

PROCEEDINGS OF THE 2ND NATIONAL CONFERENCE ON SUSTAINABLE LAND MANAGEMENT

**1ST – 4TH JUNE 2016 | SENTRIM ELEMENTAITA LODGE NAIVASHA,
KENYA**



Compiled & Edited by: Leonard Odingi

**THEME: ADAPTATION TO CLIMATE CHANGE THROUGH SUSTAINABLE
LAND MANAGEMENT IN DRY LANDS OF KENYA: TOWARDS IMPROVING
RURAL LIVELIHOODS**

Copyright © 2016, by Mainstreaming Sustainable Land Management in Agro Pastoral Production Systems of Kenya. All rights reserved. The project encourages the use of its material provided that the authors of the papers are acknowledged

Cover photo by Mr. Leonard Odi

The views expressed in this publication are the views of the authors and do not necessarily reflect the views and policies of the Mainstreaming Sustainable Land Management in Agro-Pastoral production Systems of Kenya, its development partners Global Environmental Facility (GEF), United Nations Development Programme , Ministry of Agriculture, Livestock and Fisheries, Kenya, or the editors of this publication.

Furthermore, the project makes no representation concerning, and does not guarantee the source, originality, accuracy, completeness or reliability of any statement, information, data, finding, interpretation or views expressed in this publication.

Please direct inquires and comments to: slm.ke@undp.

Table of Contents

Acknowledgement í ...

Abbreviations & Acronyms í í í í í í í í í í í í í í í í í í í .í

- 1. About the Conference í
- 2. Conference Opening Sessioní .
- 3. Conference Plenary Presentationsí í í í í í í í í í í í í í í í í í í .í
- 4. Parallel Sessions í ..
- 5. Field Excursion Report í ..

Annexes í

MAINSTREAMING SUSTAINABLE LAND MANAGEMENT IN AGROPASTORAL
PRODUCTION SYSTEMS OF KENYA PROJECT

Mainstreaming Sustainable Land Management in Agro Pastoral Production Systems of Kenya Project (SLM) is a 5 year project (2010 ó 2015 financed by Global Environment Facility (GEF) supported by United Nations Development Programme (UNDP Kenya) and implemented through the State Department of Livestock through the Ministry of Agriculture, Livestock & Fisheries of the Government of Kenya. For more information about the project visit www.slmkenya.org

Acknowledgement

We wish to take this opportunity to thank everyone who took part in this conference and made it a success. We are especially grateful to our collaborators, Kenya Agriculture Livestock and Research Organization (KALRO), University of Nairobi, Jomo Kenyatta University of Agriculture Technology (JKUAT) and the board of the Mainstreaming Sustainable Land Management in Agro ó Pastoral Production Systems of Kenya project for their collaboration and support for the conference.

We wish to acknowledge the financial support received from our development partners including the United Nations Development Programme (UNDP), the Global Environmental Facility (GEF) and the Government of Kenya through the Ministry for Agriculture, Livestock and Fisheries, State Department of Livestock.

The entire Project Management Unit team played a crucial role in the success of the event. We thank them all for their various contribution and logistical support. We are particularly grateful to Leonard, the National Project Manager, who led the team that prepared the proceedings for the conference including Joseph Satty Munyao, Esther Opande, Benard Ouma and Julliette Muchaho.

We consider this a great milestone towards achieving vibrant and better coordinated research on Sustainable Land Management (SLM) practices and policies for the benefit of all stakeholders and our country Kenya.

Partners

This workshop is a collaboration of the following organizations:



University of Nairobi Kenya Agricultural Research Institute Jomo Kenyatta University of Agriculture and Technology

Donors

This workshop was funded by:



*Empowered lives.
Resilient nations.*

Abbreviations & Acronyms

ASALs	Arid and Semi-Arid Lands
\$	US Dollar
ASDS	Agriculture Sector Development Strategy
ASPSC	Agricultural Sector Programme Steering Committee
AWF	Africa Wildlife Fund
BBC	British Broadcasting Corporation
BMUs	Beach Management Units
CA	County Assembly
CBOs	Community Based Organizations
CCDN	Community Combating Desertification Network
CDD	Community Driven Development
CDM	Clean Development Mechanism
CDTF	Community Development Trust Fund
CEOs	Chief Executive Officers
CG	County Government
CO ₂	Carbon dioxide
Comp.	Component
COP7	The 7 th Conference of Parties
CSø	Cabinet Secretaries
CSO	Civil Society Organization
CSOs	Civil Society Organizations
DANIDA	Danish International Development Agency
DEC	District/Divisional Environment Committee
DOL	Diocese of Lodwar
EAWS	East Africa Wildlife Service
EMCA	Environmental Management and Co-ordination Act
FAO	Food and Agriculture Organization
FFS	Farmers Field School
FHI	Food for Hungry International
GEF	Global Environment Facility
GoK	Government of Kenya

Govt	Government
GPS	Global Positioning System
Ha	Hectare
ICC	Inter-Ministerial Committee
ICIPE	International Centre of Insect Physiology and Ecology
ICRAF	World Agroforestry Centre (formerly International Centre for Research in Agro-Forestry)
IPM	Integrated Pest Management
ISFM	Integrated Soil Fertility Management
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KACP	Kenya Agricultural Carbon Project
KAPAP	Kenya Agricultural Productivity and Agri-business Project
KAPP	Kenya Agricultural Productivity Programme
KAPSLMP	Kenya Agricultural Productivity and Sustainable Land Management Project
KARI	Kenya Agricultural Research Institute
KATO	Kenya Association of Tour Operators
KEFRI	Kenya Forest Research Institute
KEMFRI	Kenya Marine and Fisheries Research Institute
KESREF	Kenya Sugarcane Research Fund
KFS	Kenya Forest Service
KFWG	Kenya Forest Working Group
kg	Kilogram
KSIF	Kenya Sustainable Land Management Investment Framework
Ksh.	Kenya Shilling
KSLMAPSP	Kenya Sustainable Land Management in Agro-Pastoral Production Systems Project
KWS	Kenya Wildlife Service
LVEMP	Lake Victoria Environment Management Project
LWF	Laikipia Wildlife Fund
M	Million
M&E	Monitoring and Evaluation
M ³	Metres Cubed

MAD	Movement Against Desertification
MDGs	Millennium Development Goals
MEMR	Ministry of Environment and Mineral Resources
MEW&NR	Ministry of Environment, Water and Natural Resources
MIDP	Merti Integrated Development Project
MIT	Massachusetts Institute of Technology
MOA	Ministry of Agriculture
MOAL&F	Ministry of Agriculture, Livestock and Fisheries
MOLD	Ministry of Livestock Development
MoUs	Memorandum of Understandings
MOWI	Ministry of Water and Irrigation
MTEF	Medium Term Expenditure Framework
MYWO	Maendeleo Ya Wanawake Organization
NA	National Assembly
NAP	National Action Plan
NCCD-K	National NGOs Coordinating Committee on Desertification in Kenya
NCCRS	National Climate Change Response Strategy
NEAP	National Environmental Action Plan
NEMA	National Environment Management Authority
NGO	Non-Governmental Organization
NGOs	Non-Governmental Organizations
NMK	National Museum of Kenya
NSLMC	National Sustainable Land Management Committee
NRT	Northern Rangeland Trust
NLC	National Land Commission
NYS	National Youth Service
NSC	National Steering Committee
NWSC	Nairobi Water and Sewerage Company
PC	Project Coordinator
PELUM	Participatory Ecological Land Use Management
PES	Payment for Environmental Services
PFII	Policy Formulation Implementation and Interpretation
PFM	Participatory Forest Management

PFM	Permanent Farm Monitoring
PFMP	Participatory Forest Management Plan
PISP	Pastoralist Integrated Support Programme
PPP	Public Private Partnership
PPPs	Public Private Partnerships
REDD	Reducing Emissions from Deforestation and Forest Degradation
REGAL	Resilience and Economic Growth in the Arid Lands
Rep.	Representative
rep	Representative
RFA	Rumuruti Forest Association
RRDO	Relief Reconstruction and Development Organization
SAG	Special Advisory Group
SGP	Small Grant Programme
SL/NRM	Sustainable Land and Natural Resources Management
SL/NRM	Sustainable Land and Natural Resources Management
SLM	Sustainable Land Management
SMEs	Small and Medium Enterprises
SSA	Sub-Saharan Africa
SusWatch	Sustainable Environmental Development Watch
SWC	Soil and Water Conservation
TA	TerrAfrica
TARDA	Tana and Athi Rivers Development Authority
TERA	Turkana Environmental Resources Association
TNC	The Nature Conservancy
TOR	Term of Reference
TTRA	Taita Taveta Ranchers Association
TTWF	Taita Taveta Wildlife Fund
TUPADO	Turkana Pastoralist Development Organization
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UoN	University of Nairobi
US	United States

USAID	United States Agency for International Development
WARREC	Water Research and Resource Centre
WB	World Bank
WETPA	Western Tree Planters Association
WFP	World Food Programme
WRMA	Water Resources Management Authority
WRUAs	Water Resources Users Associations
WSTF	Water Services Trust Fund
WWF	Worldwide Fund for Nature
YMCA	Young Men Christian Association
yr.	Year
YWCA	Young Women Christian Association

1.0 Overview of the Conference: *Adaptation to Climate Change through Sustainable Land Management in Drylands of Kenya: Toward Improving Rural Livelihoods*

1.1 Background of the Conference (Dr. Zeinabu Khalif, UNDP)

The 2nd National Conference on Sustainable Land Management was organized by the Mainstreaming Sustainable Land Management (SLM) in Agro-pastoral Production system of Kenya project. The SLM Agro-Pastoral project is financed by Global Environment Facility (GEF), the United Nations Development Programme and the Government of Kenya through the Ministry of Agriculture, Livestock & Fisheries. The project's goal is to address land degradation problems in the arid and semi-arid areas (ASALs) of Kenya using two approaches; firstly, by supporting review of policies related to sustainable land management and mainstreaming SLM in all national planning process. Secondly, by implementing land management technologies through community level initiatives using Farmer Field Schools (FFS) approach.

Agriculture and livestock production plays a key role in Kenya's economy. About 30% of Kenya's Gross Domestic Product (GDP) is derived from Agriculture with 10% of it from livestock sub sector. Kenya has a suitable environment for increased production of livestock, poultry and fish to meet the requirements of the domestic and export markets. However, the sector has not been adequately exploited, particularly with regards to improved health, production and processing. Expanding human needs from the land and its constituent natural resources is creating competition and conflicts that lead to land degradation. In order to meet human requirements in a sustainable manner, land use conflicts must be resolved and ways found for more effective and efficient utilization of land resources.

