



5 Collaborative Research in East Africa: Towards More Sustainable Development in Highly Dynamic Settings

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5.1 Introduction

5.1.1 Main problems and potentials of sustainable development

The East African region has traditionally included Kenya, Uganda and Tanzania, although Rwanda and Burundi joined recently after the revival of the East Africa Community (EAC). The former three countries share a similar political history as well as similar social, cultural and ecological characteristics. They have more or less similar development potentials, and face common development challenges in terms of environmental and economic issues (Hurni et al 2004).

The region is facing a myriad of problems and challenges related to unsustainable development (Hurni et al 2004). Poverty and livelihood insecurity have the greatest impact in rural areas, but are also becoming worse in urban areas and in all contexts. These problems are exacerbated by factors such as a declining natural resource base and growing water scarcity (Figure 1), inequality of ownership and access to land, natural and common-property resources; conflicting land-use systems and inappropriate technologies; and poor water supply and environmental sanitation. The region also faces the problem of loss of biological diversity (in protected areas in highlands and semi-arid areas) and agro-biological diversity (in smallholder agro-pastoral communities) (Emerton 1995; Gathaara 1999; Kiteme 2000; Lambrechts 2000; Jambiya and Sosovele 2001). Efforts to address these problems have been hindered by contradictory policies, weak formal institutions, and governance failures, among other factors.

Despite the challenges presented by these problems, the region has an unmatched wealth of great potentials that can be tapped to enhance problem-

solving and achieve sustainable development. In the context of the above-mentioned problems of sustainability, these potentials can be summarised as diversity of formal and informal institutions; diversity of service providers; conducive policies and legislation for natural resource management, especially in the water sector; diversity within and among livelihoods; relative political stability in spite of recurrent turbulence as experienced in Kenya since the 2007 general elections; human resources capacity; a strong knowledge base; diverse producer and consumer markets; diversified formal and informal economic sectors; and diverse environmental and natural resource management capacities – to mention but a few.

5.1.2 The NCCR North-South research approach in East Africa

The main aim of the Swiss National Centre of Competence in Research (NCCR) North-South programme in East Africa is to develop a participatory and comprehensive approach to syndrome mitigation research and find pathways for sustainable development in the contexts of urban and peri-urban areas, semi-arid areas, and highland–lowland systems (Hurni et al 2004). Research activities implemented in the region pertain to three overarching

Fig. 1
A group of food-security trainees visiting a small-holder drip irrigation system in the semi-arid footzone of Mt. Kenya. The area has undergone dramatic land-use transformation and is characterised by severe water scarcity as a result of growing demand and low and unreliable rainfall. (Photo by Boniface P. Kiteme)



themes: natural resource management; livelihoods, vulnerability and resilience; and integrative knowledge for syndrome assessment and mitigation. Individual research projects are located in three main geographical areas: in the Mt. Kenya and Mt. Kilimanjaro regions and their related highland–lowland systems; the Eastern Arc Mountains; and the semi-arid areas of Kenya and Tanzania. Alongside these three clusters, studies based on the urban and peri-urban context are concentrated in Kisumu, Nakuru, Nanyuki, Dar es Salaam, Morogoro, and Dodoma.

5.1.3 The three synthesis themes

The contribution of the East Africa region to the present synthesis book consists of findings related to three themes: 1) *Managing Water Resources in Dynamic Settings: A Multi-level and Multi-stakeholder Perspective*; 2) *Strengthening Policies and Institutions to Support Adaptation to Climate Variability and Change in the Drylands of East Africa*; and 3) *Features of Successful Syndrome Mitigation: Enhancing Resilience and Empowering the Vulnerable*. These three themes were designed to ensure joint authorship by the involved researchers and to achieve both topical and methodological integration. Broad topical inclusion and integration in these themes demonstrate how NCCR North-South research has helped to address some of the key problems of unsustainability in the region as listed in the initial section above.

5.2 Main outputs

Research in the broad area of *Managing Water Resources in Dynamic Settings* (see Chapter 6 in the present volume) focused on hydrological monitoring and modelling (Figure 2), multi-dimensional approaches and the role of geo-information technology in sustainability, water resources accounting, water-related environmental services, institutional arrangements, spatially differentiated stakeholder analysis, and system dynamics modelling for irrigation water. Research on the theme *Strengthening Policies and Institutions to Support Adaptation to Climate Variability and Change in the Drylands of East Africa* (see Chapter 7 in the present volume) focused on drought vulnerability and risk assessment, agro-pastoral strategies, policy frameworks for enhancing adaptation to climate change, institutions and power relations in common-property regimes, and efficient water use for crop production in dryland environments. The key findings regarding these two themes are summarised in Table 1.

Table 1

Theme	Key findings
Managing Water Resources in Dynamic Settings	<ol style="list-style-type: none"> 1. Discharge prediction (using streamflow model) in the Mt. Kenya region under two scenarios of land use and climate change revealed that conversion of forest area to cropland (up to 3200 m) will increase annual flow by 11%, mainly due to increased flood flows and slightly reduced low flows. With respect to climate change as projected by the Intergovernmental Panel on Climate Change (IPCC) Task Group on Scenarios for Climate Impact Assessment (IPCC-TGCI 1999), a 17% increase in annual rainfall will result in an increase of annual runoff by 26%, with a severe increase in flood flows, and a reduction of the lowest flows to about a tenth of the base case (IPCC-TGCI 1999; IPCC 2000; Notter et al 2007; Kiteme et al 2008). 2. The decline in dry-season river flows in the catchments was driven by land-use transformation experienced in the past decades, rather than by the effects of climate change (Notter et al 2007; Kiteme et al 2008). 3. In planning for ecological sustainability, a river basin is the best level for awareness creation, multi-stakeholder negotiations and policy dialogue; however, it is limited as a decision-making unit due to its lack of requisite elements such as authority, technical capacity, and political support for implementing desired interventions (Wiesmann 1998; Kiteme 2006; Kiteme and Wiesmann 2008). 4. River water users' associations (RWUAs) are important grassroots institutions with a potential for endogenous solutions to problems of sustainable resource use and management (Kiteme and Gikonyo 2002; Liniger et al 2005; Kiteme 2006).
Strengthening Policies and Institutions to Support Adaptation to Climate Variability and Change	<ol style="list-style-type: none"> 1. The household strategies of peasants in rural Kenya continue to be highly dynamic and adaptive, and reveal a progressive erosion of traditional African social security networks and a corresponding trend towards individualisation (Wiesmann 1998; Holdener 2007; Wiesmann 2008). 2. The dominance of maize in the semi-arid farm and market systems has led to a neglect of indigenous crops such as millet and sorghum, and this has had adverse impacts on food security in the affected semi-arid areas (Ifejika Speranza 2006a; Ifejika Speranza et al 2007). 3. Conservation agriculture (mulching) has the potential to improve crop yields by up to 4 times in semi-arid environments (Njeru 2005). 4. No single harmonised policy framework exists to deal with the effects of climate variability and climate change. The many existing sectoral policy instruments indirectly address this problem through drought, and only focus on securing production and food availability without addressing the issues of securing access to resources, which are a major concern of the vulnerable (Ifejika Speranza 2006a, 2006b; Ifejika Speranza and Wiesmann 2006; Ifejika Speranza et al 2007). 5. The effective traditional institutions for management of common-property resources have been replaced over the years with modern structures that are inherently weak and already compromised. This change has resulted in a shift from a common-property regime to a private- and state-property regime; the related changes in power relations have shifted endowment and entitlement structures within the communities, thereby disempowering those most dependent on resources (Mbeyale 2008).

Key findings of research done under Themes 1 and 2.

Scientific capacities and competences have been enhanced by these research activities and a huge body of knowledge has been built and disseminated. In particular, some of the key findings in the area of water resources have been instrumental in furthering water sector reforms and project planning in



Fig. 2
Rainfall variability
in Kenya; more
precise informa-
tion about rainfall
patterns is a key to
sustainable water
resource manage-
ment. (Photo by
Urs Wiesmann)

Kenya, and have helped to mobilise relevant stakeholders to form grassroots institutions that enhance participation in water resource management and reduce user conflicts in the Ewaso Ng'iro (Mt. Kenya) and Pangani (Mt. Kilimanjaro) basins (Mujwahuzi 2001; Kiteme and Gikonyo 2002; Lini-ger et al 2005; Kiteme 2006). Similarly, results related to the second theme helped to deepen understanding of key concepts and methodologies – for example, in relation to drought impact and vulnerability assessment – and triggered specific mitigation actions such as the design of a short course on food security and drought management, and negotiations for funding to promote conservation agriculture in semi-arid areas.

Furthermore, other research innovations were implemented in pilot projects within the Partnership Actions for Mitigating Syndromes (PAMS)² frame-
work, the results of which form the core focus of the third theme, *Features of Successful Syndrome Mitigation* (see Chapter 8 in the present volume). In total, five PAMS projects were implemented in various places in Kenya and Tanzania between 2003 and 2007. Table 2 lists the five PAMS and summarises their main outcomes.

Table 2

PAMS	Main outcomes
Local Urban Observatory for the Municipal Council of Nakuru (January 2003–October 2004)	A functional local urban observatory for Nakuru Municipality; a database on development priorities; a participatory spatial database, containing about 40 individual information layers; the NakInfo software as a tool; strategically positioned dissemination centres; capacity-building was extensively provided to the project team and to potential beneficiaries.
Strengthening local natural resources governance capacity in the Rufiji floodplains in Tanzania (2003–2005)	Highly sensitised and empowered communities resulting in increased participation; grass-roots institutions (Village Environmental Management Committees and Village Natural Resources Scouts Committees) and instruments (Village Environmental Management Plans and village by-laws) for participatory management of common-property resources in the Rufiji floodplains.
Supporting the efforts of the Likii slums community in Nanyuki, Kenya to establish a voluntary counselling and testing (VCT) centre and a dispensary to address HIV/AIDS (2004)	A VCT Centre; Likii Intersectorial HIV/AIDS Control Group (LISHACG); increased awareness and voluntary counselling and testing through the VCT centre; broadened financial support: from the Municipal Council of Nanyuki (for a dispensary) and from SAFARICOM (for a library).
Implementation of flood-flow abstraction devices to demonstrate and test irrigation with flood flow and to guarantee secure low flow for downstream water users on Burguret River on Mt. Kenya (September 2003–2005)	Two self-regulating weirs (SRWs) on the Burguret and Likii rivers; two small-scale flood storage structures; awareness (at River Water Users Associations and Water Officials levels) of the impacts of SRWs on river flows and individual water supplies; improved stream-flow and abstraction data on the two rivers; and documentation of experience and knowledge for further implementation of water allocation and abstraction projects.
Promotion of low-cost biogas digesters for renewable fuel production on small-scale farms on the Kenyan coast in Kilifi district (2004–2005)	Community awareness and capacity to install and use biogas digesters; a biogas training manual in the local language; 2 biogas projects initiated on the basis of community demand: one at a local Institute of Agriculture and the other at a local slaughterhouse with a capacity of 100 cows per day.

Main outcomes of the Partnership Actions for Mitigating Syndromes (PAMS) implemented in East Africa during Phases 1 and 2 of the Swiss National Centre of Competence in Research (NCCR) North-South programme.

As can be seen from the main outputs in Table 2, these interventions made significant contributions to mitigating the targeted problem(s) of unsustainability by empowering local people through participation, reducing local people's vulnerability and strengthening their resilience to adverse conditions of global change.

5.3 Outlook for future research

5.3.1 Research challenges

Before outlining the main research areas that will constitute the future NCCR North-South research agenda in East Africa, it is important to briefly highlight some of the challenges that hindered optimal engagement in the eight years of research implementation. These include 1) a technological divide and infrastructural inadequacies that affected communication between collaborators, data capture and processing, and further dissemination; 2) database limitations, especially due to lack of baseline data in areas with no prior research results, or outdatedness and low spatial and temporal resolution of data; and 3) the challenge of dealing with the complexity of policy and practice. Although considerable investments have since been made to improve IT facilities and support geographical expansion and regular review of base layers (to the appropriate resolutions), these challenges will require further attention if performance is to be improved.

5.3.2 Future research focus and questions

The three overarching themes outlined in section 5.1.3 will continue to guide future research activities in the region. The broad areas of water resources, biodiversity and livelihoods will continue to dominate the research scene. In particular, the following key areas will constitute the agenda for research in East Africa in the coming years:

- *Livelihood options and social exclusion*: Research in this area is intended to create a deeper understanding of the tension between existing livelihoods, livelihood options (Figure 3), and related conflicts and processes of exclusion/inclusion.
- *Sexual and reproductive resilience*: Here, the main focus will be on identifying and understanding supportive environments for female adolescents



Fig. 3
The creativity of
populations bur-
dened by poverty
can lead to
successful multi-
ple livelihood
strategies. (Photo
by Urs Wiesmann)

in a particular locality, in order to deal with reproductive health challenges; moreover, research will focus on how the interplay between female adolescents and other social actors (male adolescents, family members, peers, community members), institutions and organisations contributes to resilience-building processes and supports the scope of decision-making and action available to female adolescents.

- *Genderised sanitation*: In giving special attention to this topic, research on user-driven sanitation will explore the question of what stimulates changes in behaviour and demand for improved sanitation facilities.
- *People's access to services and resources*: Research will address the question of the spatial, economic and social factors that limit people's access to services and to natural resources, as well as how this limited access impacts on their household welfare.
- *Land resource potentials*: Here, the goal will be to identify sustainable land management systems that promote effective use of land resource potential for increased agricultural production, enhanced resilience to climate change, and carbon sequestration, as well as to quantify these effects at local and regional scales.

- *Landscape transformation*: Future research will also focus on landscape transformation and its impacts on respective spatial configuration and the related ability of the land to perform its functions, including essential environmental services.
- *Features of resilience and transformability*: Finally, future research will seek to identify features of resilience and transformability that enhance adaptive capacities and contribute to adaptive governance in dynamic socio-ecological systems driven by climate change and other stressors.

5.3.3 Opportunities for collaboration

East Africa will continue to explore opportunities for collaboration that help to achieve a more effective partnership between academic and non-academic partners. The current network will consolidate into regional nodes anchored in key academic and non-academic NCCR North-South partner institutions in Kenya and Tanzania, including the Centre for Training and Integrated Research in Arid and Semi-arid Land Development (CETRAD), the University of Nairobi, Egerton University, the University of Dar es Salaam, and Sokoine University. The Centre for Development and Environment (CDE) of the University of Bern, Switzerland will continue to be the main partner at the international level. The regional nodes, together with CDE, will provide a platform for collaboration with a second tier of associated partners, such as the Eastern and Southern Africa Partnership Programme (ESAPP) and the Volkswagen Foundation, among others.

Endnotes

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² Partnership Actions for Mitigating Syndromes (PAMS) are projects implemented by local actors together with scientific and non-scientific stakeholders. As a component of the NCCR North-South programme they are designed to implement and validate approaches, methods and tools developed in research, with a view to finding promising strategies and potentials for sustainable development. Moreover, they are intended to promote mutual learning and knowledge-sharing between academic and non-academic partners in sustainable development.

References

Publications elaborated within the framework of NCCR North-South research are indicated by an asterisk (*).

