CURRENT AFRICAN ISSUES 63

Agricultural Water Institutions in East Africa

Edited by: Atakilte Beyene

NORDISKA AFRIKAINSTITUTET, UPPSALA 2015

INDEXING TERMS:
Water resources
Water management
Irrigation systems
Climate change
Agriculture
Farming
Community participation
Appropriate technology
Development projects
Case studies
Kenya
Tanzania

ISSN 0280-2171
ISBN 978-91-7106-777-7

Cover photo: A Somali elder cleans his face in an irrigation canal, 40 km North of Beledweyne, Somalia. By Ilyas A Abukar. Public Domain
Production: Byrå4
Print on demand, Lightning Source UK Ltd.

Contents

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Acrimony

AEZ	Agro-Ecological Zones
ASAL	Arid and Semi-Arid Lands
BWS	Blue Water Saving
CAAC	Catchment Areas Advisory Committees
CDM	Clean Development Mechanisms
CMS	Catchment Management Strategy
CWMS	Community Water Management Systems
EMCA	Environmental Management Coordination Act
ENSO	El Niño Southern Oscillation
ES	Ecological/Environmental Services
EWS	Early Warning Systems
FGD	Focus Group Discussion
GoK	Government of Kenya
GWC	Green Water Credits
GWS	Green Water Saving
LIF	Legal and Institutional Framework
LSCA	Lower Sub-Catchment Area
PAE	Performance Assessment and Evaluation
PES	Payments for Ecological/Environmental Services
PPF	Production Possibility Frontiers
PPP	Public-Private Partnerships
PWS	Payment for Watershed Services
REDD+	Reducing Emissions from Deforestation and forest Degradation
SCMP	Sub-Catchment Management Plans
SPSS	Statistical Package for Social Sciences
SWC	Soil and Water Conservation
USCA	Upper Sub-Catchment Area
WAB	Water Appeal Boards
WASREB	Water Services Regulatory Board
WRMA	Water Resources Management Authority
WRMD	Water Resource Management and Development
WRUA	Water Resource Users' Associations
WSB	Water Services' Boards
WSP	Water Service Providers

Strengths and Weaknesses of Kauti Irrigation Water Users' Association, Kenya

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Introduction

The topographic and orographic characteristics of water catchments are key factors disadvantaging farmers living upstream in accessing water resources while their downstream counterparts enjoy plenty of water. Climate change is another threat to water availability for farming and poverty alleviation in rural areas. Finally, the absence of market outlets locks these farmers out of business opportunities.

In response to these issues, the Government of Kenya (GoK) introduced seve ral pro-poor schemes enabling stakeholder participation in the management of their water resources to ensure water equity and poverty alleviation. This chapter evaluates the strengths and weaknesses of the Green Water Saving (GWS) schemes implemented in Muooni Catchment in Kenya. It focuses on the results of the Political, Economic, Social, Technological, Legal and Ecological (PESTLE) and Strengths, Weaknesses, Opportunities and Threats (SWOT) analyses of Kauti Irrigation Water Users' Association (Kauti IWUA) and presents findings based on the responses of 101 farmers and 20 key informants and a Focus Group Discussion (FGD).

The results reveal that Kauti IWUA has a high potential for curbing floods and ensuring water equity under conditions of drought. However, its weak institutional, financial and technological capacities are major barriers to achieving environmental sustainability. The latter was underscored by the lack of proper strategic plans and a disaster preparedness system as well as the obsolescence of

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the hydro-meteorological equipment. The findings of this evaluation can assist with the further implementation of the water sector reforms enshrined in the Kenya Constitution 2010.

Purpose of the Study

Climate change has been blamed for segregating rich and poor people in most rural areas in Africa, owing to its adverse effects on their livelihoods (Bates et al. 2008). In response to these climate risks and impacts, GoK introduced several pro-poor schemes to enable farmer participation in the management of natural resources and to achieve poverty alleviation (K'akumu 2008; Luwesi and Bader 2013).

In assessing the strengths and weaknesses of the GWS schemes implemented in Muooni Catchment by Kauti IWUA, the study revealed both farmer vulnerability and capability vis-à-vis water stresses in these Arid and Semi-Arid Lands (ASALs). The study particularly focused on the risks facing farmers as well as the strategies they put in place to mitigate the effects of environmental degradation on water availability and farming production under fluctuating rainfall regimes.

