to 1,000,000 tons per year in Mexico.

ECOTRUST established the Trees for Global Benefits Programme, in the **Bushenyi District,** south-western Uganda, in 2003, after conducting a socio-economic assessment of farmers. Workshops and field visits are essential to involve farmers in the project and communicate the concepts of carbon sequestration and trading. Although farmers join voluntarily, they are selected from collaborative natural resource management groups. However, ECOTRUST ensures that tree planting does not enter into competition with crop production, and carefully evaluates the farming system and the extension of land to be planted. Farmers are advised to plant according to three systems: boundary planting, agroforestry or woodlot planting. Forest technicians guide farmers in designing their plan vivos and provide training in good silvicultural practices during the various stages of implementation. Once a plan vivo is verified, farmers are registered and sign a 50-year carbon sale agreement with ECOTRUST.

This system sells carbon offsets that are projected to be produced in the future (ex-ante credits). For this reason, conservative technical specifications are defined for each project in a specific agroecological zone. They serve to calculate the carbon sequestration potential of different land-use systems and are based on available evidence, such as growing conditions, planting densities and tree age, biomass and stand volume. The technical specifications developed for the Trees for Global Benefits Programme are woodlots of *Maesopsis emini* and mixed native species woodlots composed of *Prunus africana* and *Grevillea* spp. among others. The total carbon storage of one hectare planted with 400 trees sequesters 226 tons of CO_2 over 25-50 years, depending on the farming systems (e.g. 25 years for a woodlot of *Measopsis* sp. and/or 50 years for mixed native species woodlots). These land-use systems were chosen because *Maesopsis* sp. is a native tree found in tropical ecosystems of East, Central and West Africa, is one of the quickest growing timber trees in the country and can thrive in a wide range of ecological rainfall and altitudinal conditions. Other features, such as germplasm availability, ease of propagation, compatibility with most agricultural crops and superior timber products make the species suitable for tree planting. The primary objective of the woodlot system is to produce high-quality timber at the end of established rotations, as well as fuelwood obtained through thinning and pruning. The technical specifications take into account that the branches removed are used to produce charcoal, and that the combustion of the wood will release a part of the carbon sequestered.

The principal short-term benefits include income from payments and the opportunity of opening a bank account, medicinal extracts from some indigenous trees such as *Prunus africana*, fruits, fodder,

manure, shade for crops, fuelwood from branches and support to honey production. Farmers also receive training and capacity-building in tree planting and agroforestry. Long-term benefits are soil conservation and restoration of environmental and ecological functioning in heavily degraded areas. Such functions include runoff and soil erosion control, microclimatic stabilization, and increased terrestrial biodiversity, for example birds. Some farmers are using *Maesopsis* for provision of shade on coffee and banana plantations. It has long been proved that shaded coffee yields better and is of superior quality than the conventional unshaded coffee.

Other benefits are expected to derive from the sale of high-quality timber harvested at the end of the rotational period. The timber extracted by 400 trees is expected to be worth at least 80 million Ugandan shillings (US$48,600) for species such as *Maesopsis eminii*. The figure is higher if you consider species such as the mahoganies, whose timber is of higher value. In addition, once *Prunus africana* is mature, it will produce high-quality bark with anticancer properties that can be sold to pharmaceutical industries in Europe. At present the tree cannot be commercialized, because it is listed in Appendix II of the CITES Convention. However, if the National Forest Authority (NFA) can prove that *Prunus africana* stock in one area is sufficient for sustainable harvesting, a commercial agreement can be signed between the Bushenyi communities and a pharmaceutical company. The project is contributing to preserve this important threatened species. Hence, other indirect positive impacts are natural resource conservation and the mainstreaming of environmental awareness.

The Plan Vivo Foundation facilitated identification of carbon buyers (Tetra Pak UK Ltd., the Carbon Neutral Company, INASP and the Katoomba Group, among others). However, ECOTRUST is responsible for fundraising to cover project coordination and monitoring, farmer training and technical support. The payments to farmers or the community are released through microfinance institutions (MFIs) located in the villages. Farmers receive 30 per cent of the total amount after registration, 20 per cent on the first year, 20 per cent on the third year, 10 per cent on the fifth year and 20 per cent on the tenth year. Payments are released according to specific targets set over a period of 10 years: percentage of the plot planted (i.e. years 0 and 1), survival rate (year 3), and growth rate (years 5 and 10).

Contribution to mitigation

The main objective of any carbon sequestration project is to absorb excess carbon dioxide from the atmosphere and thus help mitigate climate change. Since 2003 some 104,150 tons of CO_2 have been sold to investors in developed countries. The Trees for Global Benefits Programme has now expanded to two new districts (Hoima and Masindi) and its future carbon offset potential has been estimated at 100,000 tons of CO_2 per year from 2008; with an additional 100,000 tons of CO_2 per year predicted to be available for sale from 2010.

The following are important characteristics that affect an offset project's integrity and credibility:

Leakage: To avoid a situation in which planting trees on agricultural land leads to further deforestation as farmers encroach on forests to cultivate crops, the plans are approved only if farmers have identified management objectives beyond receiving carbon payments and have sufficient land for farming and planting trees (WWF 2008).