Extensive agricultural and livestock research in sub-Saharan Africa has generated applicable technological solutions to low productivity, but these have not been optimally exploited. Poor linkage among the stakeholders is partly to blame for shelved technologies and innovations.

The forum shed light on novel research and development approaches that will have a positive impact on adaptation to climate change and sustainable land management in Kenya.

1.2 Conference Sub – Themes

The theme of the conference was *Adaptation to Climate Change through Sustainable Land Management in Drylands of Kenya: Towards Improving Rural Livelihoods*

The Papers and posters to be presented in the conference included the following **sub-themes**:

1. Climate change impacts, adaptation and resilience in agro-pastoral production systems.
2. Land conservation and management
3. Integrated crop and livestock production systems and management in the drylands
4. Policy and Social-economic issues in land management supportive of climate change adaptation in the drylands.

1.3 Conference Objectives

The conference objective was to bring together land users, planners, policymakers, scientists and civil society organizations from research organizations, universities, government and non-governmental organizations to share knowledge and experiences on Sustainable Land Management.

1.4 Conference Methodology

The conference lasted for 2 days and adopted a dynamic participatory process which encouraged networking activities, knowledge circulation and collaborative strategic planning.

It took the following formats:-

Plenary Sessions: This involved keynote speeches by selected experts in Drylands, Environments, Climate Change and Energy. These were followed by brainstorming sessions to fill knowledge gaps and address questions arising

Parallel Break out Sessions: - Presentations by authors for accepted research papers based on the sub-themes of the conference in different break- away rooms.

Plenary Sessions: - Participatory discussions aimed at framing common response strategies, research and policy strategies and way forward for realizing development of dry lands through sustainable land management.

2. CONFERENCE OPENING SESSIONS

2.1 Facilitation

The discussions were moderated by Ms. Agnes Yobterik, the Director of Programmes, Project & Strategic Initiatives in the Ministry of Environment and Natural Resources & Regional Development Authorities. Dr. Patrick Gicheru was the rapporteur for the session and captured the opening remarks and key-note address.

2.2 Remarks by Mr. Michel Balima, Resident Representative a.i



The opening session of the conference kicked off with welcoming remarks from Mr. Michel Balima, Resident Representative a.i

Mr. Balima took the opportunity to express his sincere appreciation for being invited to the second national conference on sustainable land management. He reiterated that indeed, it was a very important conference. He explained that climate change is a major threat to global development and stated that indeed, none of the 17 Sustainable Development Goals can be achieved without addressing climate change and its impact.

He appreciated that most African countries have least contribution to the emission of Green House Gases, they are the most affected by effects of climate change. He reiterated that indeed most countries especially in sub-Saharan Africa are undergoing serious developmental challenges due to climate change. Using Kenya as an example, he said that Kenya's Climate Change Response Strategy (2010) and the National Climate Change Action Plan (2012) reported that Kenya's socio-economic development is threatened by climate change events. He explained that this was because Kenya's economic growth is mainly pegged on nature-based enterprises such as agriculture and tourism.

He noted with concern that the frequent droughts are threatening to reverse the gains made in poverty reduction especially in the drylands of Kenya. He explained that the country continues to witness massive loss of livestock during lengthy dry seasons and droughts thus aggravating the food insecurity situation for the most vulnerable in society. He emphasized that, drought as a result of climate change has resulted in loss of life, wealth and livelihoods. He noted that the country is also witnessing an increase in human-wildlife conflicts as a result of scarce resources. Indeed, if this situation is not arrested more households will fall into poverty trap.

He said that in the recent years, concern around climate change has taken a centre stage in the global development discourse. As you may recall the issues of environment became the single most important agenda during the Rio Summit in 1992. This global concern on environment led to the establishment of funding mechanisms to enable countries respond to the challenges. One such mechanism is the Global Environmental Facility Trust Fund that was set up to support implementation of five environmental conventions. He explained that since 1991, GEF has provided 13.5 billion Dollars in grants to 165 developing countries. The money is used to finance the incremental environmental costs of activities related to biodiversity, climate change, international waters, land degradation, and chemicals and waste management.

He said that the United Nations Development Programme being one of the leading GEF agencies has been able to channel at least 39% of these funds to countries around the globe. He reported that the current GEF funding to Kenya is approximately 20 Million Dollars, supporting projects on climate change, biodiversity, land-degradation, chemical management and grassroots community led GEF/Small Grant Programme.

He said that Kenya also stands to benefit from the Green Climate Fund which was established in 2010 as the financial mechanism of the United Nations Framework Convention on Climate Change (UNFCCC). The fund of USD 100 Million per year was established by developed countries as an additional resource to developing countries to address climate change. Moreover, Kenya has also received funds from the Least Developed Countries Funds (LDCF) to support the climate adaptation initiatives in the drylands of Kenya. Through the Kenya Adaptation to Climate Change in Arid Land (KACCAL) project, communities in Mwingi sub-county have been supported to undertake climate resilient livelihoods.

He emphasized that adaptation to climate change is therefore not a choice but a mandatory pathway that should be pursued and supported at national and sub-national levels. He said that UNDP is working closely with the national and county governments to ensure the country achieves sustainable economic growth with minimal Green House Gas emissions.

With support from Development Partners such as USAID and DFID, UNDP is working with Ministry of Environment to promote low emission climate resilient development and with the National Treasury and county governments in mainstreaming climate change in the national planning and budgetary processes. UNDP is making great effort to enhance the capacities of key national institutions and research organizations to enable them tackle the challenges posed by climate change.

He noted that global and national level efforts on climate change are futile if we are not looking inwards to assess our capacities and opportunities as a country. The universities and research institutions should help us come up with the most appropriate responses to climate change. The research findings should be cascaded from scientific forums and lecture halls to the local farmers and pastoralists. Let us see more interactions between the formal-scientific knowledge and the indigenous one. The farmers and pastoralists should start telling their stories and as scientists you should be able to listen and compare notes.

He emphasized that we should work hand-in-hand with the local communities to ensure that they widely adopt sustainable land management practices such as improved and climate resilient farming methods, soil and water conservation, on-farm tree planting, adoption of drought resistant crops and livestock breed improvement among others.

He urged participants to interrogate more and push the frontiers of knowledge. He explained that it is only by sharing our knowledge widely that we begin to see changes. So, let this knowledge be shared widely through publications, radio programs, public meetings and field days. He called upon participants join hands to enhance community's response to climate change and help them adopt appropriate technologies that will strengthen their livelihoods and enhance their resilience.

In conclusion, he expressed special gratitude to the State Department of Livestock, UNDP's Implementing Partner for Sustainable Land Management Project. Our partners; the University of Nairobi, the Kenya Agriculture and Livestock Research Organization, the Jomo-Kenyatta

University of Agriculture and Technology for being at the centre of organizing this conference. A very big thank you to the Sustainable Land Management project team for their great effort in ensuring this conference is a success. Last but not least, I thank the presenters and the participants who took time away from their busy schedules to participate in this conference.

2.3 Remarks by Dr. Andrew Tuimur, the Principal Secretary – State Department of Livestock.



The Principal Secretary, Dr. Andrew Turmur welcomed all the participants to the Conference. He applauded the organisers of the conference and thanked them for bringing various stakeholders on board. The PS said that he was delighted to join the participants in an important occasion of the second Conference on Sustainable Land Management organized by Mainstreaming Sustainable Land Management in Agro-Pastoral Production Systems of Kenya project.

He took the opportunity to recognize and thank the organizers of the conference for bringing various stakeholders on board. He gave an overview of the agricultural sector which he explained constitutes a fundamental part of the Kenyan economy; contributing up to 25 percent of the total Gross Domestic Product and another 27 percent indirectly. He said that the sector employs over 40 percent of the population and over 70 percent of the rural people. It accounts for 65 percent of the export earnings and provides livelihood for more than 80 percent of the Kenyan population.

He emphasized that the success of the sector ensures good performance of the entire economy. In this regard, the sector is expected to be a major contributor to the projected 10 percent annual economic growth rate under the Kenya Vision 2030. The country suffers from periodic droughts whose magnitude and severity has increased in the recent past as a result of climate change.

The arid and semi-arid lands remain the most vulnerable due to its fragile ecosystem. Nevertheless, the Arid and Semi-Arid Lands which constitute over 80 percent of the country's land mass, has enormous potential that remains largely untapped. Although there are 24 million ha of land that can be used for livestock production, only 50 percent of the carrying capacity is currently being exploited.

In addition, 9.2 million ha have potential crop production if irrigated. This irrigable land is equivalent to the total farmland in high and medium potential areas in the country. The under exploitation of this potentials have had negative economic and social consequences especially for the arid and semi-areas.

In this regard, he acknowledged the Mainstreaming Sustainable Land management in Agro-Pastoral Production Systems of Kenya Project borne of a partnership between the Global Environment Facility (GEF), United Nations Development Programme (UNDP) and the Government of Kenya through the State Department of Livestock in the Ministry of Agriculture, Livestock & Fisheries for taking keen interest to develop the arid and semi-arid lands with the aim of restoring their economic potentials for the good of the communities living in these areas.

He expressed concern with regards to the dry lands of Kenya which he explained has over the years been degraded due to unsustainable land use practices. Land degradation in ASALs is linked to diverse factors including inappropriate land use as a result of inappropriate development models, unsuitable farming practices, reduced livestock mobility, over-exploitation of the available pastures and high population growth encroaching on wet season grazing areas for pastoralists. It is for this reason that the project was initiated to address land degradation problems in the Arid and Semi-Arid Lands (ASALs) of Kenya

He noted that increasing demand for fuel, wood, charcoal and timber by growing rural and urban population has led to loss of important forest covers aggravating land degradation. These man-made crisis coupled with the impact of climate change has further undermined the lives and livelihoods of pastoral and agro-pastoral communities rendering them perpetual dependants on famine-relief.

In addition, the PS noted that the theme of this conference *Adaptation to Climate Change through Sustainable Land Management in Drylands of Kenya: Towards Improving Rural Livelihoods* was in line with Agricultural Sector Development Strategy (2010 to 2020) production factors strategic focus of transforming land use for better and sustainable use and management. He was delighted to note that the local communities have been trained and supported to adopt various sustainable land management practices. He noted that the conference brought together key stakeholders in land management and provided an avenue for knowledge transfer through sharing of research findings, experiences and lessons learnt. This knowledge will be cascaded to the lowest level to enable improvement in land management. He considered it an asset to rural communities because they are dependent on the land resources for their survival. He pointed out that the SLM project uses Farmer Field Schools Approach to provide group members with knowledge and skills needed to sustainably utilize their land. He commended the project for this mode of delivery of extension services to the communities.