By focusing on the strengths and weaknesses of GWS schemes, the study will advance existing knowledge on pro-poor schemes. This will help to enhance farm profitability and foster the financial and economic viability of farmers in both on-farm and off-farm activities.

Literature Review

Climate Change and Water Inequality

Climate change is a great threat to environmental sustainability, economic development and social welfare in our global society (Field et al. 2012). Several climate scenarios predict that unprecedented natural disasters arising from social and economic changes and environmental changes will have lasting effects on community livelihoods at local, regional and global scales (Hulme et al. 2001; Pachauri 2004). Africa is especially vulnerable in as much as many rural communities, living with limited resources, depend on rainfed agriculture and livestock keeping for their livelihood (FAO 1995a).

Moreover, the changing effect of land use/cover change on hydrology is further exacerbated by global warming, resulting in increased mean surface temperatures and unpredictable rainfall patterns (FAO 1995b; UNEP 2009). This is evidenced by the cycle of El Niño (flooding) and La Niña (drought) experienced every decade in Kenya since the 1980s (Shisanya 1990; Shisanya et al. 2011). This perturbation of rainfall constitutes a major constraint on agricultural development and crop yield, with some areas being more vulnerable than others owing to the topographic and orographic characteristics of water catchments (FAO 2003; UNEP 2002; WRI 2003). These factors disadvantage many farmers living upstream in terms of access to water resources while their downstream counterparts enjoy plentiful water (Ngonzo et al. 2010). There is thus a need for "business not as usual" in the management of water resources (Berntell 2008). An Integrated Watershed Management (IWM) system is proposed to correct the differences in water use, water rights and accessibility that often result in "water inequality" (Cosgrove and Rijsberman 2000; Biswas 2004). Successful conservation of water catchments requires effective management of water at source, its equitable allocation and its efficient use by farmers (Luwesi 2011).

Pro-Poor Schemes in Response to Water Inequality

Besides facing "water inequality," most farmers in the tropics have to contend with poor incomes, not only because of poor yields but also because of the absence of market outlets and hence of business opportunities (FAO 2003). Moreover, the market provides misleading information to economic decision-makers at all levels by failing to reflect the full costs of goods and services (Brown 2001).

Effective farming resource management and decision-making should consider both endogenous and exogenous factors pertaining to agricultural production and resource allocation, use and management (Al-Salaymeh et al. 2011). Sound management of endogenous factors tends to maximise business strengths and minimise its weaknesses, while that of exogenous factors, both social and environmental, may present business opportunities that may lead to effective conservation of resources and prevent disastrous threats to their management (Waswa 2006; Boseman and Phatok 1989).

Hence, in responding to climate change and its repercussions for water, GoK introduced several reforms to the Water Act 2002, paving the way for pro-poor schemes (Mogaka et al. 2006; K'akumu 2008). These were intended to enable farmers to participate in the planning, development, allocation, management, monitoring and evaluation of water resources for poverty alleviation (WRMA 2010). Novel schemes have recently been developed based on the premise that there are cause-effect relationships between land use/cover changes, ecological functions and community welfare (Luwesi and Bader 2013). They include Payments for Watershed Services (PWS), Green Water Credits (GWC), Clean Development Mechanisms (CDM), and Reducing Emissions from Deforestation and forest Degradation (REDD+) (Luwesi et al. 2012; Akombo et al. 2014).

These schemes enable community members, water services providers and development partners to pay for watershed services that are provided by local stakeholders in a well-defined and voluntary transaction. The aim is to secure the sustainability of the services, provided the stakeholders continue to supply these services (conditionality) (Wunder 2005). These schemes actually result in benefits that would not have been provided without payment. These payments in cash or kind, including governmental duties, result in invaluable environmental services provided to local stakeholder and the government (Jumbe and Angelsen 2011). Above all, these pro-poor schemes have been found to be effective mechanisms initiated by local stakeholders for poverty alleviation in place of national poverty reduction strategies (Hardner and Rice 2002). They are well suited to ensuring sustainable farming management in times of water stress and scarcity (Luwesi and Bader 2013).