- Emerton L. 1995. *Socio-Economic Notes on Mount Kenya Forest Reserve*. Nairobi, Kenya: Centre for Biodiversity, National Museums of Kenya.
- Gathaara GN. 1999. *Aerial Survey of the Deforestation of Mt. Kenya, Imenti and Ngare Ndare Forest Reserves*. Nairobi, Kenya: Wildlife Service.
- * Holdener K. 2007. *The Importance of Trans-spatial Economic and Social Networks in Household Strategies of Peasants in Rural Kenya* [Master's thesis]. Bern, Switzerland: University of Bern.
- * Hurni H, Wiesmann U, Schertenleib R, editors. 2004. *Research for Mitigating Syndromes of Global Change: A Transdisciplinary Appraisal of Selected Regions of the World to Prepare Development-oriented Research Partnerships*. Perspectives of the Swiss National Centre of Competence in Research (NCCR) North-South, University of Bern, Vol. 1. Bern, Switzerland: Geographica Bernensia.
- * Ifejika Speranza C. 2006a. *Drought Vulnerability and Risk in Agro-pastoral Areas: An Integrative Approach and Its Application in Kenya* [PhD dissertation]. Bern, Switzerland: University of Bern.
- * Ifejika Speranza C. 2006b. Gender-based analysis of vulnerability to drought among agro-pastoral households in semi-arid Makueni district, Kenya. In: Premchander S, Müller C, editors. *Gender and Sustainable Development*. Perspectives of the Swiss National Centre of Competence in Research (NCCR) North-South, University of Bern, Vol. 2. Bern, Switzerland: NCCR North-South, pp 119–146.
- * Ifejika Speranza C, Kiteme BP, Wiesmann U. 2007. Droughts and famines: The underlying factors and the causal links among agro-pastoral households in semi-arid Makueni district, Kenya. *Global Environment Change Journal* 18(1):220–233. doi:10.1016/j.gloenvcha.2007.05.001.
- * Ifejika Speranza C, Wiesmann U. 2006. Post-harvest management strategies, drought vulnerability and food security. In: Ammann WJ, Dannenmann S, Vulliet L, editors. *Coping with Risks Due to Natural Hazards in the 21st Century – RISK21*. London, UK: Taylor and Francis, pp 127–138.
- IPCC [Intergovernmental Panel on Climate Change]. 2000. *Special Report on Emissions Scenarios*. Cambridge, UK: Cambridge University Press. Also available at: http://www.grida.no/publications/other/ipcc_sr/?src=/climate/ipcc/emission/; accessed on 26 August 2009.
- IPCC-TGCI [Intergovernmental Panel on Climate Change Task Group on Scenarios for Climate Impact Assessment]. 1999. *Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment*. Version 1. Geneva, Switzerland: IPCC-TGCI.
- Jambiya G, Sosovele H. 2001. *Conservation and Poverty: The Case of Amani Nature Reserve*. Dar es Salaam, Tanzania: Institute of Resource Assessment (IRA), University of Dar es Salaam.
- Kiteme BP. 2000. *Conservation and Protection of Mt. Kenya Global Heritage Site: A Baseline Survey on Biological Ecosystem, People and Land (Resources) Use in and Around the Site*. Unpublished report prepared for the United Nations Development Programme (UNDP) Global Environment Facility (GEF) Small Grants Programme (SGP). Available from Boniface P. Kiteme.
- * Kiteme BP. 2006. *Multidimensional Approaches to More Sustainable Natural Resources Management in Highly Dynamic Contexts in East Africa* [PhD dissertation]. Bern, Switzerland: University of Bern.
- * Kiteme BP, Gikonyo J. 2002. Preventing and resolving water use conflicts in the Mount Kenya highland–lowland system through water users' associations. *Mountain Research and Development* 22(4):332–337.
- * Kiteme BP, Liniger HP, Wiesmann U, Notter B, Kohler T. 2008. Dimensions of global change in African mountains: The example of Mount Kenya. *IHDP Update* 2008(2):18–22. Also available at: <http://www.ihdp.unu.edu/category/44?menu=23>; accessed on 26 August 2009.

- * Kiteme BP, Wiesmann U. 2008. Sustainable river basin management in Kenya: Balancing needs and requirements. In: Hirsch Hadorn G, Hoffmann-Riem H, Biber-Klemm S, Grossenbacher-Mansuy W, Joye D, Pohl C, Wiesmann U, Zemp E, editors. *Handbook of Transdisciplinary Research*. Berlin, Germany: Springer Verlag, pp 63–78.
- Lambrechts C. 2000. The highlands of Kenya: The threatened forests of Mount Kenya. In: Mountain Agenda, editor. *Mountains of the World: Mountain Forests and Sustainable Development*. Bern, Switzerland: Mountain Agenda, pp 30–31. Also available at: <http://www.cde.unibe.ch/CDE/pdf/MountainAgenda2000.pdf>; accessed on 26 August 2009.
- * Liniger HP, Gikonyo J, Kiteme BP, Wiesmann U. 2005. Assessing and managing scarce tropical mountain water resources: The case of Mount Kenya and the semiarid Upper Ewaso Ng'iro basin. *Mountain Research and Development* 25(2):163–173.
- * Mbeyale GE. 2008. *The Impact of Institutional Changes on the Management of Common Pool Resources in Pangani River Basin: A Case of Same District, Tanzania* [PhD dissertation]. Dar es Salaam, Tanzania: University of Dar es Salaam.
- Mujwahuzi MR. 2001. Water use conflicts in the Pangani Basin: An overview. In: Ngana JO, editor. *Water Resources Management in the Pangani River Basin: Challenges and Opportunities*. Dar es Salaam, Tanzania: University Press, pp 128–137.
- * Njeru L. 2005. *Monitoring and Modeling Crop Growth, Water Use and Production Under Dryland Environment: NW Foot-slopes of Mount Kenya* [PhD dissertation]. Bern, Switzerland: University of Bern.
- * Notter B, McMillan L, Viviroli D, Weingartner R, Liniger HP. 2007. Impacts of environmental change on water resources in the Mount Kenya region. *Journal of Hydrology* 343(3/4):266–278.
- Wiesmann U. 1998. Balancing ecological sustainability and short-term needs: A regional approach to water supply planning. *Eastern and Southern Africa Geographical Journal* 8:77–90.
- Wiesmann U. 2008. *Sustainable Regional Development in Rural Africa: Conceptual Framework and Case Studies from Kenya*. African Studies 14. Bern, Switzerland: Geographica Bernensia.

6 **Managing Water Resources in Dynamic Settings: A Multi-level, Multi-stakeholder Perspective**

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Abstract

The aim of the present article is to contribute to the debate on the role of research in sustainable management of water and related resources, based on experiences in the Upper Ewaso Ng'iro and Pangani river basins in East Africa. Both basins are characterised by humid, resource-rich highlands and extensive semi-arid lowlands, by growing demand for water and related resources, and by numerous conflicting stakeholder interests. Issues of scale and level, on the one hand, and the normative dimension of sustainability, on the other hand, are identified as key challenges for research that seeks to produce relevant and applicable results for informed decision-making. A multi-level and multi-stakeholder perspective, defined on the basis of three minimal principles, is proposed here as an approach to research for informed decision-making. Key lessons learnt from applying these principles in the two river basins are presented and discussed in the light of current debate.

Keywords: Water management; scale; level; sustainability; decision-making; contextuality; generalisation; East Africa.

6.1 Introduction

Water poses serious challenges to resource management. Growing populations and increasing economic activity are resulting in greater demand for water-related ecosystem services such as the provision of drinking water, food and energy. At the same time, supply is becoming less predictable as a result of environmental degradation and climate change in many parts of the world. The great dynamics of the changes that affect water supply, coupled with the fact that negative outcomes can occur spatially and temporally removed from their causes, lead to highly unpredictable situations for individual stakeholders. Informed decision-making is therefore a prerequisite for sustainable resource management.

Research is expected to provide a basis for informed decision-making, but there is a growing concern that the results of research are not necessarily useful in making management decisions (FAO 2006; Hermans 2008). The causes cited to explain the lack of relevance and applicability of research results include an incomplete understanding of natural processes (Calder 2002; FAO 2006), issues of scale and resulting challenges (Kiersch 2000; Cash et al 2006), lack of incentives for efficient resource use (Aylward 2004; MA 2005), insufficient participation of and collaboration between scientists and stakeholders (Pahl-Wostl et al 2007), and institutional rigidity (Bohensky 2008).

The Upper Ewaso Ng'iro Basin in Kenya and the Pangani Basin in Tanzania exemplify the complex human–environment interactions that characterise watersheds. These basins have similar physical settings, with humid highlands surrounded by semi-arid lowlands (Figure 1). Favourable conditions in the footzones of the mountains have attracted in-migration and economic development. The resulting increase in water demand is a cause of water scarcity and a source of conflicts between different user groups (e.g. farmers versus pastoralists, or farmers versus hydropower producers) and also within user groups (upstream versus downstream farmers, large-scale versus small-scale farmers). The authorities lack both the information and the financial means to correctly allocate resources and implement rules (Wiesmann 1998; Wiesmann et al 2000; Mbonile 2002; IUCN 2003).

Research carried out by the Swiss National Centre of Competence in Research (NCCR) North-South programme in the two basins offers an opportunity to study the role of research in sustainable management of

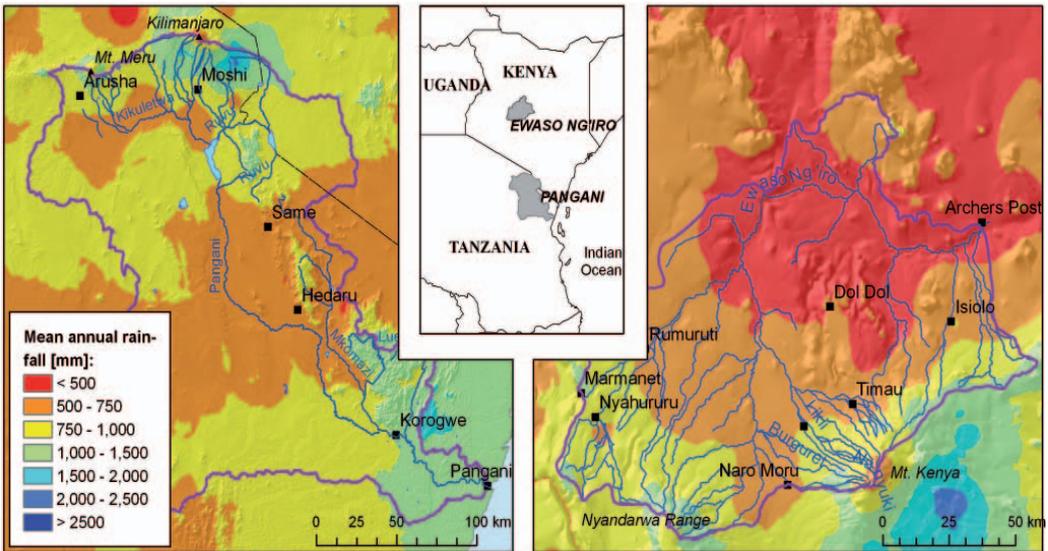


Fig. 1
 Overview of the two river basins. (Map by B. Notter; data sources: B. Notter, CETRAD – Centre for Training and Research in Arid and Semi-Arid Lands Development)

water and related resources. Based on practical experience (Wiesmann 1998; Wiesmann et al 2000; Kiteme and Gikonyo 2002; Aeschbacher et al 2005; Ehrensperger 2006; Notter et al 2007) and a review of existing literature, the present article identifies two key challenges posed by: a) issues of scale and level, and b) the normative dimension of sustainability. A multi-level and multi-stakeholder perspective based on three minimum principles is proposed as a way of addressing these challenges, and experience from the application of these principles in research in the two river basins is presented and discussed.

6.2 Challenges for research in watershed management

Various constraints affect the relevance and applicability of research results in the two river basins. These can be attributed to two key challenges: 1) issues of scale and level that arise because different actors and processes are active at different levels and scales and interact across them; and 2) the normative dimension of sustainability, which is defined by differences in the values that actors attach to resources, processes, or institutions.

6.2.1 Issues of scale and level

In the following sections we use the definition of Gibson et al (2000) that differentiates between “scale” as the analytical dimension for assessing a certain phenomenon, and “level” as the respective unit of analysis. The spatial scale ranges from micro- to macro-levels, for example, or from the local to the international level; the temporal scale ranges from short- to long-term, e.g. daily, monthly, annual and inter-annual levels. The fact that processes, actors and perceptions differ between levels or scales and interact across different levels and scales can result in serious constraints on the applicability and relevance of research results.

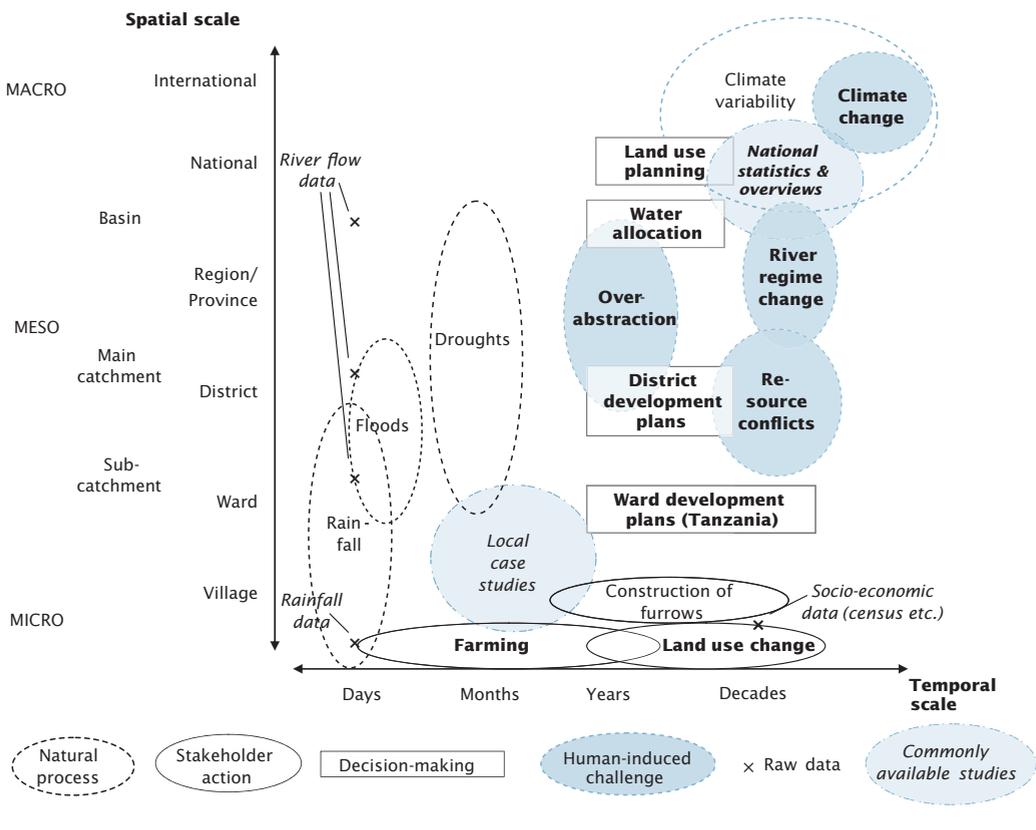
An inappropriate spatial and temporal extent or resolution of assessments limits the applicability of outputs. Hydrological studies typically describe river catchments; national overviews present socio-economic information on countries or provinces; and numerous case studies contain detailed information about specific aspects of small areas. It is very difficult for non-scientist decision-makers to take decisions concerning their unit of responsibility (e.g. a district) based on such research results. Moreover, assessments are often carried out based on time series that are too short to capture long-term variability, resulting in biased resource allocation. Some studies are not explicit about the temporal and spatial timeframes considered, which limits their applicability and re-usability. Finally, the most serious challenges to watershed management, such as declining dry-season flows, resource conflicts or climate change, unfold at spatial and temporal scales covered by few scientific assessments and are thus insufficiently taken into account in decision-making processes (Figure 2).

Lack of awareness of issues of scale and level can be an obstacle to the implementation of research results. For example, most farmers in the footzones of the mountains are unaware of water scarcity at the basin level. Faced with inter-annual variability in rainfall, which they do perceive, they irrigate their fields with river water, thereby unknowingly contributing to problems further downstream.

Finally, *decision-making at inappropriate levels* can be an obstacle to sustainable management. At the temporal scale, decisions are too often taken with a perspective of 5–10 years, depending on the period of time considered appropriate for assessment of decision-makers’ success – e.g. an election interval or a project phase. At the spatial scale, a large-scale paddy irrigation

scheme in the Pangani Basin can serve as an illustration for decision-making at an inappropriate level: The scheme was managed by the regional government, which commissioned a foreign consultant to do a study but did not consider the knowledge of district authorities or local stakeholders about ongoing irrigation projects undertaken by villages and clans in upstream areas and about existing downstream water demand. Nowadays, only half of the area covered by this scheme is productive, owing to increased irrigation upstream, while downstream areas have been left degraded by farmers engaging in illegal charcoal production in a nearby forest reserve due to lack of irrigation water for their fields.

Fig. 2
 Visualisation of scale and level challenges in the Upper Ewaso Ng'iro and Pangani river basins. Processes and challenges, as well as institutions and information necessary for decision-making, are found at different levels on the spatial and temporal scales. (Source: Adapted from an original figure by Clark [1987])



6.2.2 The normative dimension of sustainability

“Sustainable development” is a normative concept. Different actors attach different values to resources, processes and institutions. This represents a second key challenge to research for sustainable watershed management, since it implies that sustainable development is driven by values and norms that cannot be identified by scientific research alone but which must emerge from negotiations among relevant stakeholders in a concrete societal and political context (Wiesmann 1998).

Unclear research objectives are a major constraint on the relevance and applicability of research results. Sustainability-related problems are often complex and controversial. A potentially unlimited number of elements could be included in the “system” assessed by a study or research project. This situation, which has been referred to as the “systemic trap of sustainability” (Wiesmann and Messerli 2007), often means that research projects are initiated without a clear aim and with multiple interlinked objectives that are difficult to operationalise and to distinguish from each other. For example, in both river basins, a variety of studies (e.g. Rohr 2003; McMillan and Liniger 2005) aimed to develop a “hydrological model” of the basin or parts of it; however, there was no explicit reflection in each case on what the model should do: Was the primary aim to assess the impacts of change, to gain a better understanding of processes, or to obtain information about unmeasured locations? Who were the stakeholders interested in the outputs, and how were their interests captured by the output variables of the model? At which level and scale were outputs needed? All these questions need to be answered in order to avoid including too high a number or an inappropriate selection of elements in the model structure or system.