He reiterated the government's commitment to sustainable land management and its role in ensuring legal frameworks and policies are in place to enable smooth project implementation for the benefit of the communities. The government, he said, would also implement an effective institutional framework to ensure a coordination mechanism to facilitate multi-sectorial development in these areas. In addition, the government would invest in targeted areas through development programmes and projects and he pointed out that "Mainstreaming Sustainable Land Management in Agro-Pastoral Production Systems of Kenya project" is one such programme that is helping the Ministry achieve this goal. To reduce poverty among agro-pastoral communities, the government is keen on promoting diversification of income and employment sources. Through various programmes and projects, the government is enhancing livestock value chain such as processing meat, milk, honey, hides, skins and bone as well as soap and oil making, commercial tree planting will be encouraged to provide income, medicines, fodder foliage, bio-fuels, fruit juices and jams, dyes, silk and spices. In addition, priority will be given to the establishment of wildlife conservancies and game farming as land use under local community management.

The flagship projects for arid and Semi-arid lands identified under the agricultural sector in vision 2030 will be implemented in integrated manner and I am happy to say this is being achieved through this project.

He called upon and urged all the stakeholders and the development partners to continue working closely with government for programmes support and strengthening of sector-wide approach to development. He said that the government recognizes the great support being received from partners especially Global Environmental Facility and United Nations Development Programme (UNDP). He emphasized that achieving sustainable land management requires a concerted effort from land users to planners and policy makers urging all to join together to enhance productivity while ensuring the quality of land resources in the country are not compromised.

2.5 Overview, achievements and Results of Mainstreaming Sustainable Land Management in Agro-Pastoral Production Systems of Kenya (Mr. Leonard Odini, National Project Manager)



Introduction:

The project, "Mainstreaming Sustainable Land Management in Agro-pastoral Production Systems of Kenya" is a five year project borne of partnership between Global Environment Facility (GEF), United Nations Development Programme (UNDP-Kenya) and Government of Kenya (GoK) through Ministry of Livestock Development (now Ministry of Agriculture,

Livestock and Fisheries). The overall development outcome of the project goes beyond the issue and challenge of land degradation and improving agro-pastoral production systems in ASALs. The project has a broader context that includes upstream advocacy, links to the climate change, disaster prevention and management, conflict prevention, poverty reduction, access to and governance of natural resources and improvement of livelihoods. Further the project covers natural production systems and ecosystem services. Further, the project does not only focus on productivity but also on how agro-pastoralists can deal with changing livelihoods and resources base by enhancing resilience to drought related disasters common in the ASALs. Another key element is mainstreaming SLM principles and practices into overall development framework at all levels including climate change adaptation and coping mechanisms together are key outputs of the project. The envisaged benefits of the project include reduction of conflicts, secured livelihoods, generating knowledge products, preparedness and on coping mechanisms of rural poor.

Project outputs and benefits were realized by providing land users and managers with enabling policy and institutional capacity, technical capacity and financial incentives for effective adoption of SLM. Alongside the project also aims to enhance the capacity of the local communities to mitigate impacts of climate changes by adopting appropriate technologies that promote socio-economic resilience. The project uses two pronged approaches in achieving its goal. At national level, it supported review of policies related to Sustainable Land Management and mainstreaming of SLM at all national planning processes. At local level, the project SLM activities are implemented in sites located in four districts (now sub-counties) namely; Mbeere North in Mbeere Sub-County of Embu County, Kyuso in Mwingi Sub-County of Kitui County, Narok North Sub-County in Narok County and Dadaab Sub-County in Garissa County. The interventions in each site took into consideration aspects such as the levels of land degradation and the type of agro-ecological zone.

The project objective is achieved through the following four outcomes:

Outcome 1: Knowledge based land use planning forms the basis for improving drylands sustainable economic development.

Outcome 2: Viability of the agro-pastoralism production system increased through diversification and access to finances for SLM.

Outcomes 3: Policy and institutional framework supportive of SLM mainstreaming in agro pastoral production system and ASALs.

Outcome 4: Project managed effectively, lessons used to upscale SLM in the ASAL districts and the country.

ACHIEVEMENT AND RESULTS

Outcome 1: Knowledge based land use planning forms the basis for improving drylands sustainable economic development.

Use of Farmer Field School

- Over 61 Farmer and Pastoral Field Schools established and 11,448 trained and 243 663 community members have benefitted indirectly since the start of the project.
- FFSs have also increased the ability of farmers to articulate their problems and thus to create effective demands on services, so that these shift from being supply-driven to demand-driven
- Improved skills from the farmers' value and use of team work and group dynamics, leadership, in a wide range of improved sustainable land conservation and management practices, in land rehabilitation, and in land and animal husbandry. Farmers also gained skills on, value addition and strategic marketing of agriculture and livestock produce among others.
- FFSs and requisite methodologies have been used to broaden farmers' understanding of many other aspects of rural life and to increase their skills and ability to cope with a widening range of problems affecting their livelihoods e.g. HIV/AIDS, nutrition, table banking and merry-go-rounds, access to financial institutions for credit, reproductive health, gender mainstreaming establishment of group business enterprises among others.
- As an organized group some FFSs have managed to link-up with financial institutions who then offer free training in areas such as accessing bank services, credit and basic book keeping.
- The FFS platform has also been used by District/Sub-county Peace Committees to hold security meetings between sub-clans and between pastoralists and farmers thereby reducing conflict incidents.
- Other partners, programmes and projects in the areas where the SLM project was implemented have also adopted the FFSs as beneficiaries thereby saving resources that would have otherwise been used to mobilize and organize the beneficiaries.

- Leadership and oral communication skills gained among and between farmers have resulted in self-confidence and recognition of personal abilities. As a result of the enhanced competencies some members of FFSs, particularly women, have taken leadership positions as members of County Assemblies, local government, School Boards and Committees.
- In addition the FFS approach has enabled men and women to learn jointly as equals. This has enabled inter-gender respect and recognition of individual abilities in applying learnt skills irrespective of a person's gender.
- FFSs have brought major attitude change among beneficiary communities in areas such as gender bias against women, pasture establishment, use of manure to increase harvests and that one must not have to go to a formal school to learn.
- Published a book on Sustainable Land Management in Dry Lands of Kenya
- At least 75% of farmers in the pilot landscapes adopting improved farming practices
- At least 70% of cultivators in the pilot areas are consistently engaging to 3 -5 improved farming practices, crop rotation, intercropping, use of manure, use of zai pits, terracing and conservation agriculture

Project Staff and Post Graduate Level Training and Research

- The project through a MoU partnered with the University of Nairobi to review and evaluate the current curricula of some programmes with the aim of improving the standard of teaching, reaching more potential candidates through Open Distance Learning and to keep pace with recent development and requirements in the field of Sustainable Land Management. The project also supported post graduate training and research in a range of topics in soil science, land and water management for MSc and PhD related to SLM. Results of the research have provided excellent baselines, benchmarks and deeper understanding of SLM in the pilot sub-counties.
- A graduate SLM training and research programme at university and other levels contributed to development of knowledge and skills required for SLM. The training also contributed to the reduction of technical human capacity gap and succession management in sustainable land management cadres. The project targeted students at various levels who come from the pilot districts/sub-counties i.e. 3 PhD, 12 Masters, 7 Diploma, and 15 Certificate.

- Results of capacity building included training of: 60 DEC members on water and landscape management, 11 officers on Environmental Impact Assessment, 35 officers on Climate Finance, Resource Mobilization and project formulation, Finance and Procurement, 56 DMT members on monitoring & evaluation, 60 DMT members on communication and documentation training, 35 officers on gender mainstreaming, 4 Senior leadership course, and 60 DMT members on FFS methodology

Land Rehabilitation

The baseline survey established a 50% level of degradation that of the total area of 640,000Ha in all the four pilot districts. 72,000Ha of the degraded land was adopted for



rehabilitation. The project used different tools and practices to rehabilitate degraded landscapes. The practices included grass reseeding and planting trees. The project also constructed water harvesting and gully expansion control structures such as semi-circular bands, water retention trenches and ditches, and water pans, particularly in areas

with steep slopes to prevent and reduce both water run-off and soil erosion and to enhance regeneration of vegetation. These practices were applied in Narok at Olesharo Hills, Suswa and at Itivanzou in Kyuso.



Soil and water conservation structures (retention ditches and semi circular bunds) as a measure to rehabilitate Ole sharo gully in Suswa before and after rehabilitation

Soil and Conservation Measures and Structures

Terracing is a soil conservation practice applied to prevent rainfall runoff and soil erosion in farms on sloping land. Terraces consist of ridges and channels constructed across the slope line by digging a trench and throwing and piling-up the soil upslope (*fanya juu*) or below (*fanya chini*) the contour trench to create bunds. Planting grass bushes and trees along the banks stabilizes the bunds and also increases productivity and biodiversity. The trench also serves to hold and harvest water.

Forestry and Agro-forestry

Forestry best practices involved identification of tree species suitable to local environment, establishment of tree nurseries and tree planting. To enhance tree planting the project also introduced a tree approach, where every pupil in the schools planted and took care of a tree. The schools awards scheme plays a similar role



Rehabilitation of degraded land through tree planting in Seretho, Dadaab and Ewaso Ng'iro, Narok

Results and Benefits

- Increased tree cover over the last five years through tree planting; with planting of implementation with 115,000 planted in Narok, 150,000 trees in Kyuso, 191,550 trees in Mbeere North and 170,000 in Dadaab, with an average 60% survival rate.
- Increased efficiency of using land, soil conservation, improved soil quality and productivity.

Establishing Soil Type and Fertility

At the start of the project a baseline was undertaken by sampling soil from representative sites in the pilot districts and undertaking testing or analysis. This was done under partnership with KARI (now KALRO). The results established soil structure and type, nutrient content, fertility, composition, and other characteristics of the soils for selected sites in pilot districts. Farmers were also trained on how to take soil samples for laboratory analysis. Alongside farmers were also trained on the basic of soil management, soil type and quality indicators such as colour, texture, crop yield and plant species growing in the area.

Rain Water Harvesting

Sand Dams

Sand dams were constructed in several areas such as Gachuriri, Magomano, and Manzyundu in Kyuso and at Marimwe in Mbeere North.



Earth Dams

An earth dam is a rain water harvesting structure simply built with highly compacted earth which blocks the waterway in an area with limited infiltration capacity. Under this practice rainwater is captured and stored for different uses. The project constructed three dams in Kyuso at Itivanzou, Masamba and Manzyundu.



A woman getting water from an earth dam in Ngomeni and the Principal Secretary commissioning an earth dam in Itivanzou that was constructed by the project

Water Pans

A water pan is a small reservoir constructed to collect and store runoff water from relatively small catchments such as hillsides, roads, rocky areas and open rangeland. Water Pans were constructed in the Ole Sharo Hills in Suswa and at Mandongoi area in Ngomeni and at Ilaretok in Narok.