However, some scholars are sceptical about the ability of such schemes to generate valuable environmental services (Achard et al. 2002; Balmford et al. 2002). One reason is that degradation continues, despite billions of dollars invested in stemming the global loss of native ecosystems (Pattanayak and Kramer 2001; Pattanayak and Wendland 2007). This rapid ecosystems' degradation may be partly attributed by the fact that many of the environmental services supplied are by nature externalities (Arrow et al. 2000). Consequently, communities implementing these pro-poor schemes have failed to create institutions that internalise the public values of intact ecosystems (Pattanayak et al. 2010). Finally, Shisanya et al. (2014) argue that GWS schemes are at a crossroads in the ASALs of Kenya because they are not financially and economically feasible, despite being environmentally, politically and socially innovative. This chapter presents empirical results that enhance our understanding of the pro-poor schemes adopted in Kenyan ASALs and their strengths and weaknesses in curbing climate change impacts and assuring farmers' livelihoods.

Methodology

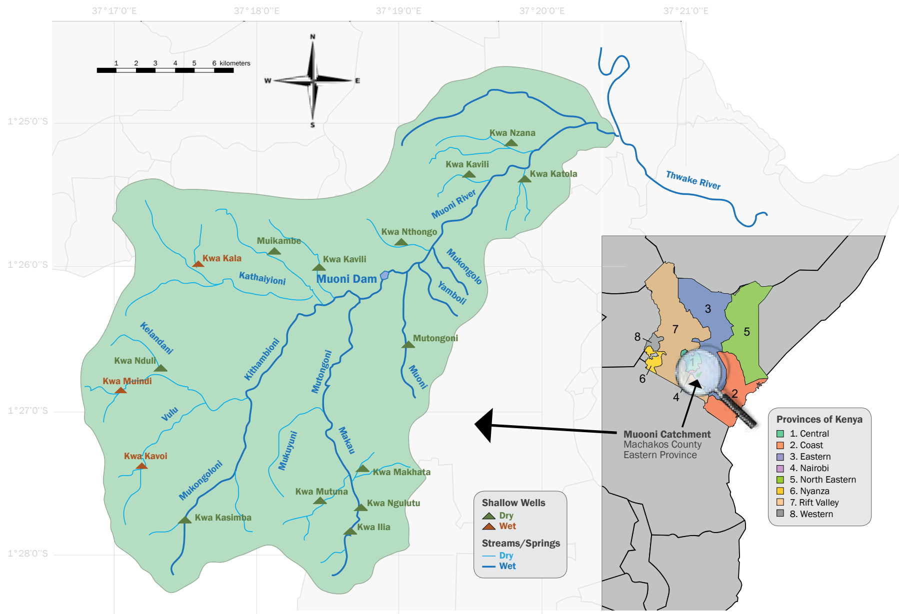
Study Area

Muooni Catchment is a small catchment area located in south-eastern Kenya, within Machakos County, Kathiani Division and Mitaboni Location. It is 25 km^2 large and lies between latitudes 1.24 °S and 1.28 °S, and longitudes 37.16 °E and 37.20 °E (Figure 1). It is dry and hilly area, with altitudes of 1,434 (near Kathiani) to 2,005 metres (at Mutondoni) above sea level. The catchment is part of Upper Midland Agro-Ecological Zone 4 (UM4-AEZ), a zone of medium potential and suitable for sunflowers and maize. The land is intensively cultivated, even the steep slopes. Yet, its climate is not suited to such cropping, conditions ranging from arid to semi-arid (Luwesi et al. 2011).

The El Niño Southern Oscillation (ENSO) often affects agricultural production in terms of rainfed and irrigated agricultural yields and crop treatments (Jaetzold et al. 2007). That is why the short rainy season becomes either extremely wet or totally dry in the course of climate change. Mean annual rainfall ranges between 500 and 1,300 mm, with 66 % reliability and annual evapotranspiration of about 1,622 mm. Water in the catchment area is mainly supplied by Muooni River and its dam, as well as by rainfall (Table 1).