The fact that *societal contexts in which sustainability goals can be negotiated change rapidly in time and space* represents another challenge. Each context becomes a unique case, and the concrete aims of sustainable development cannot be transferred from one to another. Correspondingly, we observe a growing number of highly contextualised and frequently local-level case studies (see Figure 2) with clear limitations on generalisation and comparability. This phenomenon has been referred to as the “ideographic trap” of sustainability (Hurni et al 2004). It is a significant cause of limitations on the production of scientific knowledge that informs decision-making at higher levels.

6.3 A multi-level and multi-stakeholder research perspective

A multi-level and multi-stakeholder research perspective can serve as a possible response to the challenges arising from issues of scale and level and from the normative dimension of sustainability. Its goal is to help bridge the gap between knowledge production and decision-making in sustainable management of water and related resources. Based on the practical challenges and theoretical considerations outlined above, such a perspective can be defined on the basis of the three principles listed in Table 1.

Table 1

Principle	Requirements	The three minimum principles underlying the proposed multi-level and multi-stakeholder research perspective on sustainable river basin management.
Transdisciplinary, value-based system delineation	<ul style="list-style-type: none"> – System delineation based on collaboration of stakeholders concerned and experts – Elements valued by stakeholders form the core of the system – System boundaries determined by scientific expertise 	
Explicit reference to multiple levels	<ul style="list-style-type: none"> – Assessment at multiple levels in order to capture level-specific characteristics and cross-level interactions – Explicitness about level and scale as a prerequisite for integration of findings 	
Balance between contextuality and generalisation	<ul style="list-style-type: none"> – Focus on recurring linkages and patterns instead of context-specific characteristics allows generalisation without giving up context-boundedness of sustainability 	

The NCCR North-South’s syndrome mitigation approach (Hurni et al 2004) offers a way of designing research that adheres to these principles. The research projects currently implemented in the Upper Ewaso Ng’iro and Pangani river basins have contributed to application of and experimentation with the syndrome mitigation approach. Experiences and lessons learnt in this process are presented below.

6.4 Experiences in the two river basins

6.4.1 Transdisciplinary value-based definition of system boundaries

Application of the first principle in Table 1 in the Ewaso Ng'iro and Pangani basins indicates that it can yield well-targeted research results if a transdisciplinary definition of relevant values and value scales (see Wiesmann 1998) is used from the beginning of the research programme, involving stakeholders at all levels, and is consequently implemented in spatio-temporal system delineation for individual assessments.

Priority research themes in the East African region were identified at the outset of the NCCR North-South programme in a workshop attended by local scientists and decision-makers (Hurni et al 2004). Multiple levels were considered when it came to the selection of stakeholders to be consulted. A sole focus on local-level participation can be counterproductive, since a given situation will not improve without the commitment of decision-makers and authorities. Workshops at the local and basin levels, involving farmers and government representatives, and surveys in the field confirmed the finding that dry-season water from perennial rivers is the resource that is most highly valued, mainly by stakeholders in the footzones of the mountain ranges, while water-related resource conflicts and pressure on the land are among the most pressing problems (Wiesmann 1998; Kiteme and Gikonyo 2002; Ehrensperger 2006).

Findings from stakeholder consultations were implemented in spatio-temporal system delineation for individual assessments. For example, without stakeholder consultation, watershed boundaries are usually an obvious choice for spatial system delineation in water-related research due to upstream–downstream linkages. Based on data availability, scientists often focus on the drainage areas of existing gauges. Often, however, delineated study areas match neither the areas of greatest stakeholder interest nor decision-making units. In the Upper Ewaso Ng'iro studies, to respond to the needs of stakeholders, additional river gauges were therefore installed in the course of long-term research projects, and a simple hydrological model was developed to estimate flow at ungauged locations (Liniger et al 2005; McMillan and Liniger 2005). With respect to the temporal dimension, statistical flow analyses and model calibration focused on dry-season flows (Aeschbacher et al 2005; Notter et al 2007). This made it possible to obtain

results that directly matched stakeholder-valued resource components (i.e. water in the dry season) and areas of interest (i.e. the lower footzones). In the water use plan for Laikipia District (Upper Ewaso Ng'iro Basin), outputs are not given for hydrological catchments but for planning units (Wiesmann 1998).

6.4.2 Explicit reference to multiple levels

Application of the second principle in Table 1 yields important and sometimes unexpected results for decision-making in the two basins.

Modelling the influence of land-use and climate change on river discharge, for example, has indicated that deforestation on the slopes of Mt. Kenya would have little overall impact on dry-season flows at the catchment level. However, model outputs at the grid cell level (50–500 m resolution) suggest that forests at high elevations have a potential to sustain base flow, while forests at lower altitudes drain more water from soils by transpiration than they cause to infiltrate during storms. At the temporal scale, climate change scenarios show an expected overall increase in annual discharge; disaggregation to the monthly level reveals that rainy seasons may shift in time and cause destructive flood flows, while periods of drought may be prolonged with discharge reduced almost to zero for several consecutive months (Notter et al 2007). These modelling results are made possible and supported by long-term monitoring – not only of trends in climate, discharge, and water use from plot to basin levels, but also of population and settlement dynamics (Mungai et al 2004). Based on such results, decision-makers can elaborate spatially differentiated land-use policies and plan for increased water storage capacity in priority locations, the urgency of which would be less perceivable if assessments were carried out at single or discrete levels on the spatial and temporal scales.

6.4.3 Balance between contextuality and generalisation

The third principle in Table 1 can be illustrated by a conceptual model of processes related to watershed management in the two river basins (Figure 3). It represents a synthesis of findings from studies already completed in both basins in the areas of natural science, socio-economics and governance (Wiesmann et al 2000; Ngana 2001, 2002; Kiteme and Gikonyo 2002; Aeschbacher et al 2005; Ehrensperger and Kiteme 2005; Gitonga 2005; Liniger et al 2005; Notter et al 2007), as well as the experience of the authors, who are

currently working in the area. The conceptual model is an attempt to strike a balance between contextuality and generalisation by opening up the context of interest from specific watersheds to a more general context that could be defined as “East African river basins with an ecological gradient from humid to semi-arid”. Consequently, patterns and processes that are present in both the Upper Ewaso Ng’iro and Pangani basins, and which are also likely to be present in other basins conforming to the context definition – although some might be more pronounced in one basin than in another – are included in the model. This allows for a transfer of findings concerning patterns that lead to problems, on the one hand, and potentials for mitigation, on the other hand, to areas that may not have been subject to sustainability-related research so far. The following paragraphs provide an explanation of the selected problems and potentials in Figure 3, and show how processes currently considered to be problems could be transformed into future potentials.

On the problem side, declining dry-season river flows due to expanding agriculture, population pressure and environmental change are presently leading to conflicts between different water user groups. These problems are compounded by conflicting policies between different government sectors, over-allocation of water due to limited and fragmented databases and inadequate stakeholder representation, and weak law enforcement. Irrigation infrastructure is poorly maintained, leading to water losses and higher abstractions.

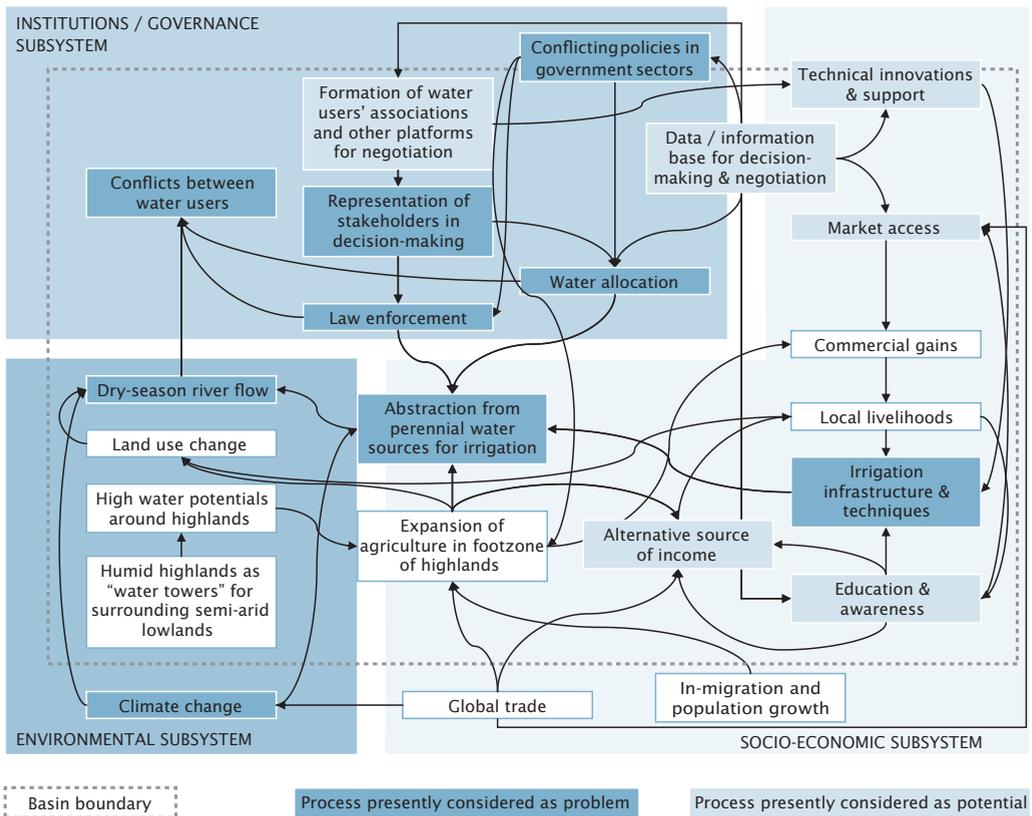
On the potential side, technical innovations such as drip irrigation, rock and roof catchments, and mulching, as well as support from NGOs and the authorities for expanding water storage capacity, are helping to ease the pressure on dry-season water resources. If such innovations can be scaled up, the ‘irrigation infrastructure and techniques’ element could also be transformed from a problem into a potential. The formation of Water Users’ Associations (WUAs) fosters self-regulation, improves participation by stakeholders in decision-making, and helps farmers to secure technical support. The procedure of allocating water could become a potential rather than a problem if farmers were represented by WUAs in the process. Alternative sources of income that do not rely on river water can also help to provide adequate livelihoods and ease pressure on this scarce resource. Education and awareness are needed, however, for farmers to take advantage of these sources. Most such potentials rely on or benefit from a comprehensive and reliable knowledge base. The same knowledge is also needed to allocate available resources equitably and to design coherent government policies.

In the Upper Ewaso Ng'iro Basin, the Centre for Training and Research in Arid and Semi-Arid Lands Development (CETRAD), the main partner institution of the NCCR North-South in East Africa, has been actively working to enhance such potentials, with activities ranging from database maintenance and awareness creation campaigns to supporting the formation of WUAs and lobbying for their formal recognition during the process of reforming Kenyan water policy (Ehrensperger and Kiteme 2005; Liniger et al 2005).

6.5 Conclusions

The Upper Ewaso Ng'iro and Pangani river basins are faced with considerable challenges but also share important potentials for sustainable development. Research in the framework of the NCCR North-South has shown

Fig. 3
Patterns of potentials and problems identified as common to both the Upper Ewaso Ng'iro and Pangani basins.



that a perspective which considers multiple stakeholders at multiple levels is required and can lead to more relevant and applicable outputs. At the same time, the normative dimension of sustainability and the resulting complexity of values, dimensions and contexts represent a challenge that has to be met by striking a balance between contextuality and generalisation.

Although these findings largely concur with the substance of current discourses in watershed management, some important differences can be identified. First, systems processes and dynamics can only be meaningfully investigated with a clear analytical scope. As this scope cannot be defined by researchers alone, it is crucial to collaborate with the stakeholders concerned. However, the goal should not be merely to include stakeholders, but to establish which components of the environment are valued in which way, so that research outputs can be tailored to these interests. Second, processes and the ways in which they are perceived and valued by stakeholders have very specific manifestations in time and space, i.e. they refer to a specific context. These contexts are often not congruent, and hence the context of water-related problems may not be identical with an overlapping context of economic development, the sphere of influence of a specific stakeholder, or the extent of a new land-tenure policy. Therefore, the a priori choice of the watershed as the relevant context for water development should not be an imperative, as more important opportunities for achieving sustainable development in a region may emerge from a different definition of the context of the human–environment system. Finally, while newer-generation watershed management approaches (e.g. FAO 2006) underline the importance of multi-stakeholder collaboration in a framework of light institutions, as opposed to bottom-up or top-down approaches under heavy donor or government programmes, experience in the Ewaso Ng'iro and Pangani basins demonstrates the need for a more careful focus on knowledge-based decision- and policy-making. Merely by ensuring participation, supporting negotiation, and building multi-level institutions, the resulting knowledge base will be nothing more than the sum of individual contributions. Fragmented and need-based knowledge can be an obstacle to successful negotiation processes and collaborative management. Experience in the Ewaso Ng'iro and Pangani basins underlines the importance of producing scientific knowledge that: a) not only focuses on immediate needs but also on long-term requirements; b) strives for a balance between specialisation and generalisation by studying patterns of problems and potentials; and c) pursues system boundaries that are identified in a transdisciplinary manner rather than by a priori choices relating to watersheds.

Endnotes

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References

Publications elaborated within the framework of NCCR North-South research are indicated by an asterisk (*).

- * Aeschbacher J, Liniger HP, Weingartner R. 2005. River water shortage in a highland–lowland system: A case study on the impact of water abstraction in the Mt. Kenya region. *Mountain Research and Development* 25(2):155–162.
- Aylward B. 2004. Land use, hydrological function and economic valuation. In: Bonnell M, Bruijnzeel LA, editors. *Forests, Water and People in the Humid Tropics*. Cambridge, UK: Cambridge University Press, pp 99–120.
- Bohensky E. 2008. Discovering resilient pathways for South African water management: Two frameworks for a vision. *Ecology and Society* 13(1):19. Also available at: <http://ecologyandsociety.org/vol13/iss1/art19/>; accessed on 29 April 2009.
- Calder IR. 2002. Forests and hydrological services: Reconciling public and science perceptions. *Land Use and Water Resources Research* 2:2.1–2.12. Also available at: <http://purl.umn.edu/47860>; accessed on 7 May 2009.
- Cash DW, Adger WN, Berkes F, Garden P, Lebel L, Olsson P, Lowell P, Young O. 2006. Scale and cross-scale dynamics: Governance and information in a multilevel world. *Ecology and Society* 11(2):8. Also available at: <http://www.ecologyandsociety.org/vol11/iss2/art8>; accessed on 28 April 2009.
- Clark WC. 1987. Scale relationships in the interactions of climate, ecosystems, and societies. In: Land KC, Schneider SH, editors. *Forecasting in the Social and Natural Sciences*. Dordrecht, the Netherlands: Reidel, pp 337–378.
- * Ehrensperger A. 2006. *Potentials, Limitations and Risks of Geo-Information Technology for Sustainable Development Approaches in Kenya* [PhD dissertation]. Bern, Switzerland: Institute of Geography, University of Bern.
- * Ehrensperger A, Kiteme B. 2005. *Upper Ewaso Ng'iro River Basin Water Management Information Platform: Survey on Development Priorities, Information Needs, and Conflict Management Efforts*. Nanyuki, Kenya: Centre for Training and Research in Arid and Semi-Arid Lands Development (CETRAD). Also available at: http://www.nccr-north-south.unibe.ch/publications/Infosystem/On-line%20Dokumente/Upload/Survey_report_ewaso_2b.pdf; accessed on 30 March 2009.
- FAO [Food and Agriculture Organisation of the United Nations]. 2006. *The New Generation of Watershed Management Programmes and Projects: A Resource Book for Practitioners and Local Decision-makers Based on the Findings and Recommendations of a FAO Review*. FAO Forestry Paper No. 150. Rome, Italy: FAO.
- Gibson C, Ostrom E, Ahn TK. 2000. The concept of scale and the human dimensions of global change: A survey. *Ecological Economics* 32:217–239.
- * Gitonga JNL. 2005. *Monitoring and Modeling Crop Growth, Water Use and Production under Dry Land Environment North-West of Mt. Kenya* [PhD dissertation]. Bern, Switzerland: Institute of Geography, University of Bern.
- Hermans LM. 2008. Exploring the promise of actor analysis for environmental policy analysis: Lessons from four case studies in water resources management. *Ecology and Society* 13(1):21. Also available at: <http://www.ecologyandsociety.org/vol13/iss1/art21/>; accessed on 17 July 2009.
- * Hurni H, Wiesmann U, Schertenleib R, editors. 2004. *Research for Mitigating Syndromes of Global Change: A Transdisciplinary Appraisal of Selected Regions of the World to Prepare Development-oriented Research Partnerships*. Perspectives of the Swiss National Centre of Competence in Research (NCCR) North-South, University of Bern, Vol. 1. Bern, Switzerland: Geographica Bernensia.
- IUCN [International Union for Conservation of Nature]. 2003. *The Pangani River Basin: A Situation Analysis*. Nairobi, Kenya: IUCN, Eastern Africa Programme.
- Kiersch B. 2000. Land–water linkages in rural watersheds: A literature review. *FAO Land and Water Bulletin* 9:35–44.
- * Kiteme BP, Gikonyo J. 2002. Preventing and resolving water use conflicts in the Mount Kenya highland–lowland system through water users' associations. *Mountain Research and Development* 22(4):332–337.