An established water pan in Ewaso Ngiro and Itivanzou

Roof Catchments

Roof catchment is an ex-situ rain water harvesting practice that uses gutters to collect water from the roofs of buildings. The water is then stored in tanks. The water would have gone to the ground running down the slope thereby causing soil erosion and degradation. The practice was applied at Itivanzou Secondary School, in Kyuso.



Securing Water Springs

A spring is a place on the earth surface where water naturally flows from an underground aquifer. The amount of water coming from a spring is determined by status and spatial extent

of spring's recharge basin and the amount of precipitation. This means that the flow will be reduced during the dry season when there is no surface water to recharge the aquifer.

Some of the pilot districts had springs that were the only source of water for livestock and domestic use during the dry season. At such times the use of a spring was characterized by scramble for the reduced water resource, pollution and conflicts. Concentration of large numbers of livestock polluted the water, caused soil erosion and land degradation in the spring's immediate environs. Women were also spending long periods waiting to draw water leaving little time for other livelihood chores. Further, women and children used to draw water at dawn and at dusk hours exposing them to insecurity.



Bore Holes

Towards accessing and using water to support sustainable land management initiatives, at several sites with no rivers, in the pilot districts, target beneficiaries identified access to water as priority. The project adopted the relatively low cost approach of drilling boreholes. This practice was applied in at Alikune in Dadaab to get water for domestic use and for livestock and for small irrigation of farms at Mulot in Narok to provide water for domestic use and for watering livestock. The use of relatively green vegetation as an indicator of underground water informed drilling sites selection. Because the areas have reliable and predictable sunlight, solar energy driven pumps were installed to pump water to plastic storage tanks. Water was then supplied by gravity through pipes to the farms for irrigation, for domestic use from tapped water points and to troughs for watering livestock.



Outcome 2: Viability of the agro-pastoralism production system increased through diversification and access to finances for SLM.

Improvement of Local Breeds

To enhance animal productivity the project initiated a programme of cross-breeding local breeds with faster growth breeds to attain marketable weight and for meat production, for higher milk production and adaptiveness to local environment.

The introduced breeds were Sahiwal bulls, shoat breeds were German Alpine, Kenya Alpine, Galla goats and Dorper rams. In poultry cockerels of better breeds such as Kenbro, Saso and Kutch were introduced.

Results and Benefits

- Diversification of livestock enhances resilience against climate shocks.
- Higher sale price was obtained for the faster growth breeds of introduced and resultant cross-breeds that attained marketable weight faster.
- Better goat breeds improved milk production.
- Introduced goats for milk production often give birth to twins that are sold to boost family income.
- Alternative and increased sources of income for the family and women from sale of goats, goat milk, chicken and eggs.

Livestock Marketing and Value Addition of Livestock Products

Livestock marketing, the practice through which live animals change ownership, is critical for improving pastoral household income. Efforts to address constraints to efficient livestock marketing activities are vital in reducing land degradation together with agro-pastoralists' vulnerability to drought. The baseline survey at the start of the project indicated that lack of marketing infrastructure, lack of information on markets and low prices as the major constraints. The project initiated development and renovation of slaughter houses and slabs, livestock marketing yards and also organized market trading to keep away middlemen and brokers. Further the project supported documentation and dissemination of real-time livestock prices at major markets to livestock traders. Farmers who formed livestock marketing groups under FFSs were also trained on use of mobile phones and SMSs to access market information. Flayers were trained on processing of hides and skins. The project also initiated partnerships with National Livestock Marketing Council (NLMC) to enhance the institutions capacity and the Kenya Meat Commission for purchase of livestock.

Results and Benefits

- Formation of Livestock Traders Association (LTA) and Market Committees in Dadaab
- Improved prices and returns from sale of shoat and cattle.
- The better prices improved family income from quality skins and hides
- Rehabilitated slaughter houses, and improved markets, and construction of livestock sale yards earning revenues for country governments
- Improved slaughter houses and slabs improved hygiene and cleanliness of meat, with less health risks.

Beekeeping

Beekeeping as a component of livestock rearing was introduced as a practice to manage bee colonies for production of honey and bees wax. The promotion of the practice involved training of farmers in value of bees, bee colony management, beekeeping technologies such as improved bee hives and honey processing. The project then supported the farmers with provision of Langstroth and Kenya Top Bar beehives. The initial pilot hives had a relatively high colonization and the practice has been up-scaled within the pilot districts.

Results and Benefits

- Areas set aside as apiaries and excluded from other uses have indirectly promoted environmental conservation and preventing land degradation.

- The practice also promoted pollination of plants wild plants and crops for genetic posterity and productivity. Bees play a major role in maintenance of biodiversity through pollination
- Diversification of livelihood sources and income with minimal disturbance of the natural vegetation.
- Low labour and capital investment requires less land and has minimal competition with other forms of land uses.
- Honey which has medicinal value and is also a food
- New and incremental income from the sales of honey and wax particularly for women
- Employment creation and enhancing women empowerment.

Fish Farming

The securing and rehabilitation of Omomet spring in Mulot resulted in a constant and continuous flow of clean fresh water. The local community decided to secure a natural pond below the spring and to construct one pond for fish farming. The pond was designed in 2014, stalked with catfish and tilapia fingerlings in 2015 and first harvest was done in June 2016. The practice has been a successful alternative livelihood and extra income source and farmers have already started harvesting the fish for domestic consumption and for sale.

Results and Benefits

- Optimal use of the water resource
- Extra new income from sale of fish
- Improved nutrition

Conservation Agriculture (CA)

This practice sought to increase land productivity, food security, alleviate poverty, conserve biodiversity and safeguard ecosystem services. These targets were to be realized by minimizing soil disturbance and growing grass crops to improve pasture and to produce hay. The main feature of the practice was minimal or no tillage. It was applied in Ewaso Ngiro in Narok, Ngomeni in Kyuso and Alikune in Dadaaab.

Soil and Water Conservation

There are strong links between measures for soil conservation and measures for water conservation. Many practices are directed primarily to one or the other, but most contain an element of both. Reduction of surface run-off by structures reduces soil erosion. Similarly, reducing erosion will involve preventing splash erosion, or formation of crusts, or breakdown of structure, all of which will increase infiltration, and so help the water conservation. Broadly the practice improves yield and decreases the inputs.

Soil and water conservation practice entailed improving and maintaining soil fertility, reducing soil erosion and degradation together with optimal water harvesting, conservation, and use, including conveyance, reducing evaporation and run-off and small scale irrigation. Initially soil quality and any requisite requirement to enhance fertility were establishing by appropriate soil sampling and laboratory analysis. Using FFSs, farmers were trained in and applied various soil and water conservation methods and techniques including use of farm yard manure and fertilizers, use of crop residues for mulching and composting, and laying appropriate infrastructure for holding water such as terraces, ditches, semi-circular bands, micro basins, Zai pits and small scale irrigation and proper ploughing so as to enhance infiltration.

Outcomes 3: Policy and institutional framework supportive of SLM mainstreaming in agro pastoral production system and ASALs.

Policy Development

The project implementation was guided by and aims to support implementation of many relevant national policies. The policies implementation through the project activities generated information valuable in the policies review and for developing of new policies.

Results and Benefits

- Mainstreaming of sustainable land management in the new National Livestock Policy and the draft National Camel Policy.

Energy Efficient Cooking Stoves

The project adopted wood fuel efficient technologies to reduce consumption and extraction of biomass from the landscapes. This involved use of a variety of energy efficient cooking stoves

that use much less fuelwood including Maendeleo Liner Jiko in Narok, Jiko Liners, Rocket Stoves, Kuni Mbili Jikos and the Institutional Jiko in schools.

Results and Benefits

- The best practice is economical fuel consumption because of use of less charcoal or firewood compared to the three stone traditional stoves.
- Use of less fuelwood thereby conserving woodlands and forests and reduces land degradation
- Reduce burden of searching for firewood and time spent by women and children in collecting firewood avails time to undertake other livelihood tasks including school work.
- Reduced time spent in cooking meals releasing time to women to undertake other livelihood chores.
- Less smoke and improved indoor environment and air quality which improves health, particularly of women
- In Mbeere the training and promotion of energy efficient stoves under the project has created a vibrant stove fabrication informal industry, with 34 stove builders engaged in the sector. The industry sells an average of 60 stoves, makes 400 rocket inserts, and installs 15 bricks stove in homes per month.
- Employment creation and increased incomes in rural areas

Efficient Production of Charcoal

Charcoal burning is carried out in project pilot districts mainly by men to generate income particularly in time of extended drought and crop failure. But because of limited alternative livelihood options, women are also resorting to charcoal burning.

The traditional earth kiln method that uses huge logs to produce charcoal is however very inefficient. The kiln also consumes a lot of time and labour in cutting huge trees, digging out soil, carrying and arranging huge logs and covering logs with leaves, grass and soil. All these activities also cause environmental degradation.

To address this challenge the project in partnership with Kenya Forest Service introduced the modern Half Orange Brick kiln in Mbeere to improve the efficiency and performance of the charcoal production. The practice aimed at increasing production from the same volume of biomass material. Using the kiln charcoal can be produced from twigs and branches. Kilns were constructed in Kune, Mitamisiyi, Ngomeni, Kamusiliu in Mbeere.

Farmers were also assisted to form Charcoal Producer Associations, a mandatory KFS requirement to be allowed to take part in charcoal production. Farmers were also trained in charcoal policy and regulations and growing of fast growing trees for charcoal production.



Traditional charcoal burning and a half orange kiln (modern kilns) for sustainable charcoal production at Njiga, Mbeere North

Results and Benefits

- Charcoal producers have been sensitized and trained on improved charcoal production technologies, selective harvesting of shrub and tree species, pruning of branches for charcoal production, promoting natural tree regeneration of harvested areas.
- Establishment of tree nurseries of fast growing exotic and indigenous tree species for timber and for charcoal production.
- Use of twigs and branches from pruning of trees instead of cutting them retaining tree cover. Further, reduced pressure on indigenous species and planting of trees increased tree/forest cover towards the 10% national target.
- The earth traditional kilns which normally set up in forests and woodlands are often a source of bush fires that cause land degradation. Modern kilns remove this risk.
- Gender sensitivity and women empowerment; modern kiln are less hard labour intensive and are easily used by women to produce charcoal for domestic use and for sale to generate income particularly during drought periods when land productivity is low or non-existent.
- Time and labour saved used in other livelihood activities and improved and healthy working conditions for charcoal producers.
- Charcoal Producer Associations enable collective bargain for better prices and for doing business in a sustainable way with dealers.