Some homesteads harvest rainwater and/or pump water directly from the

Figure 1: Muooni Catchment Area



Source: Luwesi et al. (2012)

Table 1: Key hydrological features of Muooni Catchment

No	Characteristics	Values
1	Catchment area	25 km^2
2	Muooni dam reservoir area	15.2 hectares
3	Annual average rainfall	~ 540 mm
4	Rainfall reliability (% Effective Rainfall)	66 %
5	Estimated evapo-transpiration	~ 1,622 mm
6	Altitude at spillway level	1614 m
7	Catchment altitude	1,434–2,005 m.
8	Average Min. temperature	12.0 °C
9	Average Max. temperature	23.0 °C
10	Average annual temperature	17.5 °C
11	Population in 2010	~ 25,000 pers.
12	Population density in 2010	~ 1,000 pers./km^2
13	Total water demand in 2010	~ 842 m^3/day
14	Estimated water demand by 2030	~1,800 m^3/day
15	Average Muooni dam yield	~ 258.5 m^3/day
16	Muooni dam specific capacity (Spillway level)	~836,000 m^3/year
17	Average borehole yield	~8.64 m^3/day
18	Borehole specific capacity	~451.1 m^3/year
19	Average discharge during high flow	1.69 m^3/ sec

Source: Luwesi et al. (2012)

dam for storage in plastic and underground tanks (Oduor 2003). Food is generally provided through agriculture, livestock-keeping and small-scale businesses. No doubt, soil erosion, water stress and food insecurity are major concerns among Muooni Catchment farmers. Since 2009, the Water Resources Management Authority (WRMA) has tried to address these challenges by developing a Catchment Management Strategy (CMS) for the Athi Basin (WRMA 2010). However, a Water Resource Users' Association (WRUA) has not been established in Muooni Catchment, although an environmental management committee overseeing Muooni Dam has, as has the Kauti IWUA.

Research Design

This research was built on an explanatory design to develop causal explanations between the effect of GWS schemes on environmental services at one end and the effect of farming water availability on farmers' profitability and welfare at the other (Krathwoh 1998). The explanatory design is useful for answering the "why" questions pertaining to the sustainability of pro-poor schemes in Kenyan ASALs in the course of climate change (Mugenda and Mugenda 2003). The explanation was not restricted to fact finding about Kauti IWUA but was extended to other Kenyan ASALs so as to be able to generate problem-solving strategies for farming water disasters (Kerlinger 1986).

Sampling Strategy and Data Collection

The selection of Muooni Catchment is mainly explained by the need to build scenarios of vulnerability-capability in relation to water disasters, with a focus on droughts and floods. A stratified random sampling strategy was used to select farms at Muooni Dam site. The study area was divided into two homogenous ecological strata to ease data collection, namely the Upper Sub-Catchment Area (USCA) and the Lower Sub-Catchment Area (LSCA) (Krumme 2006). The USCA was demarcated as the "green water provision area," owing to its higher altimetry (generally greater than 1 %). The LSCA was "the green water demand area," since its altimetry is normally below 1 %. The study also used the Zeiller (2000) random walk sampling technique to demarcate a total of 101 farms for survey questionnaires, 21 FGD participants and 20 key informants for in-depth interviews. These data enabled the development of a database in the Statistical Package for Social Sciences (SPSS) and MS Excel spreadsheets.

Data Analysis

Firstly, the study rated the performance of the management of Kauti IWUA to evaluate water service delivery against the targets set out in its strategic plans using an integrated PESTLE analysis and Downing (2003) Vulnerability-Capacity Assessment (VCA) (Table 2).

Table 2: Communities' response-capacity to climate disasters

	Adaptive Capacity	
Impacts	Low	High
High	Vulnerable communities	Development opportunities
Low	Residual Risks	Sustainability

Source: Adapted from Downing (2003)

The PESTLE and VCA were based on farmers' responses during the FGD and the survey as well as literary works related to the study area. Then, the study explored the best farming and watershed management practices and the failures under the GWS schemes in Muooni Catchment. SWOT analysis of these pro-poor schemes was useful for this purpose.