- * Liniger HP, Gikonyo J, Kiteme B, Wiesmann U. 2005. Assessing and managing scarce tropical mountain water resources: The case of Mount Kenya and the semiarid Upper Ewaso Ng'iro basin. *Mountain Research and Development* 25(2):163–173.
- MA [Millennium Ecosystem Assessment]. 2005. *Ecosystems and Human Well-Being: Synthesis*. Washington, D. C.: Island Press.
- Mbonile MJ. 2002. Rural population mobility in the Pangani basin, Tanzania. In: Ngana JO, editor. *Water Resources Management: The Case of Pangani River Basin. Issues and Approaches*. Dar es Salaam, Tanzania: Dar es Salaam University Press Ltd., pp 14–27.
- MacMillan L, Liniger HP. 2005. Monitoring and modelling for the sustainable management of water resources in tropical mountain basins: The Mount Kenya example. In: Huber UM, Bugmann HKM, Reasoner MA, editors. *Global Change and Mountain Regions: An Overview of Current Knowledge*. Berlin, Germany: Springer Verlag, pp 605–616.
- * Mungai DN, Ong CK, Kiteme B, Elkaduwa W, Sakthivadivel R. 2004. Lessons from two long-term hydrological studies in Kenya and Sri Lanka. *Agriculture, Ecosystems and Environment* 104:135–143.
- Ngana JO, editor. 2001. *Water Resources Management in the Pangani River Basin: Challenges and Opportunities*. Dar es Salaam, Tanzania: Dar es Salaam University Press Ltd.
- Ngana JO, editor. 2002. *Water Resources Management: The Case of Pangani River Basin. Issues and Approaches*. Dar es Salaam, Tanzania: Dar es Salaam University Press Ltd.
- * Notter B, MacMillan L, Viviroli D, Weingartner R, Liniger HP. 2007. Impacts of environmental change on water resources in the Mount Kenya region. *Journal of Hydrology* 343(3/4):266–278.
- Pahl-Wostl C, Craps M, Dewulf A, Mostert E, Tabara D, Taillieu T. 2007. Social learning and water resources management. *Ecology and Society* 12(2):5. Also available at: <http://www.ecologyandsociety.org/vol12/iss2/art5/>; accessed on 28 April 2009.
- Rohr PC. 2003. *A Hydrological Study Concerning the Southern Slopes of Mt Kilimanjaro, Tanzania* [PhD dissertation]. Trondheim, Norway: Norwegian University of Science and Technology (NTNU).
- Wiesmann U. 1998. *Sustainable Regional Development in Rural Africa: Conceptual Framework and Case Studies from Kenya*. African Studies 14. Bern, Switzerland: Geographica Bernensia.
- * Wiesmann U, Gichuki FH, Kiteme BP, Liniger HP. 2000. Mitigating conflicts over scarce water resources in the highland–lowland system of Mount Kenya. *Mountain Research and Development* 20(1):10–15.
- * Wiesmann U, Messerli P. 2007. Wege aus den konzeptionellen Fallen der Nachhaltigkeit – Beiträge der Geographie. In: Kaufmann R, Burger P, editors. *Nachhaltigkeitsforschung – Perspektiven der Sozial- und Geisteswissenschaften*. Bern, Switzerland: Schweizerische Akademie der Geistes- und Sozialwissenschaften (SAGW), pp 123–142.

7 **Strengthening Policies and Institutions to Support Adaptation to Climate Variability and Change in the Drylands of East Africa**

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Abstract

We analysed how policies in Tanzania and Kenya address the strategies of agro-pastoralists for coping with and adapting to climate variability and climate change, based on data from semi-structured household surveys, group discussions, policy documents and other material. Many policies indirectly address climate variability and change by focusing on drought, suggesting that some form of mainstreaming already exists. Although the United Nations Framework Convention on Climate Change (UNFCCC) National Communications and the Tanzania National Adaptation Programme of Action propose technological rather than social adaptation measures, they address a broader range of adaptation strategies than development policies do and can be used as vehicles for improving adaptation planning. Some policies focus on securing production and food availability but do not address access to resources, a major concern for the vulnerable. Despite overlaps, few policies focus on key agro-pastoral strategies such as diversification, migration and multi-locality. Mixed cropping – a core agro-pastoral strategy – needs to be re-examined to ascertain the use of key crops that reduce vulnerability. Strategies promoted in policies related to soil conservation are not widely adopted, and land-use regulations are difficult to enforce: this needs to be re-examined. The multitude of policies translates into a multitude of institutions, duplication of activities, and conflicting goals, making it difficult to achieve synergies or set priorities. Creating enactments can offer guidelines for policy implementation. We show that by integrating the perspective of agro-pastoralists, i.e. the majority of the rural poor, policies and pro-poor adaptation strategies can be strengthened.

Keywords: Climate variability; climate change; vulnerability; adaptation; livelihoods; agro-pastoralists; institutions; policies.

7.1 Introduction

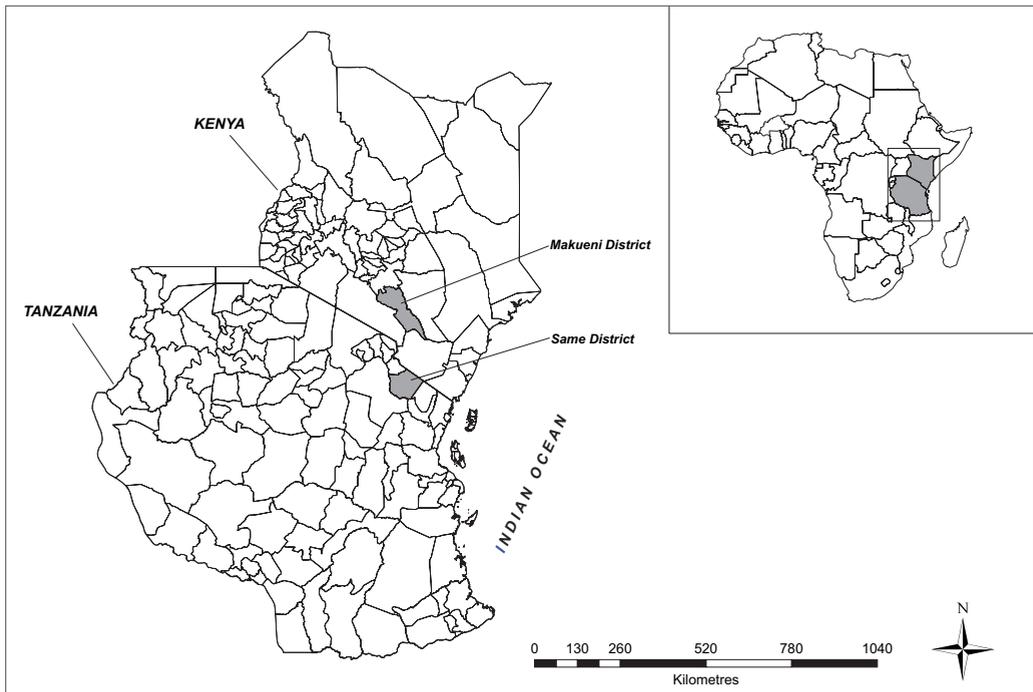
The rising atmospheric concentrations of greenhouse gases, their lagged effect on climate, and the observed effects of climate variability and change⁷ highlight that besides mitigation, adaptation is crucial (IPCC 2007). This recognition led to Decisions 5/CP.7, 7/CP.7 and 28/CP.7 of the 7th session of the Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC) in 2001 to support the Least Developed Countries (LDC), inter alia, in the preparation and implementation of National Adaptation Programmes of Action (NAPAs; UNFCCC 2001a, 2001b).

Widespread climate-induced food insecurity and disruption of natural resources-based livelihoods in sub-Saharan Africa (Ifejika Speranza 2006; Boko et al 2007) and inadequate capacity to deal with these phenomena indicate a close link between development on the one hand and climate variability and climate change on the other. This close link (Burton et al 2002; RoK 2002; URT 2003; Adger et al 2007; McGray et al 2007) and projections of future climate change (Hulme et al 2001; Thornton et al 2006; Notter et al 2007) imply that development policy and practice must account for climate risks in order to deal with the consequences of climate change. However, since reducing poverty does not always reduce vulnerability (Adger et al 2003; Eriksen and Kelly 2007), mainstreaming climate change into development policy and practice can pre-empt maladaptation to climate change (Huq et al 2003; Klein 2008).

Thus public policy and its importance in facilitating adaptation to climate change (Adger et al 2007) remain a major focus of adaptation studies (Smith and Lenhart 1996; Burton et al 2002; Tompkins and Adger 2005). Because policies define issues, offer guidance and influence decision-making and societal action, mainstreaming adaptation into development policies will ensure that climate change risks are considered in decision-making and that activities are aimed at *reducing vulnerability* and *increasing adaptive capacities*. Therefore, identifying available policy options (Smith and Lenhart 1996) and assessing how they, together with development practice, reduce vulnerability (Burton et al 2002) are major steps in adaptation. In such an assessment, understanding societal responses and their implications for adaptation is a crucial element (Burton et al 2002) and a useful starting point in developing a national climate policy framework (Tompkins and Adger 2005).

This article analyses how specific policies in Kenya and Tanzania either support or undermine the strategies of agro-pastoralists for adapting to climate variability and climate change. The consequences of national-level climate policy are experienced at local, national, regional and international scales (Tompkins and Adger 2005). Thus national-level climate policy needs to account for such consequences – in particular, it needs to take account of how adaptation is practised on the ground and offer guidance on how to reduce vulnerability and promote adaptation to climate change. Few previous studies have focused on how to integrate global climate policy into national development policies in Africa (Olsen 2006), or on how national policies take account of coping and adaptation practices at local levels (Eriksen 2000; Orindi and Eriksen 2005). The present article, accordingly, reflects on how to mainstream adaptation into development policies and how to strengthen such policies in their responses to climate variability and climate change in smallholder agriculture. It uses agro-pastoral responses to drought in arid and semi-arid lands (ASALs) as an analytical lens. The findings are based on research conducted in Kenya and Tanzania (Figure 1) from 2002 to 2004.

Fig. 1
The Kenyan and
Tanzanian case
study areas. (Map
by Chinwe Ifejika
Speranza)



About 80% of Kenya is ASAL, while between 45% and 75% of Tanzania consists of semi-arid areas (Morris et al 2001).⁸ Drylands comprise arid, semi-arid and hyper-arid areas. ASALs cover more than 70% of East Africa, with pockets of humid and sub-humid high-potential resource islands. Drylands have growing periods of less than 120 days (FAO 1993), high temperatures and erratic rainfall, poor soils, and vegetation consisting of shrubs, scrub and grasses. The ecosystems are fragile, with low crop and livestock production, except in areas where irrigation is possible. Subsistence agriculture, consisting of sedentary agriculture, agro-pastoralism and nomadic pastoralism, is the major land use. Wildlife conservancy is practised as well. Due to population increase and changes in land tenure, areas once used for extensive grazing or fallow have in many cases been converted to permanent cropping.

The predominance of rainfed subsistence agriculture, chronic poverty, poor governance, population pressure and use of marginal lands for rainfed agriculture (Ogallo 2000; Williams 2000), the dominance of water-demanding maize (Williams 2000), poor infrastructure and HIV/AIDS (WHO 2002) make agro-pastoralists vulnerable to climate variability. In addition, climatic hazards are likely to increase in frequency and severity due to climate change (Paavola 2003; Christensen et al 2007; Notter et al 2007). Climate projections indicate increases in precipitation only for a few parts of East Africa. Climate change will likely worsen the adverse effects of climate variability in the region by increasing droughts, floods and water stress, diminishing the amount of land suitable for agriculture, and reducing agricultural production, food security and livelihood security (Hulme et al 2001; Boko et al 2007). Hence reducing vulnerability and increasing adaptive capacity are fundamental to reducing the adverse impacts of climate variability and climate change.

7.2 Conceptual framework and methodology

Adaptation refers to adjustment in practices, processes or structures, in response to actual or expected changes in climate or their effects, which moderates harm or exploits beneficial opportunities (modified from Dixon et al 2003; IPCC 2007). Adaptation can be anticipatory, i.e. taking place before the impacts of climate change are observed. It can also be autonomous, i.e. constitute a conscious response not to climatic stimuli but rather to ecological changes in natural systems and to market or welfare changes in

human systems. Planned adaptation is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state (IPCC 2007). Adaptation thus involves building adaptive capacity to increase the ability to adapt to changes and to transform adaptive capacity into action by implementing adaptation actions (Adger et al 2005). Therefore, formulating or reviewing policies in response to actual or expected changes in climate is a form of adaptation.

The ability of agro-pastoralists to cope with and adapt to climate variability and climate change depends on their adaptive capacities, their resilience, and their vulnerability. Vulnerability to climate variability and climate change expresses the degree to which a person, group or human–environment system is likely to be exposed to, adversely affected by, and unable to cope with and recover from the impacts of climate variability and climate change (modified from Bohle et al 1994 and IPCC 2007). Vulnerability is, among other things, a function of adaptive capacity, i.e. the ability of an actor or a system to adjust to climate variability and climate change, to moderate potential damage, to take advantage of opportunities, or to cope with the consequences (IPCC 2007). This relates to resilience – the ability to maintain livelihoods in the face of disturbances or stresses arising from social, political, economic and environmental change (Adger 2000; Quinlan 2003; IPCC 2007). The livelihoods assets of an actor or actor group and the political and institutional frameworks in which actors are embedded are crucial determinants of adaptive capacity. Institutions refer to norms and values (e.g. ownership rights), both formal and informal, as well as agencies and organisations (e.g. water bodies).

The present synthesis was informed by two studies carried out within the Swiss National Centre of Competence in Research (NCCR) North-South programme, on drought vulnerability and risk in the agro-pastoral areas of Makueni District, Kenya (Ifejika Speranza 2006) and on management of common-pool resources in the Pangani Basin, Eastern Same District, Tanzania (Mbeyale 2008). The studies were conducted to find out why agro-pastoralists and pastoralists remain highly vulnerable to the adverse impacts of climate variability (including drought) and how the nature of access to natural resources influences their capacities to meet their livelihood needs. The assumptions were that livelihood assets, actor strategies, policies and institutions shape livelihood outcomes and vulnerability to climate variability and climate change. The aforementioned factors were analysed in both case studies. This synthesis presents some of the results of the studies.

7.3 Overview of the case studies

The links between policies, institutions and livelihood strategies are explored using data from semi-structured surveys of 127 and 339 households in Makueni District, Kenya and Same District, Tanzania, respectively, conducted between 2002 and 2004. The questions asked covered household livelihood strategies, climatic hazards such as droughts and floods, access to natural resources, the impact of institutional changes on the management of common-pool resources, and interactions between the households and various government departments. Other data sources were focus group discussions, workshops, policy documents and other literature. Each case study is introduced below, followed by a synthesis of adaptation practices and their links to policies and institutions. The two case studies depict different socio-ecological contexts (Table 1).

In both areas, agriculture is the major source of livelihood and accounts for more than 75% of household income. About 40% live below the poverty line (USD 1 per day per person). A mainly young population, increasing population density, subsistence agriculture and recurrent droughts are major features. Both areas derive advantages from their location between major urban centres: trading centres have emerged at which travellers are offered services and sold local produce. However, these centres have attracted people from other

Table 1

Characteristics of the two study areas.	Features	The semi-arid areas of former Makueni District, Kenya (now Makueni, Mbooni, Kibwezi, and Nzaui districts)	The semi-arid areas including the wetlands and floodplains of Same District, Tanzania
Location		Southeast Kenya lat. 1°35'S and 3°S / lon. 37°10'E and 38°30'E	Northeast Tanzania lat. 4°15'S and 10°S / lon. 35°10'E and 40°E
Altitude		400 m to around 600 m	500 m to around 900 m
Socio-ecological context		Semi-arid lowland agro-pastoral subsistence system with maize-dominant mixed cropping, cowpeas, pigeon peas, as well as cattle and goats	A densely populated highland-lowland subsistence/irrigation system with maize for subsistence and rice and ginger as cash crops
Inhabitants		Mainly Kikamba	Pare farmers, agro-pastoralists and charcoal makers; Maasai pastoralists

Sources: Ifejika Speranza 2006; Mbeyale 2008.

areas. As a result, the benefits for local people in terms of wage labour and paid employment are not sufficient to significantly reduce the widespread poverty.