- Improved overall household incomes particularly during drought periods.

2.6 Key Note Address by Mrs Mary Githaiga (Ministry of Agriculture, Livestock & Fisheries)

National Agricultural Soil Management Policy

Importance of agriculture

- Contributes 27% directly to National GDP
- Contributes 27% indirectly to national GDP
- Employs about 75% of our rural population
- Accounts for 65% export earnings
- Contributes 45% of Government Revenue
- Contributes 70% of industrial raw material for domestic agro-industries.
- Key driver of Kenya Vision 2030, growth be 7% per year
- Need to enhance agricultural productivity to meet this goal

Rationale for a policy

- Growth in the sector is constrained by, among other factors, increasing degradation and deteriorating soil fertility and health leading to declining productivity in the both the crop and livestock sectors
- The country is often faced with chronic deficits in production of major staple food crops.
- Evidence links soil degradation with the persistent low farm yields.
- Potential for maize yield is 6610 t ha⁻¹ while the national average is currently estimated at 2 t ha⁻¹.
- Impact of low farm productivity is felt more by the poor who live in the rural areas and depend on agriculture for their livelihood.
- They are vulnerable to food insecurity and poverty.
- Their influx into urban centers is causing rural-urban imbalance, which is putting a greater strain on the limited urban infrastructure, resulting in increased crime

Government felt the need to have an Agricultural Soil Management Policy formulated to address declining soil productivity

Scope of the Policy

- No comprehensive policy on soil management-though soil is mentioned in many statutes
- Provide a framework of coordination of numerous players

- Provides a framework for sustainable management of agricultural soils as per Constitution of Kenya, 2010 and a devolved form of government,
- Provide for inter-linkages of agricultural support systems such as land use, irrigation, extension, infrastructure and research
- Addresses legal and regulatory gaps essential for the integration of soils management in a devolved system of governance

Objectives

- Promote efficient and sustainable use of soil as a resource
- Mainstream agricultural soil management in both National and County governments' planning agenda
- Provide a framework for research and dissemination and utilization of appropriate technologies
- Establish legal and regulatory framework to govern soil management and provide a conducive environment for private and public investment

Policy Preparation

- Taskforce was formed and prepared a draft in 2006 but financing constraints hampered progress
- 2015 another inter-ministerial taskforce formed have prepared the technical draft by studying the various thematic areas appertaining to agricultural soil management for discussion with stakeholders.
- Policy making is a consultative process

Thematic Areas

Sustainable agricultural soil management (soil and water conservation, soil health and fertility, fertilizers, organic and conservation agric., soil biodiversity, agroforestry, soil restoration, remediation

Challenges;

- Inadequate and inappropriate soil and water conservation measures;
- Continued Land fragmentation
- Land tenure systems not favorable for investment in conservation
- Inadequate knowledge and skills in agricultural soil management;
- Inadequate and inefficient use of fertilizers;
- Inadequate legal, regulatory and institutional framework
- Inadequate enforcement of existing legislation
- Inadequate coordination among players in soil conservation arena

2. Soil Management and the Environment (climate change, infrastructure, extractive industries)

Challenges;

- “ Weak enforcement of environmental regulations
- “ Conflict in various legislations that regulate land management practices
- “ Inadequate capacity to predict and respond to adverse impacts of climate change
- “ Weak implementation of strategies to combat climate change and variability

3. Technology Development, Dissemination and Utilization (research, extension and adoption)

Challenges;

- Resources for research are spread too thinly leading to low quality research outputs.
- Loss of key scientists (brain drain) leading to undermining locally relevant research systems
- Limited training of new researchers- limited in-country post-graduate degree programs
- Dependency on donors: Research in small institutions or programs is either vulnerable or not viable because it cannot break its dependence on donors and external agencies
- Research sometimes driven by donor and does not address our needs
- Limited communication amongst research institutions dealing with various aspects of soil as well as amongst inter- and trans-disciplinary researchers.
- Poor communication and dissemination of research results across the regions through multi-institutional or projects linkages.
- Poor targeting of soil fertility challenges, soil types, beneficiaries and agro-ecological
- Inadequate involvement of farmers in technology development.
- Inadequate institutional arrangements to support implementation of programmes.

4. Fertilizer development and investments

- Lack of a comprehensive legal and regulatory framework
- High transportation costs leading to high prices of fertilizers.
- Inadequate raw materials for local manufacture of fertilizers.
- Inadequate enforcement mechanisms for biological and organic fertilizers due to unclear mandates of various state agencies.
- Sustainability of the fertilizer subsidy program.
- Unfavorable terms of trade between farm inputs and outputs.

5. Current policies, legal and institutional framework governing soil management Challenges;

- lack of a comprehensive policy, regulatory and institutional framework to govern soil management

- Weak implementation and enforcement of existing environment and natural resources policies and legislation
- There are overlapping roles among various acts and institutions.

6. Coordination, Monitoring and Evaluation of the Policy Implementation

- Important that all actors of this policy are coordinated whilst implementing the policy

7. Implementation Matrix

- Will designate the roles and responsibility of all parties and their interlinkages
- Include a set of performance indicators, timeframe and measures to assess progress of implementation
- Provide for institutional strengthening and capacity building and mechanisms for financing the implementation of the policy.

When to do a Policy

- When the situations calls for help mainly and wants government to intervene there is a crisis
- No clear law or organization is fully in charge-
- Many players who are not coordinated.
- Policy sets the rules for fair play
- Policy can either propose enactment of new laws or amendment and strengthening of existing laws
- Can also create new organizations or propose strengthening of existing ones
- Proposals to by enforced by law are put into a bill and taken to parliament

Steps in the Development of the Policy

- Formation of multi ministerial Technical Working Group
- Preparation of draft policy working document
- Intergovernmental Working Group (National and County) harmonizes draft working document
- Nationwide consultation on Draft policy
- Validation of the draft policy document
- Approval by cabinet and submission to parliamentary process
- Parliamentary review and approval of the policy document and the Bill
- Presidential ascent to the Bill to become a Law

ANNEX 1: KEY NOTE ADDRESS BY MR. MAIMBO MALESU

National Conference on Sustainable Land Management

Sustainable Land Management Experiences from Sub-Saharan Africa



1-4 June 2016, Naivasha - Kenya



Presenter:
Maimbo Malesu

Contributions:
Alex Oduor, Miyuki Iiyama, Dennis Garrity and Ermias
Betamariam

Context-Harnessing New Opportunities

20–25% of global land degraded affecting 1.5 billion people



Sustainable Development Goal # 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

SDG# 15.3- UNCCD: Land degradation neutral world by 2030



The Bonn challenge: restore 150 million ha (85 billion a year) of deforested and degraded lands by 2020 and **350 million hectares by 2030**



CGIAR strategy 2016-2030 "**Harnessing New Opportunities**": Improved National Resource Systems & Ecosystem Services (SLO 3): targets to restore **190 million hectares of degraded land by 2030**

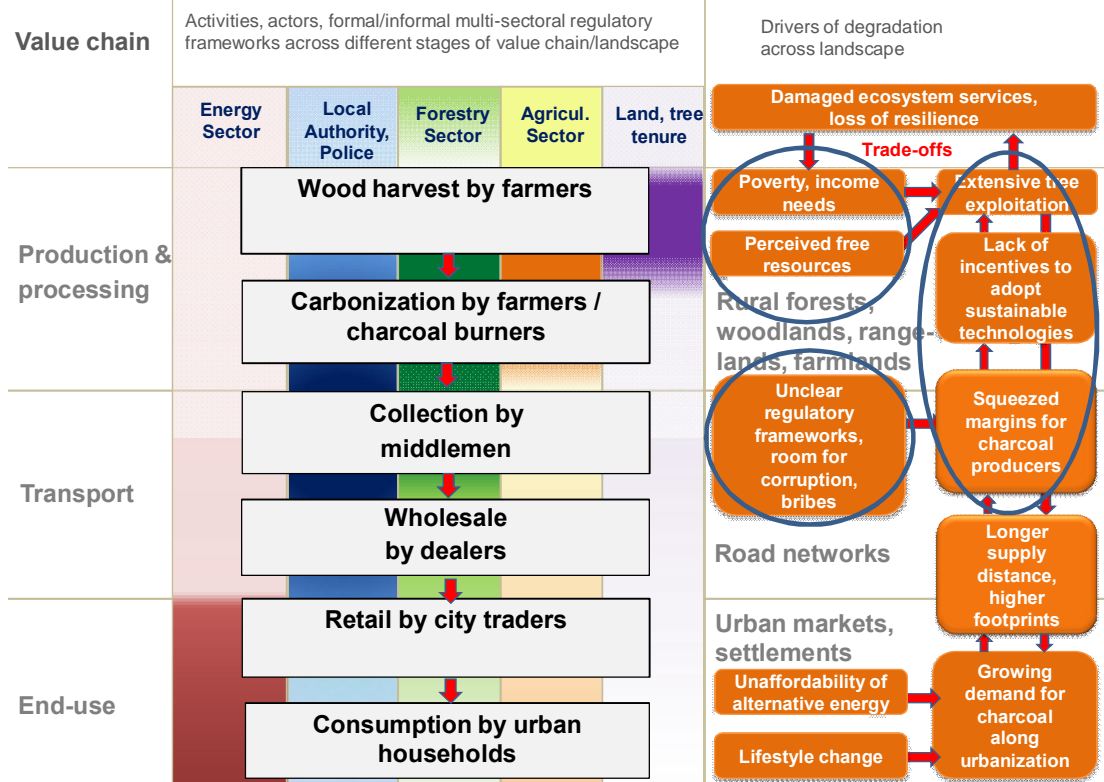
3

Livelihoods, charcoal, ecosystem...

- “ Indigenous forests of precious hardwood species, breeding sites for wild animals
- “ Lack of alternative livelihoods, need for pasture, prompting tree felling for charcoal for small return
- “ Difficulty of controlling production and trades and to conserve with complex directories and lack of clear responsibilities among ministries in charge



Charcoal Economics in Landscape Context – Conceptual Framework



goal – sustainable charcoal

Comparative studies between African countries, and even Asia/Latin America...