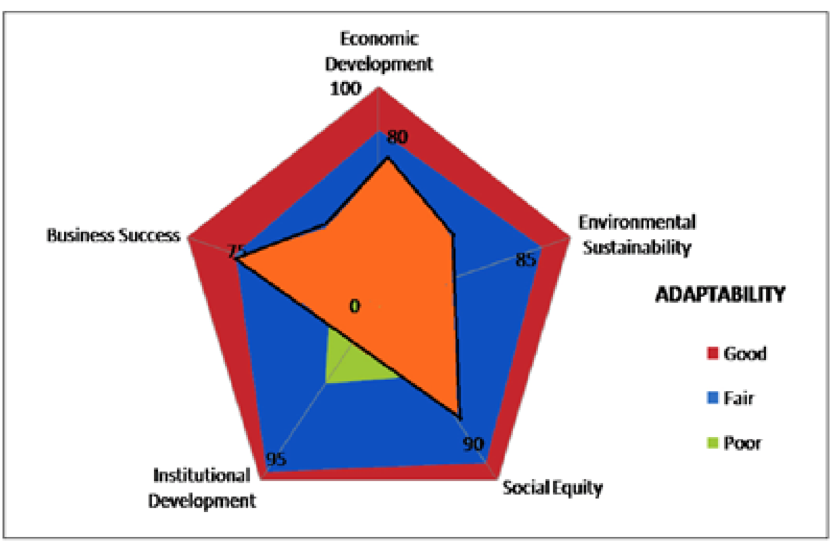
Results and Discussion

Key Findings from the PESTLE Analysis

The analysis estimated the contribution of the pro-poor schemes established by Kauti IWUA in supporting environmental sustainability and water equity in Muooni Catchment. Findings from the study show that Kauti IWUA performed fairly well but not as expected, owing to weak institutional capacity development (Figure 2).

Kauti IWUA had a weak institutional capacity (15.6 %) for achieving social equity, business success, economic development and environmental sustain-

Figure 2: Capability to manage drought in Muooni Catchment



Source: Luwesi et al. (2012)

Note: The orange polygon shows Muooni's capability to manage drought.

ability. However, its pro-poor schemes did achieve high rates of social equity (75.0 %), business success (75.1 %) and economic development (68.7 %) under conditions of drought. Its adaptive capacity was rated poor with regard to ensuring environmental sustainability (37.5 %). One major weakness highlighted in the study was the fact that Kauti IWUA did not have up-to-date strategic plans to mitigate environmental disasters. However, its overall contribution to social welfare and economic development in Muooni Catchment was rated fair (54.4 %) under changing climatic conditions. These results were later validated by the SWOT analysis.

Nonetheless, global and local climate warming will remain a serious threat to the management of Muooni Catchment. It will be accompanied by the risks of wildfire and water salination inherent in La Niña droughts (Leah et al, 2014). Risks of water-related conflicts could also escalate (Besada and Werner, 2015), along with waterborne diseases and plant, livestock and human mortality (McMichael, 2012) under conditions of severe water scarcity.

In such circumstances, farmers will face very low returns on investment and water supplies. Unfortunately, they have very weak capacity to write bankable proposals (or afford consultancy fees) in applying for grants. Further, they are unable to provide collateral for borrowing money from commercial banks and other private institutions. This is in part attributed to the lack of government backing for sovereign guarantees and insufficient motivation among bankers to design banking products tailored to the needs of smallholder farms. Thus, farmers need to diversify their financing sources alongside savings, borrowing and grant lending. Innovative financing mechanisms for farmers may encompass such pro-poor schemes as microfinance, Build-Operate-Lend (BOL), Build-Operate-Sell (BOS) or Build-Operate-Transfer (BOT), and other PPPs (Preston 1997; Luwesi 2011).

Key Findings from the SWOT and VCA Analyses

The study was interested in strategies used by farmers to mitigate the effects of land degradation and water stress. The SWOT analysis mainly focused on the three hydro-climatic components relevant to Muooni Catchment: (i) flood severity; (ii) nocturnal warming; and (iii) drought severity.

First, the analysis acknowledged farmers' use of Soil and Water Conservation (SWC) measures and Early Warning Systems (EWS) (Tiffen and Mortimore 2002). These helped to prevent and subdue high surface runoff and flash floods (Plate 1).