Transparency: Carbon accounting is calculated on a per hectare basis for a specified length of time, and is based on technical specifications, publicly available. The technical specifications define minimum management requirements and transparent calculations of carbon offset potential for different land-use systems. All Plan Vivo technical specifications are currently being externally reviewed by independent organizations, including the University of Edinburgh and TerraCarbon.

Additionality: Projects cannot be approved and registered by the Plan Vivo Foundation if it not proven that (i) the project does not owe its existence to legislative decrees or to commercial land-use initiatives likely to have been economically viable in their own right without payments for

ecosystem services; and (ii) in the absence of project development funding and carbon finance, financial, social, cultural, technical or traditional barriers would have prevented the project activity.

Permanence: The issue of permanence is addressed by a number of mechanisms: producers are under obligation to replant where trees die, for example from disease or extreme weather events, or if harvested for timber before the designated span of time. Maintenance of an unsold reserve of carbon (a 'risk buffer') covers any unexpected shortfall in carbon credits, for example due to forest loss, inaccuracies in baseline assumptions or producers defaulting on sale agreements. The level of this risk buffer is set by the Plan Vivo Foundation according to a project risk assessment (WWF 2008).

Validation and verification: Projects must be validated by the Plan Vivo Foundation, which assesses whether the project is properly designed. On the other hand, verification proves that carbon benefits are actually achieved. It is undertaken by a third-party organization approved by the Plan Vivo Foundation, and it is compulsory within five years of validation. The Rainforest Alliance is currently verifying the Trees for Global Benefits Programme.

Certification: Projects are reviewed on a yearly basis; coordinators must conduct and submit annual reports to the Plan Vivo Foundation, which reviews them and issues carbon offset certificates after approval.

Other positive environmental, social and economic outcomes and results

This programme strengthened the capacity of farmers to protect, restore and improve the natural and productive ecosystems on which they depend, while providing global ecosystem services. In practice, the programme will result in farmers' greater income from carbon offset payments and from production and retail sale of timber, building material and non-timber forest products such as fruits and fodder. Carbon payments deliver improvements in short-term cash flow and are expected to reduce costs for labour and inputs for tree planting by up to 70 per cent (CARE 2003). It has been estimated that the average number of trees planted on farms is 600, thus farmers receive on average of US$900 over 10 years. This amount is not negligible, considering that farmers in the Bushenyi District live on two dollars a day (US$720 per year). Thus an alternative income of US$90 per year in carbon payments represents a small, but significant additional income.

Improved understanding of agroforestry principles and land management techniques is leading to increased productivity and food security. There are some additional ecosystem benefits to be mentioned: biodiversity conservation, protection of native species and provision of buffer zones for the Kalizu Central Forest Reserve and the Queen Elizabeth National Park. In addition, the soil has been stabilized, moisture retention on the steep slopes is improving, the watershed is protected and the flooding risk reduced, as water enters river systems with a decreased speed in the catchments area of Lake Victoria.

General, institutional and technological success factors

- Presence of ECOTRUST, a local NGO with a strong and long-term field presence, and the capacity to identify and target small farmers effectively.
- Sales agreements with farmers place contractual long-term obligations on them to manage their land according to specific land-use plans. Discussions are held with farmers to facilitate informed voluntary participation in the project. Farmers' responsibilities, obligations and terms of payment are defined before sale agreements are signed.
- Specialized technical expertise, e.g. ECCM and ICRAF, ensures the programme's consistency and quality. Carbon benefits are calculated using recognized carbon accounting methodologies and conservative estimates of carbon storage that take into account risks of leakage and reversibility.

- Support from local leaders and farmer coordinators, who often act as exemplars to the rest of the community, is essential. The community-based monitoring system depends on the supervision of a coordinator, who is responsible for providing proper backstopping and overseeing the project at subcounty level. Farmer coordinators have the capacity to monitor whether the actual emission reductions are realized.
- Presence of the National Forest Authority (NFA) for seedling production and distribution. Establishment of commercial tree nurseries that provide seedlings for credit.
- Availability of land, favourable climatic conditions and soil fertility. The average farm size in the Bushenyi District is from 2 to 2.5 ha.

Sustainability dimensions

- Farmers receive payments and supervision for 10 years, but have signed a 50-year contract. The main weakness of the project is lack of assurance that the trees will be standing for this long period of time and will ultimately sequester the carbon sold. The rotational period for a *Measopsis* woodlot is 25 years, thus high-value timber can be extracted at the end of the rotational period only; this means that the carbon offset should be secured for at least 25 years. However, a 50-year contract entails replanting a second generation of trees for the actual quantity of carbon to be sequestered. Currently, there is no certainty that this will occur.
  For this reason, ECOTRUST intends to invest in sensitization and awareness-raising; and is planning to introduce new forest enterprise activities, such as honey production, to guarantee that environmental and economic benefits will persist after the end of the project. Moreover, monitoring of performance against specified targets is carried out over time, and accompanied by continue advice and support that encourage and reinforce farmers' commitment over the years.