The Makueni study area in its lower stretches is crossed by the Athi River, one of the longest perennial rivers in Kenya with a length of about 390 km. Although the Athi and other smaller perennial rivers (Kambu, Kiboko and Mtito-Andei) hold potential for irrigation, agro-pastoralists have not used them widely, mainly due to inadequate resources and land tenure-related constraints in access to river water. The few that do practise irrigation grow crops such as onions, cabbage, okra and sugarcane, but only at a small scale along the Athi River and the seasonal streams of the Kibwezi. The lowland semi-arid Same study area is directly dependent on the mountain zone for water. The forests of the South Pare Mountains are the source of all rivers and streams that feed the lowlands. The interspersed wetlands are important grazing areas, especially during dry seasons. Over the years, springs and streams have dried up (Ngana 2002) due to watershed degradation and high-water stress as a result of increased use by the population upstream. The situation is worsened by the institutional setup, which no longer provides for equitable water allocation for irrigation to both lowland and mountain communities, and does not take account of the differential vulnerabilities and risks that the communities face.

7.4 Agro-pastoral strategies and adaptation to climate variability and change

The purpose of this section is to examine agro-pastoral strategies and how these (can) serve as strategies for adapting to climate variability and change. The major strategies of agro-pastoralists (for details see Ifejika Speranza 2006; Ifejika Speranza et al 2007; Mbeyale 2008) are summarised below in terms of crop- and livestock-based strategies and cross-cutting strategies.

7.4.1 Crop- and livestock-based strategies

Mixed cropping: Households practise mixed cropping primarily to reduce risks, including climatic risks. However, maize remains dominant, covering most of the cropland. Despite climatic risks, people prefer to grow and eat maize, as it has multiple uses. It is the major staple, can easily be sold, and the stover is used for fodder. While rice and ginger are important cash

crops in the Same area, in the Makueni study area maize is sold to generate income. There is therefore a need to expand the potential of mixed cropping as an adaptation strategy by increasing the proportion of drought-tolerant crops and maize varieties in the cropping strategies.

Adoption of drought-tolerant crops/maize species: Although the actors widely acknowledge the advantages of drought-tolerant crops and maize species, only about 10% of the households use exclusively drought-tolerant maize species. This is due to their lower production, higher seed costs, and less preferable consistency and taste by comparison with the traditional variety. This low adoption exposes agro-pastoralists to drought impacts.

Adaptive/flexible cropping practices: This is done by intercropping, planting crops to coincide with the rains, or forfeiting planting for the season for the purpose of reducing crop loss.

Adaptive livestock production: Agro-pastoralists keep a mix of livestock such as local zebu cattle, goats, sheep and poultry to reduce risks and to produce meat for various purposes. Few improved breeds are kept for milk production.

Ensuring access to feed: Pastures are preserved and fodder is stored. Security and pasture conditions determine where livestock is grazed.

Livestock as 'banks': Actors bank their savings in livestock. However, drought causes livestock to emaciate and depreciate.

Food preservation and storage: This strategy is limited, as most agro-pastoralists produce less than they need to ensure their subsistence.

Securing access to natural resources (land and water): Actors harvest rainwater and secure access to other water resources by joining water cooperatives, or to land through arrangements with other land owners.

Accessing knowledge and information: Actors learn from one another, from radio programmes, from outreach workshops with researchers, and from public and private extension services. The aim of learning is to improve farm practices and diversify into non-farm activities.

7.4.2 Cross-cutting strategies

Cross-cutting strategies are not directly linked to agro-pastoralism, but the income derived is invested in crop and livestock production and is thus crucial for increasing households' adaptive capacities. The overarching strategy is diversification in various forms, including:

- charcoal production and casual labour;
- migration and multi-locality of livelihoods;
- investing in the education of children;
- nurturing social and family networks;
- copying what others are doing ('copy-cat' strategies).

'Copy-cat' is used here as an analogy to describe uniform adoption of other actors' strategies that often ends with adverse outcomes. It is frequently observed that shortly after a community member has started an enterprise – e.g. opened a village shop – many other community members copy this livelihood activity and open their own shops, leading to a mushrooming of village shops. By doing so they increase the supply of goods and services on offer, thereby causing demand to diminish and stagnate, and ultimately reducing the economic viability of such enterprises. Diffusion of innovations requires that people copy what others are doing to achieve better livelihood outcomes. Copying could thus be a viable strategy, provided that it is based on experience from best practices, also with regard to conducive overall conditions. However, our research shows that those who copy do not adequately consider the overall situation and factors such as limited demand and market saturation in rural areas. This leads to short-lived diversification and economic loss.

Faced with drought, agro-pastoralists reduce their food and water consumption, work as temporary labourers, produce charcoal, sell off livestock, buy food, and collect food aid. Even in 'normal' years most agro-pastoralists have difficulties building up assets; under drought conditions they are forced to dispose of these assets. Generally, they are in a position to maintain their asset level but need external support to increase it. The following section analyses how policies and institutions take these strategies into account.

7.5 Policies, institutions, and adaptation to climate variability and change

In Kenya and Tanzania there are no separate drought, flood or disaster preparedness policies (although one is being prepared in Kenya); nor do any specific climate variability and climate change policies exist. Issues related to climate are addressed in various policies and planning documents (Table 2) including the UNFCCC National Communications (NCs) and the Tanzanian National Adaptation Plan of Action (NAPA). Although not yet a policy, the UNFCCC-initiated NCs and the Tanzanian NAPA may evolve into one in the future. Most policies target the agricultural sector (Eriksen 2000). They aim to improve production and enhance drought resistance by developing and promoting drought-resistant crops and increasing water supply and irrigation. Nevertheless, these efforts do not specifically consider the extreme variability that confronts households (Eriksen 2000). This section discusses how the various policies relate to the agro-pastoral strategies listed above. The discussion is organised according to the list of strategies presented in Section 6.4; a non-exhaustive overview of how policies relate to strategies is provided in Table 2.

Mixed cropping and adoption of drought-tolerant crops/maize species: Many policies relate to mixed cropping (Table 2) but do not explicitly consider how and under what cultural, socio-economic and biophysical conditions it is practised. Only at the policy implementation level do extension officers actively promote mixed cropping, although maize remains dominant. The policies encourage farmers to grow drought-resistant crops, e.g. adapted maize varieties, millet and cassava. Some research centres have developed disease- and drought-resistant crops such as maize, sorghum, millet and cassava varieties that also take a shorter time to mature (URT 1997a; Oluoch-Kosura and Karugia 2005; URT 2007). Yet actors prefer maize to drought-tolerant crops like millet and sorghum, and mainly use maize varieties that are not drought-tolerant. The low rate of adoption shows that links remain weak between policies and agro-pastoralists' practices, as well as between crop researchers and agro-pastoralists' realities. To improve this situation, crop development approaches should allow for cooperation between agro-pastoralists and scientists. Besides the focus on maize, there is a need to promote adoption of drought-tolerant crops like millet and sorghum and to increase their acceptability. Accessing external markets for these crops is an option that can generate additional income.

Table 2

	Mixed cropping	Adoption of drought-tolerant crops/maize species	Adaptive/flexible cropping practices	Adaptive livestock production	Ensuring access to feed	Livestock as 'banks'	Food preservation and storage	Securing access to natural resources (incl. land)	Securing access to water	Accessing knowledge and information	Livelihood diversification	Charcoal production	Migration and multi-locality of livelihoods	Investing in education	Nurturing social and family networks	'Copy-cat' strategies
Agro-pastoral strategies																
Policies																
RoK Strategy for revitalising agriculture 2004	e					o	e			e	a					
RoK Food policy – Sessional paper No. 4, 1981	e						e			e						
URT National agriculture and livestock policy 1997a	e	e	d	d			d			e	e			e		
RoK Draft national livestock policy 2007a			e	d	d					e						
URT National livestock policy 2006			e	d	d					e						
RoK National environment action plan 1994	e											d				
RoK Environmental action plan for ASALs 1992	e						d									
URT National environmental policy 1997b							d		e							
RoK Forest policy 2000a					d							d				
URT Forest policy 1998a	e											d				
RoK Draft wildlife policy 2007b					d											
URT Wildlife policy 1998b	e															
RoK Draft national land policy 2006a			e	d			d	d								
URT Land policy 1997c	e	e					d									
URT Energy policy 1992	e											d				
URT National employment policy 1996						o				e				e		
URT Cooperative development policy 1997d						o				e				e		
RoK Water policy 2006b								d								
URT Water policy 2000a								d								
URT Water sector development strategy 2004								d								
RoK Vision 2030 (2007c)								d	e	a						
URT Development vision 2025 (2000b)								d	e							
RoK Free primary education 2003										e				e		
URT Education and training policy 1995										e				e		
RoK Poverty reduction strategy paper 2000b						o				e	e			e		
URT Poverty reduction strategy paper 1997e						o				e	e			e		
URT Rural development strategy 2001	a	e	e		o	a	d	e	e	e	d		e	e		
RoK first National Communication to the UNFCCC 2002	a	a	a	e					o	o						
URT initial National Communication to the UNFCCC 2003	e	e	e	e		e			o	o	e					
URT National Adaptation Plan of Action (NAPA) 2007	e	a	e	e	e			e	e	e	d					

Agro-pastoral adaptation strategies and related policies. Key: e = encouraged; d = discouraged; a = acknowledged; o = indirectly addressed through related options that can lead to positive outcomes; empty field = not addressed.

Adaptive/flexible cropping practices: Apart from the NCs and the Tanzanian NAPA (RoK 2002; URT 2003, 2007), flexible cropping practices are not targeted in any policies. Meteorological departments provide seasonal outlooks based on which some actors adapt their practices. However, extension services have inadequate resources and decision-making power to enable fast and flexible responses to climate variability and climate change.

Adaptive livestock production: The Tanzanian national-level agriculture and livestock policy discourages traditional pastoral practices; the district government encourages people to maintain no more than 50 head of livestock to avoid resource conflicts with farmers and land degradation. However, farmers have trouble reducing herds due to their importance to household income as well as the cultural values attached to livestock. Nevertheless, this culture is likely to change gradually through education; the Maasai have now started to farm in addition to keeping animals.

Ensuring access to feed: While many policies encourage adaptive livestock production, they rather discourage access to public grazing resources. Yet under drought conditions flexible access to grazing resources is crucial. The NCs and the Tanzanian NAPA do encourage provision of such access. The various policies guiding rangeland use (Table 2) have conflicting goals: wildlife policies aim to protect wildlife and provide a basis for tourism at the expense of fencing out those most dependent on resources such as grazing lands, wild plants and animals. In general, the benefits of tourism are rarely shared with local people. By accessing pastures in protected areas during droughts, agro-pastoralists risk penalisation by the government and conflict with wildlife. Buffer grazing zones for livestock during droughts are needed, but policies only make provisions for buffer zones for wildlife. In the Tanzanian study area, policies (URT 1998a, 1998b) remain silent regarding the problems that communities face during droughts, and although district governments can permit pastoralists to migrate to other areas with better pastures, they rarely do so.

Livestock as 'banks', focused asset accumulation and divestment: Savings and Credit Co-operatives (SACCOs) are widespread, but many agro-pastoralists continue to accumulate their wealth in the form of livestock even though the traditional strategy of 'storing wealth' in livestock no longer suits current conditions. Policies (e.g. URT 1996, 1997d) support the formation of savings and credit societies, but these are still in their infancy in Tanzania. Rural banking and credit services are needed as complementary sav-

ings and credit options for agro-pastoralists. Yet there are few financial and credit services in rural areas. Where they do exist, defaulting on repayments, low capitalisation, and poor capacity among communities to use available funds limit their potential to secure rural livelihoods effectively. While policies (URT 2000b, 2001; RoK 2007c) acknowledge the importance of livelihood diversification, no provision is made to train rural actors with regard to investment opportunities and their management. There is thus a need to increase awareness about financial services and to provide such training.

Food preservation and storage: Several policies (Table 2) and institutions address food availability, as well as food distribution and its coordination between the national, district and village levels. In this context, climate variability and climate change are addressed indirectly through their impacts, i.e. in this case through food insecurity. In order to discourage relief-food dependency, measures were introduced to couple relief-food distribution with productive work (RoK 2007d). Corruption is another problem: some politicians will want to send food to their constituencies even when there is no food shortage. Yet verification measures that aim to combat fraudulent food distribution increase bureaucracy and delay food distribution. Thus, there is a need to depoliticise food distribution and make it transparent.

Secure access to natural resources (including land): Policies that promote secure access to land (Table 2) also have provisions for managing conflict over natural resources (URT 1997b, 1997c, 2000a). Still, governments appear to have conflicting goals as areas that pastoralists and agro-pastoralists need for their livelihoods are converted into protected areas. Alternatives for the actors to bridge crisis periods are not considered (URT 1997a, 2001, 2006). Other policies have elements that can reduce vulnerability by allowing communities to participate in tourism. Yet there are very few examples where these principles of access and benefit sharing, community participation in tourism, and compensation for damage by wildlife are implemented.

Ensuring access to water: Agro-pastoralists harvest rainwater and runoff, but the potentials of these practices have not yet been fully exploited. Implementation of the Water Sector Development Strategy (URT 2004) led to the constitution of Water Users Associations (WUAs) in Same district. In the Makueni study area, the government also supports irrigation by smallholders in the few areas where it is viable. While WUAs have already been incorporated into policies in Kenya (RoK 2006b), they have not yet been implemented in the Makueni study area. Studies in similar areas in Kenya

show that WUAs are effective in reducing water conflicts related to over-abstraction (Liniger et al 2005; Kiteme and Wiesmann 2008). Plans call for making water available in ASALs and rehabilitating existing irrigation schemes (URT 2000a, 2000b; RoK 2007a, 2007c). In the Same study area, separation into upstream and downstream management led to a mismatch between the social and ecological scales of Common Properties Resources (CPRs) management and institutional failure. It worsened resource use conflicts and degradation of the CPRs. The ensuing reduction in access to water for irrigation reduced the capacity of communities to cope with climate variability and climate change. However, it has to be noted that the potentials for irrigation have not yet been fully explored.

Accessing knowledge and information: Many policies in both countries (Table 2) aim to improve access to knowledge and information for the rural population. In Kenya, the Ministry of Agriculture (MoA) and the Ministry of Livestock and Fisheries Development (MLFD), through their extension services, are major providers of agricultural and related information. The private sector and NGOs disseminate information as well. The meteorological departments provide seasonal outlooks, collaborate with the media, and produce a radio and internet programme in Kenya. Yet various challenges such as inadequate historical data and sparse distribution of stations (Ogallo 2000) hamper provision of reliable climate information and need to be addressed. Hence, these institutions require sustained financial and technical support.

Charcoal production: Various policies (Table 2) aim to promote a sustainable environment, increase forest cover, and ensure access to energy (RoK 1994, 2000a, 2007c; URT 1997b), as well as reduce land degradation, lack of accessible good quality water, and loss of wildlife habitat (URT 1998b; RoK 2007b). Yet no viable strategies have been proposed to reduce dependence of both rural and urban populations on fuelwood. In Kenya, the forest policy (RoK 2000a) aims at forest protection. It does not foresee co-management with the local population. However, reducing or avoiding deforestation can help reduce CO₂ emissions, thereby sequestering carbon and reducing the greenhouse effect and global warming. In both countries there is currently no viable alternative to charcoal and fuelwood; charcoal production thus remains an important strategy for the poor. Efforts to develop alternatives have either not been successful or failed to be widely adopted. Continued research is thus needed.

Education: Agro-pastoralists value education. They believe that educated persons are more likely to escape poverty by engaging in non-farm income generating activities (Mortimore 2003). Educational policies in both countries (Table 2) aim to achieve universal primary education. These policies have indeed led to increasing numbers of enrolled pupils (Vos et al 2004). However, the aim of raising literacy levels has been easier to meet than the aim of fostering growth and development through education, as a growing number of graduates find employment only months after graduation. There is thus a need to harmonise the various existing education policies and adapt them to emerging trends in the employment sector.

Activating social and family networks: Rural actors, especially women, organise themselves in Self Help Financial Groups (SHFGs) to increase their financial capacity. However, experience has shown that SHFGs collapse in a crisis. Ensuring a stable capital base for such groups is crucial in order to enable them to provide financial services continuously. No policies explicitly encourage remittances to rural areas despite the demonstrated positive effects on the household and rural economies (Ifejika Speranza 2006) or, internationally, to the recipient national economies. The proven positive effect should encourage governments to create incentives for such transfers through measures such as tax exemption. ‘Social/familial insurance’, which depends solely on family networks, needs to be formalised into social insurance and micro-insurance to improve resilience. No policies explicitly address these existing forms of insurance that rural actors use.