However, some of the SWC measures were inconsistent with soil and water conservation owing to excessive multiple cropping, the planting of eucalyptus trees in wetlands and widespread open furrows, among other factors. Among the weaknesses stressed in this study, Muooni Catchment was lacking a proper

Plate 1: Soil erosion and soil conservation measures around Muooni Dam

strategy for disaster mitigation, besides having weak technological capacity due to the obsolescence of the hydro-meteorological equipment. These weaknesses may have been compounded threats such as El Niño flash floods, high erosion and the risk of mass movements, water siltation and pollution. Weak enforcement of the Water Act 2002 by public officers and the absence of a formal institution mandated to manage the catchment were among the sources of this catchment's degradation. However, local stakeholders could have tapped the opportunities arising from local legislation and policies, institutions, strategies, plans and other disaster risk-management tools. The latter include improved farming technologies implemented in Kenya, training institutions and environmental NGOs.

Second, Kauti IWUA did not have strategic action plans focused on disaster risk reduction for the whole of Muooni Catchment. There was thus a need for training local staffers on disaster monitoring and prevention. The installation and upgrading of the existing meteorological equipment in Mitaboni and Uuni meteorological stations is also a pressing need. Finally, community sensitisation and awareness creation on climate risks and local stakeholder capacity-building on climate impact adaptation and mitigation need to be intensified.

Concerning the risks of nocturnal warming and drought severity, the SWOT analysis recognised the skills of Muooni Catchment's farmers in increasing vegetation cover and humidity by using agro-forestry and reforestation, despite their weak agronomic abilities to protect crops under water stress. There were also efficient irrigation systems introduced by Kauti IWUA. These included drip irrigation and the use of spiral or sprinkler irrigation devices. However, the analysis questioned the lack of formal coordination of catchment management, inconsistent monitoring and coordination of water withdrawals, and the very limited zero-grazing practised in the catchment.

Muooni farmers need therefore to comply with Kenyan legislation, frameworks and policies, institutions and strategies, plans and other tools for the management of natural resources at catchment level. These include the 1999 Environmental Management Coordination Act (EMCA), the Water Act 2002 and related policies and strategies. With the advice of agricultural extension officers, implementation of these legal provisions may enhance protection of forests and other public lands, and increase crop protection against water stress. This would enable carbon trading on the international market for implementation of pro-poor schemes.

The following strategic actions are recommended for the new catchment management authority: (1) to regulate, measure and charge all water uses at their abstraction or effluent discharge points; (2) to promote agronomic technologies such as greenhouses, crop selection, drought resistant plants, etc.; (3) to promote alternative farming schemes in the form of trusts and cooperatives for production, savings and credits; (4) to train farmers in PPPs, proposal writing and business literacy; (5) to train farmers in marketing strategies to enable them to explore new markets and PPP financing options and increase their investments in farming and/or in off-farm sectors.

By seizing these opportunities, farmers may be able to blend different types of financing with joint ventures for implementing GWS schemes. If some farmers feel they have reached a point of no-return, they may have recourse to available off-farm activities in the catchment.

Table 3 summarizes the results of these findings. Table 4 provides a key for the interpretation of the SWOT matrix.

Discussion of Key Findings

There is no doubt that farmers are more vulnerable to drought than flooding in Eastern Kenya. This can be attributed to the high risk of changing hydro-climatic conditions triggered by ill-planned land-use activities and subsequent environmental changes (Heurtefeux et al. 2011). The latter are linked to global warming and rising sea surface temperatures, ocean currents and atmospheric winds in the southern hemisphere commonly known as El Niño (flood) and La Niña (drought) (Jaetzold et al. 2007; McGray et al. 2007). These factors impact farmland productivity and sedimentation of water channels (Terer 2004). However, since individual farmer's capability will guide their future adaptation to water disasters, instead of their resource endowments. Unfortunately, they badly lack such capacities as well as community integration, which are key for preparedness for future disasters in Muooni Catchment (Pelling 2004; Berg 2007; Mukheibir 2008). This includes the ability of local stakeholders to initiate PPPs and build strong institutions to ensure that water is available to all equitably in normal times as well as in situations of stress (Miller et al. 1997; Adgar 2000; Agrawal and Perrin 2008).