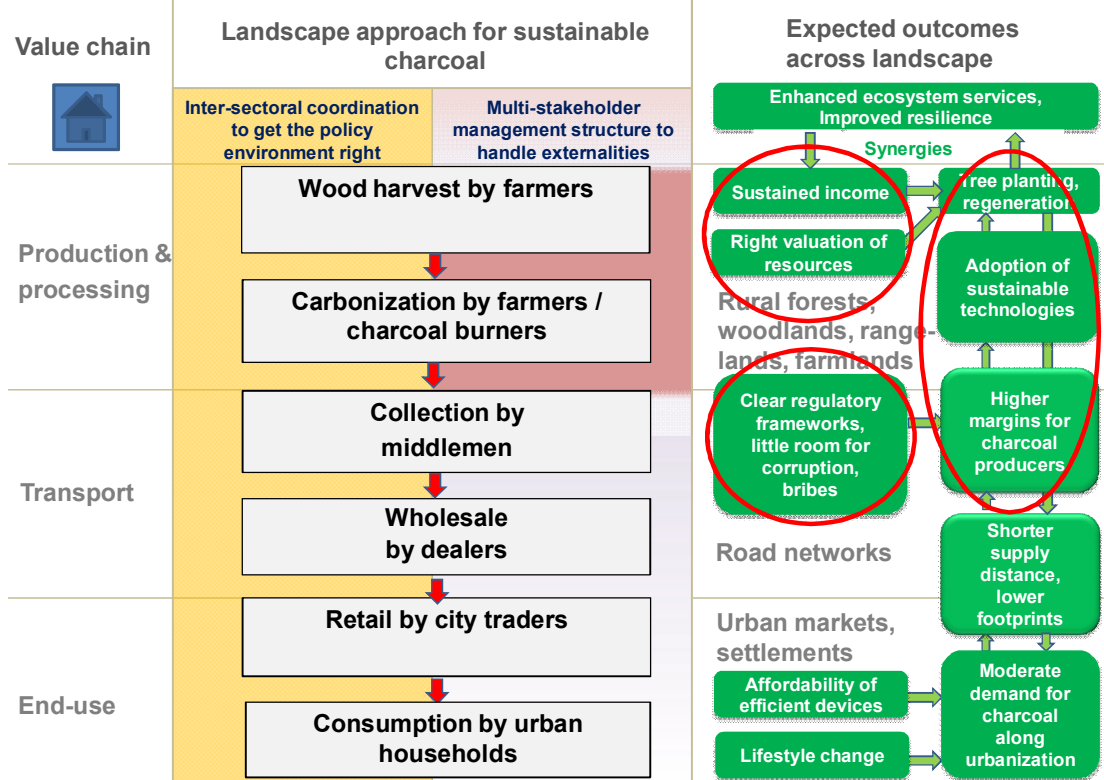
Rwanda

- Only Forestry Dep – Ministry of Natural Resources is a responsible authority.
- A land owner to clear a plot over 0.25 ha, transporters obtain permits from District Gov which controls all the revenue, while National Government does not interfere.
- Charcoal is a relatively profitable business while the same Eucalyptus can serve multiple purposes – firewood, timber, bean stakes.
- In sum, the impacts of centralized policies, decentralized implementation, higher margins for landowner/producers, multi-purpose trees compatible with local crop-livestock systems, are key

Kenya Case	Price (KSH) /35.7kg	Price (USD)/kg	Producer margin
Farm gate price	KFS - 438 Ksh (Mara - 100ksh)	0.14 \$/kg (0.03\$)	
Nairobi price	1,949ksh	0.61 \$/kg	22% (5%)

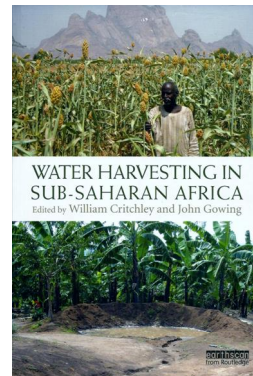
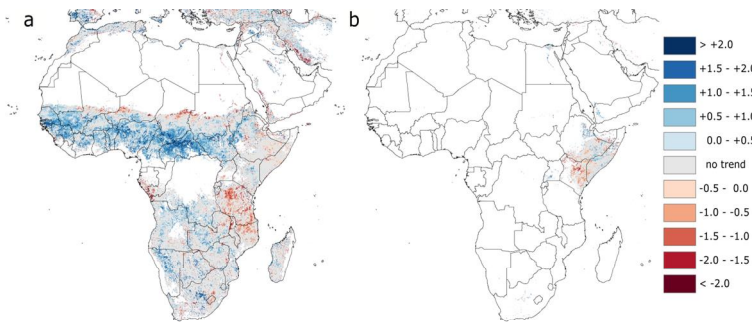
Rwanda Case	Price (RWF) /32kg	Price (USD)/kg	Producer margin
Nyungwe	4,000 RWF	0.18 \$/kg	
Butare city	5,500-6,000RWF	0.24-0.26 \$/kg	66-72%
Kigali city	7,500 RWF	0.33 \$/kg	53%

Charcoal Economics in Landscape Context – Conceptual Framework



Targeting climate smart agriculture based on LGP from 30 year satellite data

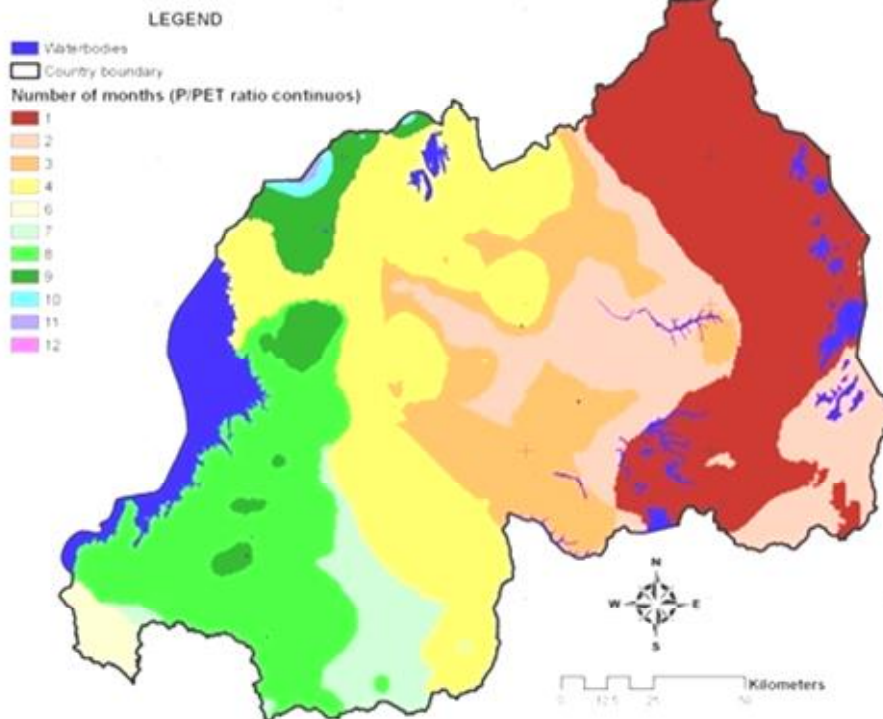
- “ Length growing period (LGP)
 - 30-45 days increase in West Africa
 - 30-45 days reduction East Africa
- “ Buffering interventions
 - Rain water harvesting
 - Agroforestry



Change in LGP (days/year) based on 30 year NOAA AVHRR imagery
 Vrieling, De Leeuw and Said, 2013, Remote Sensing

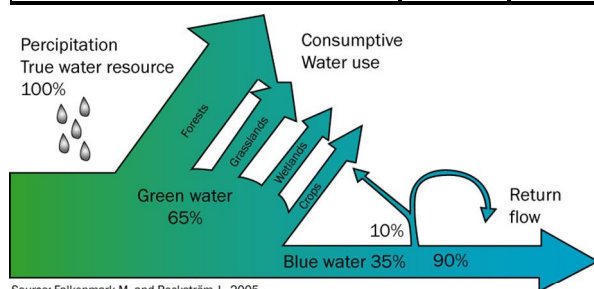


P/PET ratio



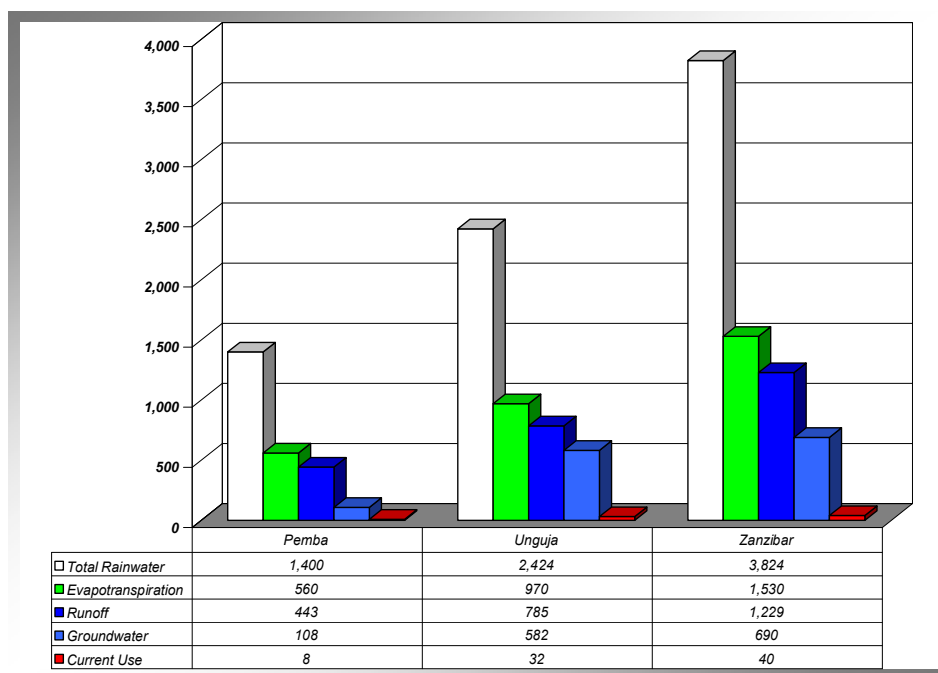
Land Use Change & Water Partition – Kenya Case Study

Class	Crops (km ²)	Forest (km ²)	Grasslands (km ²)	Wetlands (km ²)	Total (km ²)
Ewaso-Samburu System	5,650	3,850	54,790	3,347	69,127
Mt Kenya & Abaridere System	11,750	2,769	796	201	15,564
Mau and Western System	29,848	6,796	14,233	658	51,600
Coastal forest and Marine	9,626	16,758	23,520	2,811	52,873
Amboseli & Chyulu System	5,983	4,513	14,133	1,774	26,412
Total	62,857	34,686	107,472	8,791	215,576
% Landcover within the five Ecosystems	29.16%	16.09%	49.85%	4.08%	99.18%
% Landcover within Kenya	11.03%	6.09%	18.85%	1.54%	37.51%



Within the focal ecosystems, grassland occupy the largest portion at about 19%, followed by crops at 11% and forest at 6%.

Rainwater partitioning – Case of Zanzibar





Notice the difference?