Adaptation in agriculture features prominently in the first NCs of both Kenya and Tanzania (RoK 2002; URT 2003). According to the first NC of Kenya, “[a]daptation options in the agriculture sector would include: development of early maturing and high-yielding crop varieties and adaptation of agricultural technologies from analogue environments” (RoK 2002, p xx in summary). In relation to drought, the proposed adaptation strategies include the

[i]ntroduction of drought-tolerant/escaping crops, irrigation and fertilizers; development of high-yielding, more resistant, early maturing and disease- and pest-tolerant crops. Adaptation strategies will include disposing of stocks early before the onset of drought. (RoK 2002, p 44)

For Tanzania,

the proposed adaptation measures for crop production mainly involve land-use and management related changes. Changes in land use involve changes in farmed area, changes in the crop type to suit the changes in climate conditions, and changes in crop location. Changes in management require the introduction of an irrigation system and different crop cultivars, improved manure/fertilizer use, control of pests, weeds and diseases, change in planting dates, and better exploitation of climate and weather data. (URT 2003, p 44)

Apart from the technological adaptation measures, the measures proposed do not directly address the major agro-pastoral strategies identified in the previous section. They do not consider the underlying socio-economic factors that cause vulnerability, impair livelihoods and hinder the adoption of adaptation strategies. Orindi and Eriksen (2005) published similar findings on the Ugandan initial national communication on climate change.

This shows that many policies do not adequately address issues that are of concern to agro-pastoralists. Many policies are cross-sectoral; their addressing multiple issues bears the risk of conflicting goals and overlap with sectoral policies. It is not clear whether such cross-sectoral policies supersede sectoral policies. There is thus a risk of duplication of activities, as several institutions focus on ensuring food security and promoting the development of drought-tolerant crop species. Some key aspects of agro-pastoral strategies, such as diversification, migration and multi-locality, are not addressed at all in many policies. Strategies prominently promoted in some policies (e.g. RoK 2002, p 119), such as forest protection and soil conservation practices (e.g. no tillage or mulching), are not widely adopted, and specifications on land use are often not adhered to or difficult to enforce.

The policies displayed in Table 2 show that agro-pastoral strategies are not limited to the agricultural sector but span various socio-economic sectors. The diversification strategies of agro-pastoral actors call for a shift from perceiving them as being active exclusively in the agricultural sector to seeing them as partly earning their livelihood from non-agricultural sectors. Accordingly, policies should take account of these cross-sectoral diversification strategies. Table 2 also shows that some strategies, such as mixed cropping, need to be explicitly addressed and re-examined in more detail, as they form the core of agro-pastoral cropping strategy.

The multitude of policies addressing agro-pastoral strategies call for some form of policy coordination. While the Kenya Environmental Management and Coordination Act of 1999 (in force since January 2000) aims to harmonise environmental policies and mainstream environmental concerns into national planning and management processes in Kenya, including facilitating implementation of climate change mitigation, enforcement and coordination remain challenging (RoK 2002). The Tanzanian government acknowledges that “the institutional framework for climate change in Tanzania should take into account the need for an economy-wide holistic approach to mitigation and adaptation” (URT 2003, p 63). It sees the exploitation of sectoral synergies as an important element and involves all relevant sectors. Hence, perspectives from rural development and from agro-pastoralists, who constitute a large proportion of the rural poor, offer insights into how to strengthen policies and pro-poor adaptation strategies.

7.6 Conclusions

This study analyses how national policies consider local coping and adaptation strategies. The analysis shows that apart from drought, climate variability and climate change are not explicitly addressed in policy documents. Floods, storms, frost and extreme heat also need to be addressed. Several activities concerned with enhancing rural actors’ adaptive capacities need continued support in order to secure agro-pastoral livelihoods.

The various policies addressing different responses to climate variability and change show that an adaptation policy (Burton et al 2002) and some degree of mainstreaming already exist. The fact that these policies were developed to address development in the context of climate variability and other driving factors rather than focusing more exclusively on climate change impacts reflects the close link between climate change adaptation and development.

However, policies do not adequately address agro-pastoral strategies. In some cases, strategies prominently promoted in policies are not widely adopted by agro-pastoralists. There is a need to re-examine the adoption and non-adoption of certain policy-proposed strategies. Failure to do so will limit the adoption and effectiveness of adaptation measures.

The proposed activities of the NAPA (URT 2007; Osman-Elasha and Downing 2007) and the planned national strategies on adaptation are some proc-

esses that could integrate climate variability and climate change into the development process. However, a holistic policy on rural development that focuses on securing production, availability of and access to natural resources, thereby reducing poverty and vulnerability, will most likely capture local actor realities in adaptation planning. The conflicting goals of some policies can be reduced by adopting the perspectives of the vulnerable. This is imperative when the aim is to reduce poverty and where the majority of the poor are rural actors.

This contribution used agro-pastoral coping and adaptation practices as a lens to analyse how policies and institutions take them into account in the context of climate variability and climate change. This does not mean that other perspectives and levels are not important. Nevertheless, this article highlights issues that need to be addressed from a rural pro-poor perspective in order to achieve resilience to climate variability and climate change.

Endnotes

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⁷This article uses the definitions for climate variability and climate change coined by the Intergovernmental Panel on Climate Change (IPCC): “Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events” (IPCC 2007, p 944); “Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer” (IPCC 2007, p 943).

⁸Various definitions of arid and semi-arid areas in Tanzania exist due to difficulties in delineating them (Morris et al 2001).

References

Publications elaborated within the framework of NCCR North-South research are indicated by an asterisk (*).

- Adger WN. 2000. Social and ecological resilience: Are they related? *Progress in Human Geography* 24(3):347–364. doi:10.1191/030913200701540465.
- Adger WN, Agrawala S, Mirza MMQ, Conde C, O'Brien K, Pulhin J, Pulwarty R, Smit B, Takahashi K. 2007. Assessment of adaptation practices, options, constraints and capacity. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE, editors. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press, pp 717–743.
- Adger WN, Arnell NW, Tompkins EL. 2005. Successful adaptation to climate change across scales. *Global Environmental Change* 15(2):77–86. doi:10.1016/j.gloenvcha.2004.12.005.
- Adger WN, Huq S, Brown K, Conway D, Hulme M. 2003. Adaptation to climate change in the developing world. *Progress in Development Studies* 3(3):179–195. doi:10.1191/1464993403ps0600a.
- Bohle HG, Downing TE, Watts MJ. 1994. Climate change and social vulnerability: Toward a sociology and geography of food insecurity. *Global Environmental Change* 4(1):37–48. doi:10.1016/0959-3780(94)90020-5.
- Boko M, Niang I, Nyong A, Vogel C, Githeko A, Medany M, Osman-Elasha B, Tabo R, Yanda P. 2007. Africa. In: Parry ML, Canziani OF, Palutikof JP, van der Linden PJ, Hanson CE, editors. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press, pp 433–467.
- Burton I, Huq S, Lim B, Pilifosova O, Schipper EL. 2002. From impacts assessment to adaptation priorities: The shaping of adaptation policy. *Climate Policy* 2(2–3):145–159.
- Christensen JH, Hewitson B, Busuioc A, Chen A, Gao X, Held I, Jones R, Kolli RK, Kwon WT, Laprise R, Magaña Rueda V, Mearns L, Menéndez CG, Räisänen J, Rinke A, Sarr A, Whetton P. 2007. Regional climate projections. In: Solomon S, Qin D, Manning M, Chen Z, Marquis M, Averyt KB, Tignor M, Miller HL, editors. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press, pp 847–940.
- Dixon RK, Smith J, Guill S. 2003. Life on the edge: Vulnerability and adaptation of African ecosystems to global climate change. *Mitigation and Adaptation Strategies for Global Change* 8(2):93–113. doi:10.1023/A:1026001626076.
- Eriksen SH. 2000. *Responding to Global Change: Vulnerability and Management of Local Agro-ecosystems in Kenya and Tanzania* [PhD dissertation]. Norwich, UK: University of East Anglia.
- Eriksen SH, Kelly PM. 2007. Developing credible vulnerability indicators for climate adaptation policy assessment. *Mitigation and Adaptation Strategies for Global Change* 12(4):495–524. doi:10.1007/s11027-006-3460-6.
- FAO [Food and Agriculture Organization]. 1993. *Key Aspects of Strategies for the Sustainable Development of Drylands*. Rome, Italy: FAO.
- Hulme M, Doherty R, Ngara T, New M, Lister D. 2001. African climate change: 1990–2100. *Climate Research* 17(2):145–168. doi:10.3354/cr017145.
- Huq S, Rahman A, Konate M, Sokona Y, Reid H. 2003. *Mainstreaming Adaptation to Climate Change in Least Developed Countries (LDCs)*. London, UK: International Institute for Environment and Development (IIED). Also available at: <http://www.un.org/special-rep/ohrls/ldc/LDCsreport.pdf>; accessed on 16 June 2009.
- * Ifejika Speranza C. 2006. *Drought Vulnerability and Risk in Agro-pastoral Areas: An Integrative Approach and Its Application in Kenya* [PhD dissertation]. Bern, Switzerland: University of Bern.

- * Ifejika Speranza C, Kiteme BP, Wiesmann U. 2007. Droughts and famines: The underlying factors and the causal links among agro-pastoral households in semi-arid Makueni district, Kenya. *Global Environment Change* 18(1):220–233. doi:10.1016/j.gloenvcha.2007.05.001.
- IPCC [Intergovernmental Panel on Climate Change]. 2007. *Climate Change 2007: IPCC Fourth Assessment Report. Workgroup I. Annex 1: Glossary*. Cambridge, UK: Cambridge University Press.
- * Kiteme BP, Wiesmann U. 2008. Sustainable river basin management in Kenya: Balancing needs and requirements. In: Hirsch Hadorn G, Hoffmann-Riem H, Biber-Klemm S, Grossenbacher-Mansuy W, Joye D, Pohl C, Wiesmann U, Zemp E, editors. *Handbook of Transdisciplinary Research*. Berlin, Germany: Springer Verlag, pp 63–78.
- Klein RJT. 2008. *Mainstreaming Climate Adaptation into Development*. A Stockholm Environment Institute Briefing Note for the European Parliament Temporary Committee on Climate Change. Stockholm, Sweden: Stockholm Environment Institute.
- * Liniger HP, Gikonyo J, Kiteme BP, Wiesmann U. 2005. Assessing and managing scarce tropical mountain water resources: The case of Mount Kenya and the semi-arid Upper Ewaso Ng'iro Basin. *Mountain Research and Development* 25(2):163–173. doi:10.1659/0276-4741(2005)025[0163:AAMSTM]2.0.CO;2.
- * Mbeyale GE. 2008. *The Impact of Institutional Changes on the Management of Common Pool Resources in Pangani River Basin: A Case of Same District, Tanzania* [PhD dissertation]. Dar es Salaam, Tanzania: University of Dar es Salaam.
- McGray H, Hammill A, Bradley R. 2007. *Weathering the Storm: Options for Framing Adaptation and Development*. Washington, D.C.: World Resources Institute. Also available at: http://pdf.wri.org/weathering_the_storm.pdf; accessed on 27 August 2008.
- Morris M, Butterworth J, Lamboll R, Lazaro E, Maganga F, Marsland N. 2001. *Household Livelihood Strategies in Semi-arid Tanzania: Synthesis of Findings*. Annex A of the Final Technical Report of Project R7805. London, UK: Department for International Development (DFID). Also available at: <http://www.nrsp.org/database/documents/730.pdf>; accessed on 11 May 2008.
- Mortimore M. 2003. Long-term change in African drylands: Can recent history point towards development pathways? *Oxford Development Studies* 31(4):503–518. doi:10.1080/1360081032000146654.
- Ngana J, editor. 2002. *Institutional Framework for the Management of Water Resources in the Pangani Basin: Water Resources Management, the Case of Pangani River Basin*. Dar es Salaam, Tanzania: Dar es Salaam University Press Ltd.
- * Notter B, McMillan L, Viviroli D, Weingartner R, Liniger HP. 2007. Impacts of environmental change on water resources in the Mount Kenya region. *Journal of Hydrology* 343(3/4):266–278. doi:10.1016/j.jhydrol.2007.06.022.
- Ogallo LA. 2000. Predicting drought in Kenya. In: Wilhite DA, editor. *Drought: A Global Assessment*. Vol. 1. London, UK and New York, NY: Routledge, pp 52–67.
- Olsen KH. 2006. National ownership in the implementation of global climate policy in Uganda. *Climate Policy* 5(6):599–612.
- Oluoch-Kosura W, Karugia JT. 2005. Why the early promise for rapid increases in maize productivity in Kenya was not sustained: Lessons for sustainable investment in agriculture. In: Djurfeldt G, Holmén H, Jirström M, Larsson R, editors. *The African Food Crisis: Lessons from the Asian Green Revolution*. Wallingford, UK: CABI Publishing, pp 181–196.
- Orindi VA, Eriksen S. 2005. *Adaptation to Climate Change in the Development Process in Uganda*. Ecopolicy Series No. 15. Nairobi, Kenya: African Centre for Technology Studies (ACTS).
- Osman-Elasha B, Downing TE. 2007. *Lessons Learned in Preparing National Adaptation Programmes of Action in Eastern and Southern Africa*. European Capacity Building Initiative (ecbi) Policy Analysis Report. Oxford, UK: ecbi. Also available at: http://www.eurocapacity.org/downloads/ecbi_NAPA_PA_Project_2007.pdf; accessed on 12 May 2008.
- Paavola J. 2003. *Vulnerability to Climate Change in Tanzania: Sources, Substance and Solutions*. Paper presented at the Inaugural Workshop of the Southern Africa Vulnerability Initiative (SAVI), Maputo, Mozambique, 19–21 June 2003. Available at: http://www.gechs.org/savi/workshop/maputo/papers/paavola_tanzania.pdf; accessed on 11 May 2009.

- Quinlan A. 2003. *Resilience and Adaptive Capacity: Key Components of Sustainable Socio-ecological Systems*. IHDP Update. Bonn, Germany: International Human Dimensions Programme on Global Environmental Change (IHDP).
- RoK [Republic of Kenya]. 1981. *Sessional Paper No. 4 of 1981 on National Food Policy*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 1992. *Environmental Action Plan for Arid and Semi-Arid Lands (ASAL) in Kenya*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 1994. *National Environment Action Plan*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2000a. *Forest Policy*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2000b. *Poverty Reduction Strategy Paper*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2002. *First National Communication of Kenya to the Conference of The Parties to The United Nations Framework Convention on Climate Change (UNFCCC)*. Nairobi, Kenya: Ministry of Environment and Natural Resources, National Environment Secretariat. Also available at: <http://unfccc.int/resource/docs/natc/kenncl.pdf>; accessed on 11 May 2009.
- RoK [Republic of Kenya]. 2003. *Free Primary Education*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2004. *Strategy for Revitalising Agriculture*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2006a. *Draft National Land Policy*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2006b. *Water Policy*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2007a. *Draft Sessional Paper No... of... (year) on National Livestock Policy*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2007b. *Draft Wildlife Policy*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2007c. *Vision 2030*. Nairobi, Kenya: Republic of Kenya.
- RoK [Republic of Kenya]. 2007d. *The Third Annual Progress Report 2005–2006 on Economic Recovery Strategy 2003–2007*. Nairobi, Kenya: Monitoring and Evaluation Directorate, Ministry of Planning and National Development. Available at the library of the Central Bureau of Statistics, Nairobi, Kenya.
- Smith JB, Lenhart SS. 1996. Climate change adaptation policy options. *Climate Research* 6:193–201.
- Thornton PK, Jones PG, Owiyo T, Kruska RL, Herrero M, Kristjanson P, Notenbaert A, Bekele N, Omolo A, Orindi V, Otiende B, Ochieng A, Bhadwal S, Anantram K, Nair S, Kumar V, Kulkar U. 2006. *Mapping Climate Vulnerability and Poverty in Africa*. Report to the Department for International Development. Nairobi, Kenya: The International Livestock Research Institute (ILRI). Also available at: <http://www.research4development.info/PDF/Outputs/ClimChangePovInAfrica.pdf>; accessed on 20 June 2008.
- Tompkins EL, Adger WN. 2005. Defining response capacity to enhance climate change policy. *Environmental Science and Policy* 8(6):562–571. doi:10.1016/j.envsci.2005.06.012.
- UNFCCC [United Nations Framework Convention on Climate Change]. 2001 a. *Addendum Part Two: Action Taken by the Conference of the Parties*. Report of the Conference of the Parties on its Seventh Session, Marrakesh, Morocco, 29 October–10 November 2001, Vol. 1. Bonn, Germany: UNFCCC. Also available at: <http://unfccc.int/resource/docs/cop7/13a01.pdf>; accessed on 11 May 2009.
- UNFCCC [United Nations Framework Convention on Climate Change]. 2001 b. *Addendum Part Two: Action Taken by the Conference of the Parties*. Report of the Conference of the Parties on its Seventh Session, Marrakesh, Morocco, 29 October–10 November 2001, Vol. 4. Bonn, Germany: UNFCCC. Also available at: <http://unfccc.int/resource/docs/cop7/13a04.pdf>; accessed on 11 May 2009.
- URT [United Republic of Tanzania]. 1992. *Energy Policy*. Dar es Salaam, Tanzania: Ministry of Water, Energy and Minerals.
- URT [United Republic of Tanzania]. 1995. *Education and Training Policy*. Dar es Salaam, Tanzania: Ministry for Education and Vocational Training.
- URT [United Republic of Tanzania]. 1996. *National Employment Policy*. Dar es Salaam, Tanzania: Ministry of Labour and Youth Development.