Table 3: Consolidated SWOT Analysis for interventions in Muooni

Climate Factor	Strengths	Weaknesses	Opportunities	Threats	Strategic Actions
Flood Severity	S_1 ,S_2, S_3	W_1, W_2, W_3	O_1, O_2, O_3	T_1, T_2, T_3, T_4	Kauti IWUA to design a strategic action plan for disaster mitigation in Muooni Catchment Train its staff in disaster monitoring and prevention Install new hydro-meteorological stations/ upgrade existing equipment Intensify sensitisation meetings and awareness-creation campaigns on climate change and water conservation
Nocturnal Warming	S_1, S_2, S_3, S_4, S_5, S_6	W_1, W_3, W_4, W_5, W_6, W_7, W_8	O_1, O_2, O_3, O_4, O_5, O_6 O_7	T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9	Intensify sensitisation on the use of effective agronomic technologies for soil/ water conservation (i.e., mulching, tillage, greenhouses, crop selection, drought resistant plants, etc.) Kauti IWUA to introduce in situ demonstrations to upgrade farmers' knowledge Promote the use of zero-grazing WRMA Office in Machakos to initiate public consultations for the creation of a WRUA that will coordinate overall catchment management WRMA to map all water resources and demarcate them, from protected forests and other public lands as well as settlements WRUA to implement participatory approaches for water resource allocation and management by involving all relevant institutions WRUA to create awareness of the water sector reforms
Drought Severity	S_1, S_2, S_3, S_4, S_5, S_6, S_7, S_8, S_9, S_{10}, S_{11}	W_1, W_3, W_4, W_5, W_6, W_7, W_8, W_9, W_{10}, W_{11}, W_{12}, W_{13}	O_1, O_2, O_3, O_4, O_6, O_7, O_8, O_9, O_{10}, O_{11}	T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_8, T_9, T_{10}, T_{11}, T_{12}	The new WRUA to regulate, measure and charge all water users at their abstraction points or effluent discharge points by setting meters and tariffs Train farmers on PPPs and proposal writing. Promote alternative farming schemes in the form of production, savings and credit trusts and cooperatives Farmers to explore new markets and Public Private Partnership financing options (grants, lending, microfinance, BOL, BOS, BOT) Promote agronomic technologies such as greenhouses, crop selection, drought-resistant plants, etc. Increase investments in off-farm sectors Train farmers in business literacy

Source: Luwesi et al. (2012)

Table 4: Key to the consolidated SWOT matrix [1]

Climate factors	SWOT Labels	S, W, O and T Assessed
Flood Severity	Strengths	S_1: Terraces, contours and runoff cutouts to mitigate storm intensity/soil erosion S_2: Existing hydro-meteorological stations in Mitaboni and Uuni S_3: Use of early warning systems for disaster prevention
	Weaknesses	W_1: No formal strategy and plan for mitigating disaster at catchment level W_2: Weak technological capacity/obsolescent hydro-meteorological equipment W_3: Inconsistent farming methods with soil and water conservation (i.e., excessive multiple cropping, planting eucalyptus in wetlands, multiple open furrows, etc.)
	Opportunities	O_1: Disaster management legislation and policies, institutions, strategies, plans and tools for implementation O_2: Improved agro-technologies O_3: Existing training institution and NGOs
	Threats	T_1: El Niño flood destruction T_2: High risk of soil erosion and mass movements T_3: Water siltation and pollution T_4: Weak public officer enforcement capability
Nocturnal Warming	Strengths	S_4: Agro-forestry and reforestation to increase vegetation cover and humidity S_5: Existing efficient irrigation systems like drip, sprinkler and spiral irrigation S_6: Existing Kauti irrigation scheme water users' association (Kauti IWUA)
	Weaknesses	W_4: Weak agronomic abilities W_5: Inefficient crop protection under water stress W_6: Limited use of zero-grazing W_7: Lack of a formal water institutions to coordinate catchment management W_8: Lack of consistent monitoring and coordination of water withdrawal points
	Opportunities	O_4: Existing legal provisions for the protection of forests and other public lands O_5: Existing agricultural extension services O_6: Possibility of trading carbon on the international market O_7: Existing national legislation, frameworks and policies, institutions, strategies, plans and tools for implementation at the catchment level
	Threats	T_5: Catchment warming T_6: Risk of wildfire emergencies and water salination T_7: La Niña droughts T_8: High risk of escalation of water-related conflicts T_9: High risk of waterborne diseases T_{10}: High mortality risk for plants, livestock and humans due to water scarcity
Drought Severity	Strengths	S_7: Efficient hydropolicies (rainwater harvesting and storage in tanks and dams) S_8: Existing water dam at Isyukoni S_9: Existing water treatment plant in Kathiani S_{10}: Use of mulching and tillage S_{11}: Use of zero-grazing, organic and mineral fertilisers to enrich the soil
	Weaknesses	W_9: Lack of measuring devices for charging water abstractions and charging W_{10}: Lack of motivation to initiate Public Private Partnership (PPP) schemes W_{11}: Weak capacity to write proposals, afford consultancy fees and collaterals W_{12}: Limited use of crop/plant selection and greenhouses to adapt to drought W_{13}: Low returns on investments in farming and water supply
	Opportunities	O_8: Availability of governmental support and development partnersfunding for developing technical skills and improving the balance sheet O_9: Existing banking loans and private investors' joint ventures O_{10}: Availability of rentable off-farm activities O_{11}: Existing facilities and basic infrastructure for implementing GWS schemes
	Threats	T_{11}: Lack of motivation from bankers to offer banking products tailored to smallholder farmers T_{12}: Lack of government backing and sovereign guarantees allowing farmers access to diversified sources of funding.