It all started in 1994 in Zimbabwe



**SOUTH-
SOUTH existed
then!!**

- Back in Zimbabwe in 1994 A team led by WB, recognized the success of CA by commercial farmers.
- "Is it possible to scale it up to smallholder farmers?"
- A WB survey of 103 smallholder farmers in the whole country came with a decisively positive result: "Yes"
- Enthusiastic about CA potential. WB proposed to set up a regional CFU hub in Zimbabwe....But... the hub idea did not fly.
- In 1995, the Bank invited Brain Odrieve to Zambia to launch the CFU there, where there was strong political support ---from minister down.... To pioneer farmers. Partners came inNorway, Sida, FAO, ...or long term support

Almost two decades later in 2012

Zambia graphin CA?



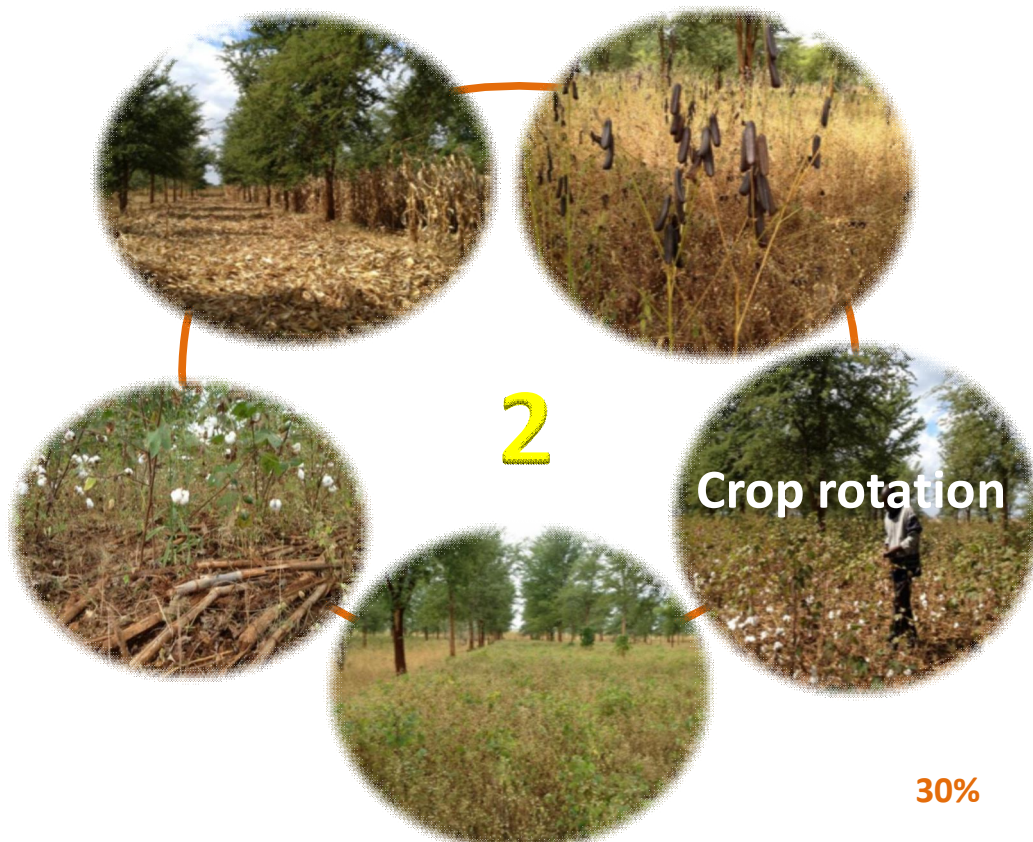
Zambia map.....in CA

By 2012, there are > 250,000 smallholder farmers practicing CA in Zambia



Three Basic Principles of CA

1 Permanent ground cover



Micro dosing



Zambia's non-negotiable points:

- “ **STOP:** No burning of residuals
- “ Permanent planting basins rightly spaced, dug before the rains
- “ Early planning and early weeding
- “ Rotate with at least 30% of legumes





10mx10m spacing



Faidherbia Trial Results in Zambia

Maize yield - zero fertiliser

	2008	2009	2010
	---- Tons/ha ----		
With Faidherbia	4.1	5.1	5.6
Without Faidherbia	1.3	2.6	2.6
Number of trials	15	40	40

What led to Success of CA in Zambia?

Govt. policy paper

- “ Strong Government **policy support** – MoA, declared CA in extension policy in 1990
- “ ZNFU Established Conservation Farming Unit -CFU – for reaching farmers, adaptation
- “ Govt. worked with research (GART – for devel. Technology)
- “ Long term donor support from Norway, FAO, SIDA...
- “ Engaged private sector - Magoye ripper, seed and herbicide

SOW FOR THE FUTURE:
Plant Musangu Trees This Year

Sufficient Seeds for one Hectare and instructions
ONLY K10,000

Faidherbia albida will provide **FREE NITROGEN** for your crops after 10-12 years!

CONSERVATION FARMING UNIT (CFU)



Constraints for up scaling



Availability of residuals

Availability of tools



Need for mechanization

Constraints for up scaling

Access to markets



Look, Conservation farming Pays!



What is Evergreen Agriculture?

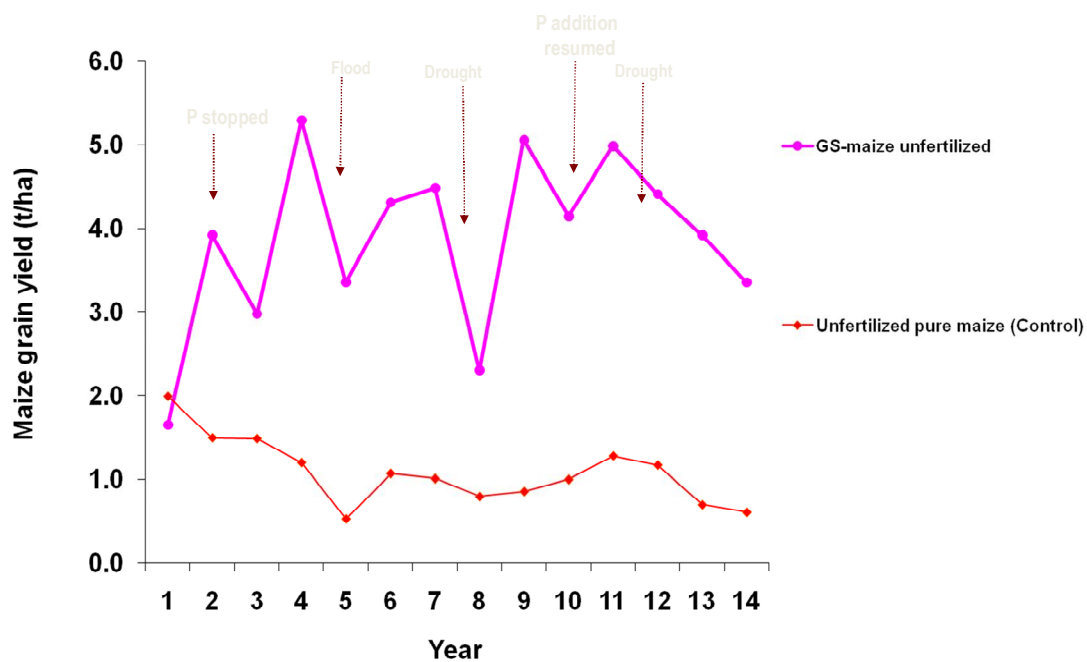
A form of more intensive farming that integrates trees with annual crops, maintaining a green cover on the land throughout the year.

Evergreen farming systems are 'double-story' systems that feature both perennial and annual species (food crops and trees).



Maize with Gliricidia Sepium:
A bumper Harvest

Long-term maize yield without fertilizer in a *Gliricidia* system



Malawi National Agroforestry Food Security Programme

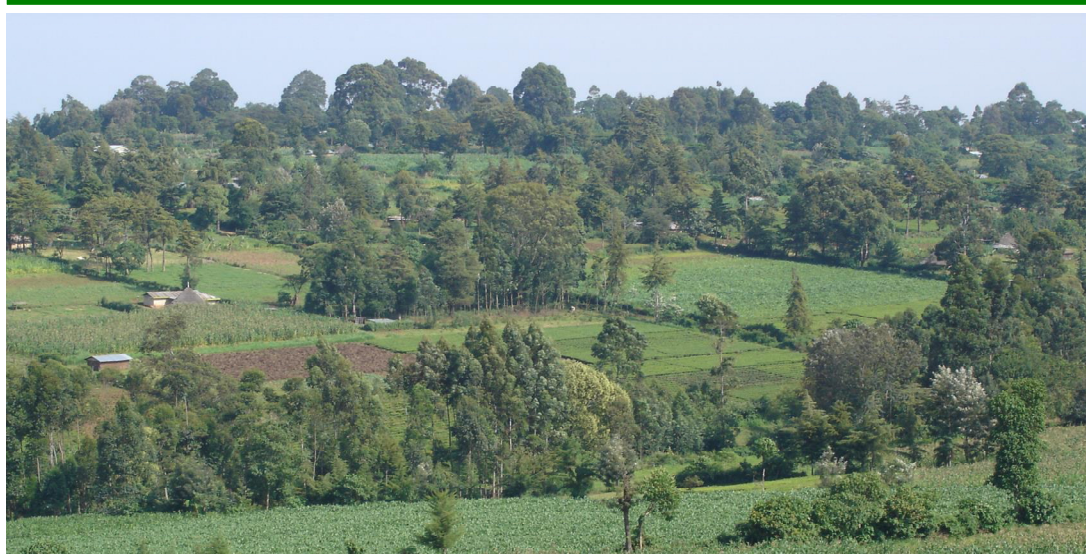


Impact of fertilizer trees on maize yield under farmer management

Plot management	Yield (t/ha)
Maize only	1.30
Maize + fertilizer trees	3.05

2011 Survey of farms in six districts (Mzimba, Lilongwe, Mulanje, Salima, Thyolo and Machinga)

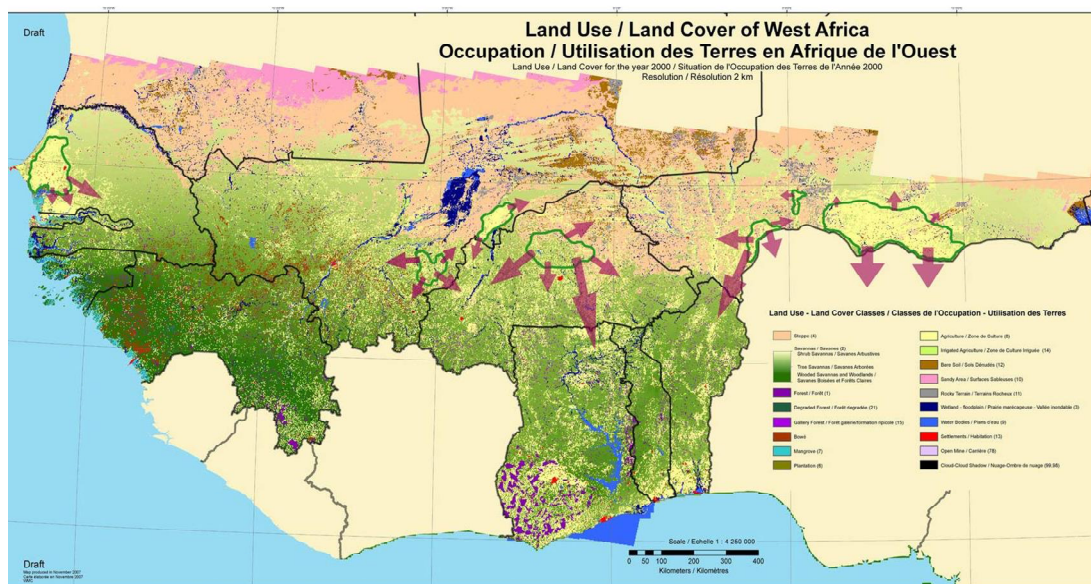
Kenyan Farmlands: Bold policy to achieve >10% tree cover on farms through a National Evergreen Agriculture Programme



What are the advantages of Evergreen Agriculture?