- URT [United Republic of Tanzania]. 1997a. *National Agriculture and Livestock Policy*. Dar es Salaam, Tanzania: Ministry of Agriculture and Cooperatives.
- URT [United Republic of Tanzania]. 1997b. *National Environmental Policy*. Dar es Salaam, Tanzania: Vice President's Office.
- URT [United Republic of Tanzania]. 1997c. *Land Policy*. Dar es Salaam, Tanzania: United Republic of Tanzania.
- URT [United Republic of Tanzania]. 1997d. *Cooperative Development Policy*. Dar es Salaam, Tanzania: United Republic of Tanzania.
- URT [United Republic of Tanzania]. 1997e. *Poverty Reduction Strategy Paper*. Dar es Salaam, Tanzania: United Republic of Tanzania.
- URT [United Republic of Tanzania]. 1998a. *Forest Policy*. Dar es Salaam, Tanzania: United Republic of Tanzania.
- URT [United Republic of Tanzania]. 1998b. *Wildlife Policy*. Dar es Salaam, Tanzania: Ministry of Natural Resources and Tourism.
- URT [United Republic of Tanzania]. 2000a. *The National Water Policy*. Dar es Salaam, Tanzania: Ministry of Natural Resources and Tourism.
- URT [United Republic of Tanzania]. 2000b. *Development Vision 2025*. Dar es Salaam, Tanzania: United Republic of Tanzania.
- URT [United Republic of Tanzania]. 2001. *Rural Development Strategy*. Dar es Salaam, Tanzania: United Republic of Tanzania.
- URT [United Republic of Tanzania]. 2003. *Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC)*. Dar es Salaam, Tanzania: Vice President's Office. Also available at: <http://unfccc.int/resource/docs/natc/tannc1.pdf>; accessed on 20 June 2008.
- URT [United Republic of Tanzania]. 2004. *Water Sector Development Strategy*. Dar es Salaam, Tanzania: Ministry of Natural Resources and Tourism.
- URT [United Republic of Tanzania]. 2006. *National Livestock Policy*. Dar es Salaam, Tanzania: Ministry of Natural Resources and Tourism.
- URT [United Republic of Tanzania]. 2007. *National Adaptation Plan of Action*. Dar es Salaam, Tanzania: Vice President's Office. Also available at: <http://unfccc.int/resource/docs/napa/tza01.pdf>; accessed on 20 June 2008.
- Vos R, Bedi A, Kimalu PK, Manda DK, Nafula NN, Kimenyi MS. 2004. *Achieving Universal Primary Education: Can Kenya Afford It?* Department of Economics Working Paper Series No. 47. Storrs, CT: Department of Economics, University of Connecticut. Also available at: <http://www.econ.uconn.edu/working/2004-47.pdf>; accessed on 16 June 2009.
- WHO [The World Health Organisation]. 2002. *World Health Report 2002: Reducing Risks, Promoting Healthy Life*. Geneva, Switzerland: WHO.
- Williams J. 2000. Drought risk management in Africa: Developing institutions to transform 'belated disaster response' into informed preparedness. In: Wilhite DA, editor. *Drought: A Global Assessment*. Vol. 1. London, UK and New York, NY: Routledge, pp 168–169.

8 **Features of Successful Syndrome Mitigation: Enhancing Resilience and Empowering the Vulnerable in East Africa**

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Abstract

This paper examines how knowledge-based interventions improve the quality of life in communities where they are implemented. It draws on case studies of three interventions implemented as Partnership Actions to Mitigate Syndromes (PAMS) within the Swiss National Centre of Competence in Research (NCCR) North-South programme. The case studies consist of a qualitative evaluation based on experience, knowledge and expertise gained through participants' observations, as well as relevant documents and reports. The concepts of 1) syndrome mitigation; 2) participation and empowerment; and 3) vulnerability and resilience are used as assessment indicators to demonstrate the levels of and differences in contributions by and among the respective interventions. The assessment reveals that although each of the three projects contributed to syndrome mitigation in its respective context, there are marked disparities in the level of individual achievement that are influenced by the nature of problems of unsustainability, technological requirements, and the implementation costs of the preferred intervention.

Keywords: Syndrome mitigation; participation; empowerment; vulnerability; resilience; East Africa.

8.1 Background

Syndromes are a combination of problems of unsustainability that occur in a given context (WBGU 1997). The Swiss National Centre of Competence in Research (NCCR) North-South supports societies in partner countries in their efforts to address syndromes in their regions and find strategies to mitigate them (Hurni et al 2004). The Partnership Actions to Mitigate Syndromes (PAMS) constitute one of the programme strategies designed to achieve this goal by making it possible to implement, test and validate research outcomes through short-term partnership actions involving researchers and the societies concerned. PAMS focus on problems of unsustainable development, as well as the potentials and societal processes that support sustainable development (Messerli et al 2007). Although PAMS are not designed as pure development projects, they constitute NCCR North-South development interventions in the areas where they are implemented.

PAMS are unique in their innovative, real-time knowledge-based approach combining research and development, but like with any development intervention the aim of PAMS is to help improve the quality of life among their target populations. Between 2003 and 2007, the NCCR North-South implemented five PAMS in East Africa focusing on 1) low-cost renewable fuel production on small-scale farms; 2) participatory urban planning and management; 3) community-based HIV/AIDS control through voluntary counselling and testing; 4) capacity development for local governance of common pool resources; and 5) river water resources management and conflict resolution, respectively. In addition, the NCCR North-South collaborated with associated programmes such as the Eastern and Southern Africa Partnership Programme (ESAPP) to implement other similar interventions in the region.

Using three interventions as a basis, this article examines whether the PAMS approach, through the respective interventions, made a measurable contribution to the goal of improving the quality of life in target communities. It discusses the assessment methodology and assessment indicators, and then describes the three case studies, examining how they helped to reduce problems of unsustainability. A comparative assessment of individual projects is then made with respect to their levels of contribution and possible explanatory factors. The article concludes by drawing four key lessons from the assessment process.

8.2 Approach and methodology

The present synthesis article uses *syndrome mitigation*, *participation and empowerment*, and *vulnerability and resilience* as assessment indicators to examine how the three interventions enhanced sustainability and improved the quality of life in the target communities. *Syndrome mitigation* is used because the PAMS were grounded in the basic assumption that sustainability problems occur in clusters and should be addressed with this in mind when mitigation approaches are sought (Messerli et al 2007). Secondly, *participation and empowerment* allow us to examine whether the interventions helped the communities to attain greater freedom for and extended their margins or spheres of action in negotiations and decision-making processes. Thirdly, *vulnerability and resilience* point to whether the interventions helped to improve livelihoods at household or community levels, not in terms of levels of income, but in terms of greater ability not only to cope with and adjust to adverse conditions but also to create sustainable options and responses that open new pathways for living with change (Obrist et al 2009).

Two PAMS projects focusing on local governance capacity for common pool resources and on river water resources management and conflict resolution, respectively, and a project by a NCCR North-South associate on wheat production in Kenya's semi-arid districts of Makueni and Machakos serve as case studies (see Figure 1). Their assessment is based on experience, knowledge and expertise gained through participants' observations during implementation, as well as available documents, including baseline survey reports. A matrix is used for comparative assessment with a view to detecting any differences in the level of success of the projects.

8.3 Conceptual considerations concerning assessment indicators

Syndrome mitigation consists of measures taken by individuals or institutions in one or more areas of intervention that help to reduce the effects of single or combinations of several core problems, thereby actually or potentially reducing negative impacts of global change and contributing to sustainable development (Hurni et al 2004).

Participation refers generally to the active involvement of the public or stakeholders concerned in decision-making and actions (Arnstein 1969; Connor

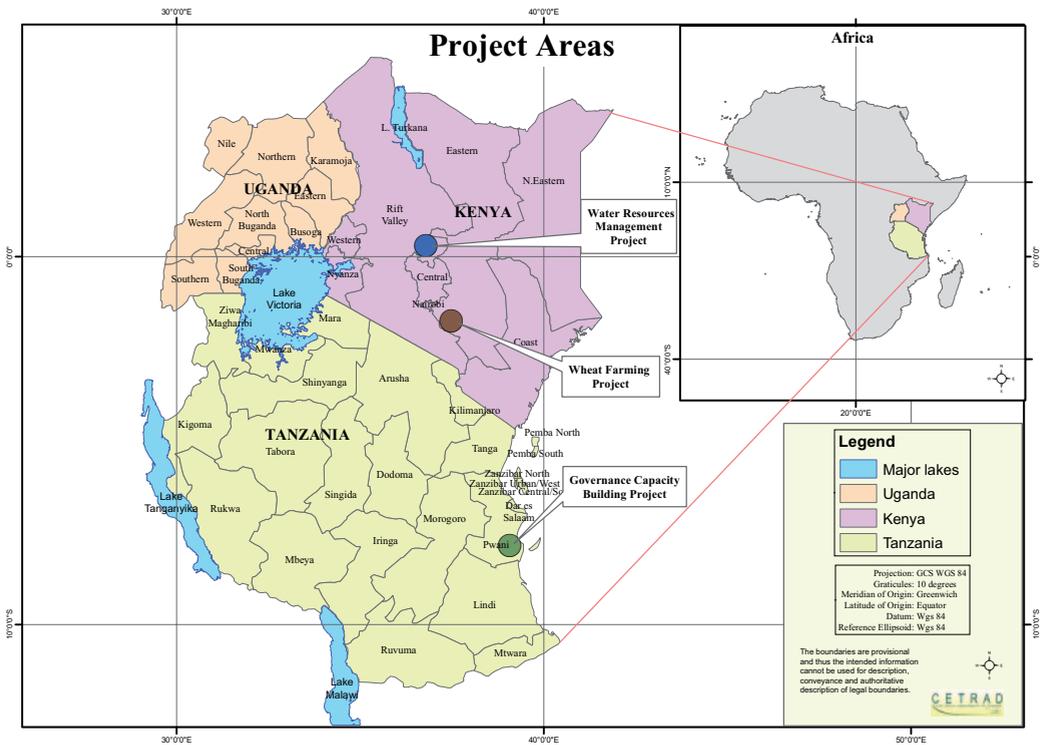


Fig. 1 Map showing the project areas of the three Partnership Actions for Mitigating Syndromes (PAMS) examined in this study.

1988; Chambers 1989; Wiedemann and Femers 1993; Dorcey et al 1994; World Bank 1996). Participation can take different forms (Arnstein 1969; Collier 2002) and may involve different stakeholder groups at different levels depending on need (Collier 2002; Kiteme and Wiesmann 2008). If properly managed, a participatory process can promote sustainability by building on existing potentials and capacities, and by enhancing ownership and increasing commitment on the part of the stakeholders, among other things.

Empowerment as defined in different socio-cultural and political contexts (Cheater 1999) is more than simply opening up space for decision-making: It entails understanding the dynamics of oppression and internalised oppression, since these affect the ability of less powerful groups to participate in decision-making and influence the world around them (Mosse 1994). Empowerment should help vulnerable populations gain power to negotiate and build capacity for active involvement in decision-making and implementation.

In the social sciences, *resilience* refers to the ability of social actors not only to cope with and adjust to adverse conditions (reactive), but also to create sustainable options and responses (proactive) that open new pathways for living with change (Obrist et al 2009). *Vulnerability*, on the other hand, is the likelihood of being harmed by a given adverse event, and has an external side consisting of risks, shocks and stress to which individuals or households are subjected, and an internal defenceless side characterised by a lack of means to cope without a damaging loss (Chambers 1989). Both concepts have been linked with ‘sustainable livelihoods’ to underscore their interrelation with livelihood assets and the institutions that mediate access to these assets, which together shape the way in which people build ‘layers of resilience’ to cope with various disturbances (Glavovic et al 2003).

Syndrome mitigation, participation and empowerment can help to reduce vulnerability and enhance resilience. By learning from those who manage certain risks and hazards better, we can identify processes and principles of resilience-building that can be strengthened and applied through empowerment and participation.

8.4 Selected case studies

8.4.1 River water resources management and conflict resolution in the upper Ewaso Ng’iro North River Basin

Long-term studies in the upper Ewaso Ng’iro catchment revealed increased overuse of low-flow water for irrigation (Aeschbacher et al 2005; Liniger et al 2005; MacMillan and Liniger 2005; Notter et al 2007), leading to reduced dry-season flow and user conflicts (Wiesmann et al 2000; Kiteme and Gikonyo 2002; Notter 2003; Ehrensperger and Kiteme 2005; Kiteme 2006; Kiteme and Wiesmann 2008). Water users continue to take advantage of institutional weaknesses in law enforcement and manipulate individual abstraction works and control devices in order to maximise off-take during prolonged dry periods. This problem has persisted despite sustained corrective efforts by the government as well as water users’ associations, which have gained some legislative backing through recent water-sector reforms (GoK 2002; Liniger et al 2005).

These findings informed the decision to develop the technology of a self-regulating weir (SRW) and test its potential contribution to guaranteeing

secure low flow for downstream water users in the catchment. This was further justified through a feedback process between researchers and key stakeholders during a series of water awareness campaigns, as well as the desire expressed by the Burguret River Water Users' Association to strengthen its regulatory role pertaining to river water use in its area of jurisdiction.

An engineering firm was commissioned to design the project and provide technical supervisory support. Subsequently, the different stakeholder groups, including relevant government departments, large-scale commercial farmers, smallholder farmers, and local administration and leadership, were mobilised for necessary negotiations and implementation of the project. After approval and acceptance by all stakeholders was secured, construction work was carried out over about 18 months, at a total cost of around USD 40,000 (2004/2005 factor prices).

The preceding discussions underline that systems knowledge was critical to triggering and sustaining successful negotiation and implementation of the innovative idea of a SRW. The SRW abstracts only the flood flow and cannot be manipulated by the water user(s), thus guaranteeing a secure low flow for downstream users. To this extent, the device has the potential to effectively address the problem of over-abstraction of river water and related user conflicts. Availability of river water to downstream users during the dry season increases their spheres of action (in crop production) and enhances their livelihood systems, thereby increasing their layers of resilience to future threats. The inclusive negotiation process helped to create a sense of ownership and commitment among the different stakeholder groups – an important element in social sustainability.

The technology became popular with the government, and the Ministry of Water approved the device for replication in areas faced with similar problems. However, the prohibitive costs and the inability of stakeholders concerned to mobilise the required resources have hindered replication plans. This limits the overall potential of the technology to contribute to sustainable management of river water in the basin and elsewhere in the country.

8.4.2 Wheat production for improved food security in the semi-arid districts of Makueni and Machakos in Kenya

A NCCR North-South study revealed that despite high rainfall variability and recurrent droughts, maize remains the dominant crop in the semi-arid

districts of Makueni and Machakos in Kenya. It is grown by all households and accounts for about 82% of the area under crop production. The reason for this is that maize doubles as a subsistence crop and a commercial crop. However, this practice constrains crop diversification as a strategy to minimise risks of crop failure associated with moisture stress (Ifejika Speranza 2006; Ifejika Speranza et al 2007). Despite the availability of alternative crops, such as the recently developed wheat varieties (*Duma* and *Njoro 1*) that were recommended for smallholder production in areas like the one examined in the above-mentioned study, uptake was hindered by a lack of seed to supply to the farmers. Based on these findings, the “Smallholder Wheat Production in Arid and Semi-arid Lands” project was developed to promote wheat farming in the semi-arid districts of Kenya through community-based seed bulking and distribution in selected areas of Makueni and Machakos districts.

Before seed bulking, selected farmers and the facilitating organisations were trained in the basics of wheat farming, harvesting and primary processing, as well as packaging and utilisation of wheat and wheat products. The training benefited over 160 farmers drawn from 13 villages in the two test areas. The facilitating community-based organisations (CBOs) were provided with 50 kg of wheat seed and basic farm inputs for initial multiplication. After the first season, the seed generated by the CBOs was distributed to 100 farmers for further multiplication. In the two subsequent seasons, enough seed was accumulated to supply over 600 farmers, increasing the initial area under production from about 6.5 acres to over 600 acres in 13 villages.