  Another positive factor is that farmers have already started appreciating the short-term benefits of the living trees. This is a strong incentive to keep the trees and to plant a second generation at the end of the rotational period.
- The approach is grass-roots, open, flexible and adaptable to meet local needs, allowing community/farmer-led planning processes.
- Uganda's economic and political stability ensures that carbon sequestration projects can be sustained in the long-term and instils confidence in intermediaries and investors to invest in the project.

Potential and opportunities for scaling-up

Both the compliance and voluntary carbon markets are growing rapidly, and the demand for carbon credits is expected to increase steadily as more industrialized countries look for cost-effective alternatives to achieve emissions reductions. Presently, in Africa, all the existing carbon sequestration projects are voluntary and constitute less than 3 per cent of the international trade in carbon offsets. Thus, there is strong potential for taking advantage of the emerging carbon market. In this context, international and national institutions should make an effort to create an enabling environment and mechanisms to attract more carbon investments and ultimately increase Africa's share of international carbon finance (Rohit, Swallow and Kerr 2006).

Expansion of carbon sequestration projects beyond a pilot scheme is feasible when there is political stability, tenure security, institutions for natural resources governance, and institutional capacity for project design and implementation. In this context, the Plan Vivo approach proved to be a viable strategy to create the conditions to attract voluntary carbon investments, contribute to mitigating climate change at the global level, while reducing rural poverty and bringing environmental benefits locally. Plan Vivo was conceived and developed in 1994, as part of a DFID-funded research project in southern Mexico. Its implementation was then expanded to Uganda in 2003 with the Trees for Global Benefits Programme, and recently to Mozambique. Two more projects have recently registered (March 2008) as Plan Vivo concepts in Malawi and Rwanda. An important factor that

makes this approach replicable is the standardization of a series of methodologies, systems and indicators for project design, validation, monitoring and evaluation. However, the main constraint on scaling up the project in Uganda is the lack of buyers; while the main limitation to replication in other countries and different agroecological and socio-economic conditions is the initial investment needed for baseline and feasibility studies, as well as for development of technical specifications.

Currently, there are no policies for setting standards and regulating carbon management activities and projects in Uganda. Thus a national certification system and a policy framework to regulate the organizations dealing with carbon sequestration would create an enabling environment to coordinate different buyers and service providers, increase international investors' interest in carbon offset schemes, and ultimately bring revenue to poor farmers in the country. However, ECOTRUST involvement in the voluntary carbon market can enable government, civil society and community stakeholders to gain experience with carbon inventories, calculations and verification of emission reductions and transactions. This contributes to building national institutional capacity and will facilitate future participation in the compliance carbon market.

Lessons learned

Transaction costs: The cost of negotiating, contracting, implementing and monitoring a carbon sequestration project can be substantial when many small landholder farmers are involved. For this reason, investors prefer large-scale projects with a limited number of partners. In Africa, most rural people own a small piece of land; thus intermediary organizations, such as NGOs, research institutions or public agencies, can play an important role in reducing transaction costs, involving small landowners and making small-scale projects attractive to investors (Rohit, Swallow and Kerr 2006). In this project, ECOTRUST has the responsibility to collect information on landowners, contact and inform them about the Plan Vivo system and encourage their participation. ECOTRUST also establishes contracts with farmers, certifies changes in land use and facilitates transactions between investors and service providers.

Property rights and land tenure: Tenure security is crucial for carbon sequestration projects. Local communities cannot guarantee commitment to supply carbon offsets without secure rights to the land and forests on which the activities are to take place (Rohit, Swallow and Kerr 2006). For this reason, the Plan Vivo approach is limited to the following land types: smallholder-owned or leased farmland, community-owned land or land for which communities have agreed use rights with the owner.

Community participation: Farmer participation at all stages, from identification of activities through project planning and monitoring, is crucial to the sustainability of the project. This is because participation ensures that the project is addressing their needs while mitigating climate change (Rohit, Swallow and Kerr 2006). ECOTRUST works with organized, gender-sensitive groups of farmers coordinated by a community leader.

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Project summary

Project title: Trees for Global Benefits Programme

Location: Bitereko, Kichwamba and Ryeru sub-counties, Bushenyi District, Uganda

Start and completion dates: Ongoing, started in 2003

Donors and investors: UK Department for International Development (DFID), Tetra Pak UK, the Carbon Neutral Company, INASP, Katoomba Group, among others

Implementing agency and main stakeholders:

Environmental Conservation Trust of Uganda (ECORUST): Provides administration and farmer technical support, serves as trust fund, conducts monitoring activities, negotiates carbon sales and reports to the Plan Vivo Foundation.

The Plan Vivo Foundation: Registers and certifies the projects, issues carbon offsets certificates (Plan Vivo Certificates), approves third-party verifiers, and performs continuous review of projects.

Edinburgh Centre for Carbon Management (ECCM): Development of technical specifications and capacity building

World Agroforestry Centre (ICRAF) through IFAD grant (Pro poor Rewards for Environmental Services in Africa – PRESA project) and National Forestry Resources Research Institute: Participated in the development of technical specifications.