Source: Luwesi et al. (2012)

Conclusion and Recommendations

This study has built a case based on the assumption that proper planning skills and the capacity to convert management tools into results are some of the abilities pro-poor schemes should consider to enable future adaptation by farmers to water disasters. Farmers living in Muooni Catchment and Kauti area in particular have a high potential to curb floods but greater vulnerability in controlling drought. Kauti IWUA has introduced innovative and efficient pro-poor schemes that perform fairly well. The analysis, however, questioned the lack of formal coordination of catchment management, which is a major cause of farmer vulnerability to water stress and scarcity. This was mainly evident in the lack of a proper strategy for disaster reduction and weak technological capacity, basically due to the obsolescence of the hydro-meteorological equipment as well as a weak financial capacity.

This study recommends that Kauti IWUA develops strategies focused on farmers' capability to manage water resources effectively and distribute them equitably to all. This will determine their future adaptation to droughts and/or floods. Though the continuous use of SWC measures and EWS remains an asset for preventing and mitigating high surface runoff and flash floods, farming practices inconsistent with soil and water conservation need to be discouraged. In that vein, crops and trees that support water infiltration and pollinator diversity can assist farmers in achieving food security and wood fuel sufficiency while sustaining water in the catchment. This would also enable farmers to take advantage of carbon trading on the international market to foster green water saving. These findings may shed light on further implementation of the water sector reforms in Muooni in line with the Kenya Constitution 2010.

Key Policies and Research Implications

Kauti IWUA needs to develop strategies that will unleash farmers' capability to manage water resources effectively and distribute them equitably to all. This study has built a response-capability case and found that pro-poor schemes need proper planning skills and the capacity to convert management tools into results. For sustainability, government policies need to focus on building watershed management institutions that enhance farmers' adaptability to water disasters. Farmers living in Muooni Catchment in general and Kauti area in particular ought to sharpen their adaptive capacities and skills in curbing drought impacts. For that reason, scientific research will have positive feedback on policy-making if innovative and efficient pro-poor schemes that perform fairly well are introduced in Muooni Catchment, Kauti area in particular. Such schemes will enable not only formal coordination of catchment management but also address the root causes of farmers' vulnerability to water stress and scarcity.

The GoK also needs to design proper strategic policies that focus on drought

Disaster Risk Reduction (DRR) based on technological innovation, meteorological information and sustained financial capacity. It should basically tackle the issue of the obsolescence of hydro-meteorological equipment, Early Warning Systems (EWS) as well as the weak financial capacity of most farmer organisations. Researchers ought to find how to blend microfinance with successful GWS schemes to enable smallholders to be eligible for borrowing and other banking facilities. Extension organisations and other social public services run by government as well as group formations, development organisations and private enterprises will need to get involved in the whole process in order to build farmers' capacity to increase GWS schemes' financial viability and efficiency through effective PPPs. Finally, the development of participatory approaches to planning, allocation, monitoring and evaluation of all resources in the catchment and irrigation in particular should be a priority in achieving water equity in farming in Muooni Catchment and Kauti area.

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