This intervention was based on knowledge derived from research that helped to understand the agronomic and socio-economic factors contributing to food insecurity in the areas concerned. This knowledge informed the design of targeted campaigns for crop diversification and suitable alternative crop varieties that meet farmers’ subsistence and commercial expectations, on the one hand, and are adapted to ecological conditions in the test areas, on the other hand. Compared with maize, the two wheat varieties *Duma* and *Njoro 1* have higher yields, fetch better prices, require less moisture and mature early, thus guaranteeing successful harvests and improved income. This broadened the spheres of action for smallholder farmers and provided them with an additional layer of resilience, greatly influencing uptake and the success of the innovation.

The intervention has a high degree of replicability, as already evidenced by the rapid increase in the number of farmers growing wheat after the initial

seed-bulking process. Due to its availability from CBOs and participating farmers, wheat seed became affordable even for poor farmers. This was a boost to upscaling efforts, as more farmers went into wheat farming beyond the initial test areas.

8.4.3 Local governance capacity development for common pool resources in the Rufiji floodplain, Tanzania

The Rufiji floodplain has very high biodiversity and provides a livelihood for more than 150,000 people. However, it is threatened by unsustainable exploitation of its natural resources by a rapidly growing population, and due to poor management and inadequate resource governance capacity at the local level (Durand 2003; Milledge and Kaale 2005). Initial field campaigns by the NCCR North-South research team identified this as a critical area of ecological unsustainability, and a PAMS project was then designed to address this. The project aimed to improve the capacity for local governance in order to enhance ownership and control of natural resources, increase the technical ability to manage physical production sustainably, and augment financial returns from common pool resources (Mottier 2005).

The project built on five years of pre-investments by the IUCN, through the Rufiji Environment Management Programme, and involved communities in seven villages in Ngumburuni Forest and three villages on Lake Zumbi, as well as IUCN Tanzania, the Rufiji District Council, specialists, and local leaders and administration. A NCCR North-South research team provided backstopping for the process. This case study focuses on interventions in Ngumburuni Forest.

Before the PAMS was launched, a stakeholders' workshop was organised in order to create awareness and analyse the situation. The project was endorsed during this workshop, and a work programme was agreed upon. The awareness campaigns aimed to educate stakeholders with regard to the status, threats and consequences of prevailing user practices, as well as potential pathways for addressing the problems observed. An integrated campaign team was formed and appropriate dissemination materials were developed to support the campaigns. A series of workshops and other events, such as screening of environmental management documentaries, role-playing and concerts, were held. Moreover, an award scheme was set up to promote active involvement by the participating villages and collaboration among local organisations. The capacity-building process involved a series of train-

ing and educational events at different levels. Two grassroots institutions (the Village Environment Management Committees and the Village Natural Resources Scouts Committees) were formed and used as entry points for capacity-building interventions. Key areas of focus included legislative and policy instruments governing natural resource management, good governance, drafting of by-laws, preparation of Village Environment Management Plans, and participatory approaches to natural resource governance, among other things.

The main outcomes of the capacity-building process and resultant institutions were the following: 1) Village Environment Management Plans for the seven villages were formulated and implemented, with the respective by-laws providing the principal instruments for enforcement; 2) the communities negotiated and gazetted boundaries for the Ngumburuni Forest Reserve (see Tanzania's Forest Act [URT 2002]); and 3) management responsibilities were transferred to the Village Natural Resources Scouts Committees.

This intervention built on pre-investments made by the IUCN in Rufiji and derived its integrative approach from knowledge innovation in NCCR North-South research (Meroka 2006). This approach led to success in empowering the communities and enhancing stakeholder participation. And although it may take more time for impacts on biodiversity conservation to manifest, a monitoring and evaluation workshop at the end of the project (i.e. after two years) reported remarkable reduction of the main threats to the Ngumburuni Forest Reserve as a result of increased surveillance by forest scouts.

The training process, together with the new governance institutions, empowered the local communities to participate actively in the management of the forest reserve, particularly in negotiating and delineating forest boundaries, setting revenue targets and making investment plans, and defining incentive and disincentive measures to curb misuse. The project interventions did not, however, create immediate resilience-building elements, especially at the household level. This can be justified by the fact that it was not one of the initial project objectives to do so. Still, it is expected that the intervention's contribution to resilience-building will become evident in the medium to long term, when degraded ecosystems services are restored and assume their optimal functions.

8.5 Comparative assessment

This section presents a comparative assessment of the three selected projects to highlight their levels of success and provide explanations for similarities and differences. The results are presented in a matrix (Table 1): the project focus and the nature of knowledge innovation, as well as the key elements of preferred interventions, are summarised in the first column; the level of the contributions made by each project, based on four assessment indicators, is summarised in the other columns, ranging from strong (+++) to medium (++) and weak (+).

The comparative assessment reveals that all three pilot projects were based on knowledge innovation that made targeting easy and effective. Each project contributed significantly at different levels to mitigating (a) problem(s) of unsustainability. There follows a brief discussion of the factors that explain these differences, based on the four assessment indicators.

Potential for syndrome mitigation: Although all three interventions have the potential to address problem(s) of unsustainability, the SRW is considerably limited because it is only effective if the technology is adapted for a majority of water abstractions in the catchment. Wheat production has the greatest potential because the technology is easily adopted and the direct benefits to the participating households motivate widespread application. The Rufiji intervention also has potential, provided that adequate awareness creation and training are conducted and appropriate grassroots institutions are created and legitimately embedded in existing structures.

Participation and empowerment: The SRW contributed little to participation and empowerment compared to the other two projects because the technological preconditions of the project limited the extent to which some stakeholder groups, especially poor and semi-literate smallholder farmers, were able to participate in making key decisions or in influencing the implementation process.

Resilience and vulnerability: None of the three projects revealed a strong impact on building resilience and reducing vulnerability. This situation can be explained by the fact that each of these interventions is subject to a multitude of preconditions for optimal performance. The contributions of both the wheat production and the local governance capacity development projects were moderate because the success of the former was also subject to a given

Table 1

	Syndrome mitigation	Participation and empowerment	Vulnerability and resilience	Replicability
<p>1. River water resources management and conflict resolution in the upper Ewaso Ng'iro North River Basin</p> <p><i>Knowledge innovation:</i> Long-term hydrological monitoring (declining dry-season flows) and socio-economic studies (increasing water abstractions for irrigation)</p> <p><i>Intervention:</i> Installation of self-regulating flood flow abstraction device</p>	++	++	+	+
<p>2. Wheat production for improved food security in semi-arid districts of eastern Kenya</p> <p><i>Knowledge innovation:</i> Agronomic and socio-economic factors contributing to food insecurity; dominance of maize in agro-ecologically marginal areas</p> <p><i>Intervention:</i> Community-based seed bulking and smallholder wheat farming</p>	+++	+++	++	+++
<p>3. Local governance capacity development for common pool resources (CPRs) in the Rufiji floodplain</p> <p><i>Knowledge innovation:</i> Stakeholder analysis in traditional and modern institutional arrangements for management of CPRs</p> <p><i>Intervention:</i> Capacity development through training, awareness creation and formation of grassroots institutions and support instruments</p>	+++	++	++	++

level of rainfall, while the latter required more time for impacts on livelihoods to manifest. By contrast, the SRW was assessed as weak because it broadened spheres of action only for a small segment of the local population. The limited scale of application of this technology downstream limits its potential to help reduce vulnerability and enhance resilience at household and community levels.

Replicability: The high costs of installing the SRW in terms of technical expertise and inputs make this technology unfeasible for individual smallholder water users; hence it has very limited replicability. Although dupli-

Summarised results of the comparative assessment of the three projects.

cation of the grassroots structures for local governance of common pool resources elsewhere is possible, the potential is curtailed by the costs of providing the required professional expertise for the training process. In this sense, these two interventions were assessed as having made weak and moderate contributions, respectively. On the other hand, the wheat production intervention was rapidly adopted due to its technological simplicity and comparatively low costs of implementation.

8.6 Conclusion

The three projects followed different paths of intervention depending on the nature of the problem(s) of unsustainability on which they focused. The river water resources management and conflict resolution project installed a self-regulating device to regulate water abstraction and guarantee a secure low flow for downstream users. The wheat production project focused on community-based seed bulking to promote smallholder wheat farming in semi-arid areas, while the project concerned with capacity development for common pool resources emphasised training, awareness creation, formation of grassroots institutions and support for legislative instruments. Overall, the wheat and governance capacity development projects performed better than the SRW project. Compared to the other two projects, the SRW project was limited by its technological preconditions and high cost of implementation. Therefore, the extent to which a given type of intervention will succeed in addressing problem(s) of unsustainability and contributing to the overall quality of life of beneficiaries is greatly influenced by its technological requirements, implementation costs, and level of integration in existing institutional structures. Based on the results of the comparative assessment and these conclusions, we derive the following key lessons:

Integrative knowledge matters: Knowledge innovation, i.e. the approach of combining research and development interventions, helps to design more effective interventions.

Grassroots structures are indispensable: Appropriate grassroots institutional structures and support instruments are necessary to promote legitimate and effective stakeholder participation and empowerment.

Costs and technologies are a very sensitive issue: Technological complexity or simplicity and project implementation costs play an important role in

hindering or promoting the rate of adoption and replicability of any given innovation.

Short-term stand-alone interventions are shaky: PAMS and associated projects are pilot actions, and their 12–24-month timeframe for implementation is not adequate to trigger and sustain the social processes associated with vulnerability and resilience. However, this can be effectively addressed if interventions are embedded in existing structures or ongoing long-term interventions.

Endnotes

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References

Publications elaborated within the framework of NCCR North-South research are indicated by an asterisk (*).

- Aeschbacher J, Liniger HP, Weingartner R. 2005. River water shortage in a highland–lowland system: A case study of the impacts of water abstraction in the Mount Kenya region. *Mountain Research and Development* 25(2):155–162.
- Arnstein SR. 1969. A ladder of citizen participation. *American Institute of Planners Journal* 35(4):216–224.
- Chambers R. 1989. Editorial introduction: Vulnerability, coping and policy. *IDS Bulletin* 20(2):1–7.
- Cheater A, editor. 1999. *The Anthropology of Power: Empowerment and Disempowerment in Changing Structures*. London, UK and New York, NY: Routledge.
- Collier D. 2002. *Community Stakeholder Involvement*. Berkshire, UK: Greenstreet Berman Ltd.
- Connor DM. 1988. A new ladder of citizen participation. *National Civic Review* 77(3):249–257.
- Dorcey A, Doney L, Rueggeberg H. 1994. *Public Involvement in Government Decision-making: Choosing the Right Model*. Victoria, Canada: Round Table on the Environment and the Economy.
- Durand JM. 2003. *Implementation of the Rufiji Forest Action Plan with Special Emphasis on Community Based Natural Resource Management and a Case Study of Ngumburuni Forest*. Rufiji Environment Management Project (REMP) Technical Report 45. Dar es Salaam, Tanzania: International Union for Conservation of Nature (IUCN).
- Ehrensperger A, Kiteme BP. 2005. *Upper Ewaso Ng'iro River Basin Water Management Information Platform: A Survey on Development Priorities, Information Needs, and Conflict Management Efforts*. Nanyuki, Kenya: Centre for Training and Integrated Research in Arid and Semi-Arid Lands Development (CETRAD).
- Glavovic B, Scheyvens R, Overton J. 2003. Waves of adversity, layers of resilience: Exploring the sustainable livelihoods approach. *Proceedings of the Third Biennial Conference of the Aotearoa New Zealand International Development Studies Network Conference 'Contexting Development: Pathways to Better Practice', 5–7 December 2002*. Palmerston North, New Zealand: Massey University, pp 289–293.
- GoK [Government of Kenya]. 2002. *Water Act 2002. Kenya Gazette Supplement*. Nairobi, Kenya: Government of Kenya.
- * Hurni H, Wiesmann U, Schertenleib R, editors. 2004. *Research for Mitigating Syndromes of Global Change: A Transdisciplinary Appraisal of Selected Regions of the World to Prepare Development-oriented Research Partnerships*. Perspectives of the Swiss National Centre of Competence in Research (NCCR) North-South, University of Bern, Vol. 1. Bern, Switzerland: Geographica Bernensia.
- * Ifejika Speranza C. 2006. *Drought Vulnerability and Risk in Agro-pastoral Areas: An Integrative Approach and Its Application in Kenya* [PhD dissertation]. Bern, Switzerland: University of Bern.
- * Ifejika Speranza C, Kiteme BP, Wiesmann U. 2007. Droughts and famines: The underlying factors and the causal links among agro-pastoral households in semi-arid Makueni district, Kenya. *Global Environmental Change* 18(1):220–233.
- * Kiteme BP. 2006. *Multidimensional Approaches to More Sustainable Natural Resources Management in Highly Dynamic Contexts in East Africa* [PhD dissertation]. Bern, Switzerland: University of Bern.
- * Kiteme BP, Gikonyo J. 2002. Preventing and resolving water use conflicts in the Mount Kenya highland–lowland system through water users' associations. *Mountain Research and Development* 22(4):332–337.
- * Kiteme BP, Wiesmann U. 2008. Sustainable river basin management in Kenya: Balancing needs and requirements. In: Hirsch Hadorn G, Hoffmann-Riem H, Biber-Klemm S, Grossenbacher-Mansuy W, Joye D, Pohl C, Wiesmann U, Zemp E, editors. *Handbook of Transdisciplinary Research*. Berlin, Germany: Springer Verlag, pp 63–78.

- * Liniger HP, Gikonyo J, Kiteme BP, Wiesmann U. 2005. Assessing and managing scarce tropical mountain water resources: The case of Mount Kenya and the semiarid Upper Ewaso Ng'iro Basin. *Mountain Research and Development* 25(2):163–173.
- MacMillan L, Liniger HP. 2005. Monitoring and modelling for the sustainable management of water resources in tropical mountain basins: The Mount Kenya example. In: Huber UM, Bugmann HKM, Reasoner MA, editors. *Global Change and Mountain Regions: An Overview of Current Knowledge*. Berlin, Germany: Springer Verlag, pp 605–616.
- * Meroka P. 2006. *Common Pool Resource Management and Conflict Resolution in Rufiji Floodplain, Tanzania* [PhD dissertation]. Zurich, Switzerland: Department of Social Anthropology, University of Zurich.
- * Messerli P, Salmi A, Herweg K, Pfister F, Breu T. 2007. *Bridging Research and Development: Partnership Actions for Mitigating Syndromes (PAMS) in the Swiss National Centre of Competence in Research (NCCR) North-South: Capitalising on Experience*. NCCR North-South Dialogue No. 17. Bern, Switzerland: Swiss National Centre of Competence in Research (NCCR) North-South.
- Milledge SAH, Kaale BK. 2005. *Bridging the Gap: Linking Timber Trade with Infrastructure Development in Southern Tanzania – Baseline Data before Completion of Mkapa Bridge*. Dar es Salaam, Tanzania: The Wildlife Trade Monitoring Network (TRAFFIC).
- Mosse D. 1994. Authority, gender, and knowledge: Theoretical reflections on the practice of participatory rural appraisal. *Development and Change* 25:497–526.
- Mottier E. 2005. *Final Report of the PAMS Project “Strengthening Local Natural Resource Governance Capacity in the Rufiji floodplain, Tanzania”*. Dar es Salaam, Tanzania: International Union for Conservation of Nature (IUCN) Tanzania Country Office.
- Notter B. 2003. *Rainfall–Runoff Modelling of Meso-scale Catchments in the Upper Ewaso Ng'iro Basin, Kenya* [MSc thesis]. Bern, Switzerland: Institute of Geography, University of Bern.
- * Notter B, MacMillan L, Viviroli D, Weingartner R, Liniger HP. 2007. Impacts of environmental change on water resources in the Mount Kenya region. *Journal of Hydrology* 343(3/4):266–278.
- * Obrist B, Pfeiffer C, Henley B. 2009. *Multi-layered social resilience: A new approach in mitigation research*. Unpublished article available from Brigit Obrist.
- URT [United Republic of Tanzania]. 2002. *The Forest Act*. Dar es Salaam, Tanzania: Ministry of Natural Resources and Tourism.
- WBGU [German Advisory Council on Global Change]. 1997. *World in Transition: The Research Challenge*. Berlin, Germany: Springer Verlag.
- Wiedemann PM, Femers S. 1993. Public participation in waste management decision making: Analysis and management of conflicts. *Journal of Hazardous Materials* 33:355–368.
- Wiesmann U, Gichuki FH, Kiteme BP, Liniger HP. 2000. Mitigating conflicts over scarce water resources in the highland–lowland system of Mount Kenya. *Mountain Research and Development* 20(1):10–15.
- World Bank. 1996. *The World Bank Participation Source Book: Environmentally Sustainable Development*. Washington, D.C.: The World Bank.