1. **Increased and more stable food crop yields**
2. **Regeneration of soil fertility**
3. **Improved microclimate** and soil water to buffer crops to rainfall variability
4. **Enhanced dry season fodder availability**
5. **Dramatically increased carbon accumulation** in food crop systems: 6-10 t CO²/ha/yr
6. **Enhanced biodiversity** in annual crop systems grown in agroforests
7. **Reduced deforestation** due to enhanced potential in rainfed agriculture

Major agroforestry regions in West Africa and directions of expansion



Conclusions

- “ SLM requires concerted efforts from all actors given its complexity and multidisciplinary nature.
- “ This is possible when biophysical and socio-economic causative factors and impacts to Land Degradation are unpacked using relevant tools and frameworks.
- “ Climate variables especially rainfall and temperature impact negatively on water resources, length of growing period eventually pasture, crop and livestock
- “ ICRAF and partners have developed appropriate GIS tools that incorporate the Options be Context and used for assessing and planning SLM e.g. Irrigation master plan for Rwanda, Food Security Masterplan for Turkana, Zanzibar water harvesting master plan.

PARALLEL PRESENTATIONS

Ten papers on the different aspects of adaptation to climate Change impacts, adaption and resilience in agro-pastoral production systems and issues of Land Conservation and Management supportive of sustainable land management were presented at the conference on the first day.

The papers were presented themes highlighted:

SUB-THEME 1: CLIMATE CHANGE IMPACTS, ADAPTION AND RESILIENCE IN AGRO-PASTORAL PRODUCTION SYSTEMS (BREAK RM 1)

Session Chair: Dr Alice Ruto

Paper 1: Spatial assessment of climate based rangeland vegetation variability in Samburu and Marsabit Counties by Charles Kigen

Climate change impacts are many, varied and location dependent. Climate is critical in vegetation distribution and its effects in Kenyan Arid and Semi-Arid Lands (ASALs) are critical in guiding sustainable development in Samburu and Marsabit Counties. These counties economic activities are dominated by livestock keeping and wildlife based investments whose dependence on natural vegetation cannot be overemphasised. This paper assessed the influence of climate on rangeland vegetation in these counties from 2010 - 2014. Analysis of the Normalized Difference Vegetation Index (NDVI) established yearly spatial correlation matrices of 0.95731 - 0.96733 and 0.92791 between years 2010 and 2014 NDVI. The analysis also illustrated that 90.82% of the areas between the five-year period experienced negative correlation within the range of -0.25 and 0-0.25 for 9.18% of the combined Samburu and Marsabit counties. This information is critical in making rangeland vegetation management decisions concerning the stocking rates and the dry season pasture.

Paper 2: Rainfall and temperature variability effects on survival of Sahiwal cattle at the National Stud at KARLO Naivasha

By Githinji M.G

The Sahiwal cattle breed have been raised over the years under semi-arid ecosystem which is classified as hotspot of climate change where temperatures and precipitation changes are increasing in magnitude and have been experiencing fluctuating herd dynamics and performance. In response, altering breeding and husbandry practices are prioritized to improve performance. However, interventions are planned without adequate understanding of the extent of sensitivity of the Sahiwal cattle breed to impacts of climate change. Sensitivity to temperatures and precipitation changes are likely to manifest in the herd dynamics and milk production performance because of associated changes in the productivity of forage and pastures and outbreaks of livestock diseases. The objectives of this study were to determine whether the variability in monthly rainfall and temperatures, have any influence on herd dynamics of Sahiwal cattle herd. The PROBIT procedure was used to fit a logistic regression model to the probability of a positive response (survive) as a function of the variables in monthly, temperature and rainfall. Considering the interaction between the rainfall and temperature on survival, there was significant month ($p < .0001$, $\chi^2 = 44.98$), rainfall ($p = 0.01$,

$\chi^2 = 6.68$), and temperature by rainfall interaction ($p = 0.01$, $\chi^2 = 6.16$) but insignificant temperature effect, ($p = 0.79$, $\chi^2 = 0.07$). The prolonged drought that came at around December all the way to January affected the survival of cattle through the constrained availability of feeds which led to starvation during this period. The month of May and October were also significant in the study because during this month there was plenty of lush pastures coming due to the long and short rainfalls and animals would feed fast, coming from a period of scarcity and this led to deaths due to bloat.

Paper 3: Pathways to building Resilience and Adaptive Capacity to Climate – Induced Vulnerability in Syembeni, Makueni County

By Joseph Lwanzia

The agro ó pastoral people of Syembeni, an ASAL area, were beneficiaries of an integrated project initiated by Urafiki Kenya, a national. The aim was to increase their capacity to cope with, adapt and build resilience against climate change shocks. A multi ó pronged approach whose objective was to significantly improve their livelihoods was initiated. Urafiki Kenya focused on four key issues for action and implementation: 1) adapting appropriate technologies; 2) strengthening food security systems; 3) building a communication platform to feed into the national policy; and 4) promoting water, environment and ecosystem conservation. Urafiki Kenya assisted in the preparation of a participatory Syembeni Community Action Plan (SCAP) in collaboration with the project implementation committee and the targeted beneficiaries. As an integral part of SCAP, a strategic project impact assessment (SPIA) focusing on the four key issues was also undertaken to systematically integrate project stakeholders concerns and implementation challenges into the overall project strategy and to provide a tiered approach to project planning and review of the implementation tools. Overall, the key achievements of the project included: improved knowledge of agronomic practices; greater access to appropriate weather information; alternative livelihoods contingency plans; participatory learning and pyramiding or cascading of technical know ó how; pursuing crop ó livestock integration and simple water conservation techniques.

Paper 4: Impact of climate variability on water resources in semi arid parts of Kenya; community perceptions and adaptation mechanisms for agricultural production

By Clifford Obiero

Climate change and variability leads to severe droughts and floods leading to livestock loss, failure of crops and drying of water resources especially in semi-arid parts. The objectives of this study were to explore rainfall trends, coping and adaptation mechanisms to climate change and variability by various communities in semi arid parts of Kenya. The study was carried out in three major river basins in Kenya: Athi, Ewaso and Tana river basins. A questionnaire was used to study the communities' perception and adaptation mechanisms to climate change and variability. Spearman rank correlation and Wavelet analysis methods were used to study rainfall and stream trend and periodicities. The results indicated that in the last 30 years, rainfall has become more unpredictable and unreliable, drought periods longer and rainfall amount, duration and intensity decreased. The study found out that the communities were reducing their water consumption and practising water recycling in order to cope with reduced amount of water and come up with initiatives to mitigate and cope with water scarcity. The analysis of stream flow data revealed both increasing and decreasing rainfall trend in some stations in the Athi river basin, while stream flow data showed increasing stream flow trend in some gauging stations. The wavelet results revealed periodic events of 2-3, 5-7 and 11 years associated Quasi-Biennial Oscillations, ENSO and Solar cycle respectively. The increase of rainfall and stream flow could be due to increased evaporation and enhanced snow melting on Mount Kenya respectively. The results are useful in designing drought adaptation mechanisms.

Paper 5: Climate Variability and Gross Primary Production in Rangelands: A Case Study of Lower Ewaso Ngiro South River Watershed

By Mathew Kiura Kigomo

The occurrence of extreme and erratic weather events usually causes irreparable damage to rangeland conditions mainly vegetation cover and gross primary production (biomass) and reduces their capacity to maintain a good ecological balance. The irreparable damage occurs through reduction of rangeland resilience against degradation and ability to regenerate after disturbance. This paper is a retrospective study providing key scientific findings about climate variability and their impacts on rangelands' land cover conditions in the Lower Ewaso Ngiro South River watershed. Based on temperature and precipitation patterns the study provides an analysis of climate variability influences on vegetation cover and gross primary productivity (biomass) in the Lower Ewaso Ngiro South River watershed, Kenya. Gross primary production, precipitation and temperature data were acquired from satellite imagery

for the period between 1998 and 2015. The results showed that changes in temperature and precipitation patterns are leading to altered vegetation covers regimes and gross primary production with varying changes across agro-ecological zones in the watershed. The changes include succession, invasion and replacement. The major explanation for these changes is conditions such as direct temperature stress, temperature-mediated drought stress, altered spatial and temporal patterns in precipitation regimes.

Plenary Discussions

Questions/Comments/ Responses

Topic: Spatial assessment of climate based rangeland vegetation variability in Samburu and Marsabit Counties

1. What is the link between vegetation and climate change?
2. The concern of the time period being too small to make a comprehensive analysis of climate variability?
 - My research was based on seasonality of the data
3. Which rangeland species were resilient to climate change?
 - There are in the final paper
4. Did you overlay some of the variables with socio-economic parameters?
 - No, that wasn't part of my research scope, but someone can look into that.
5. Is human population and livestock population taken into account as a cause of climate change especially in the Ewaso Ngiro?
 - I did not look at the human or wildlife component, but I feel it's a research gap to be explored.
6. Expound more on the scale used for NDVI?
 - My scale runs different from the normal scale because mine shows changes in NDVI, rather than actual NDVI

Topic: Rainfall and temperature variability effects on survival of sahiwal cattle at the national stud at the KARLO Naivasha

1. Which class of sahiwal was mostly affected according to your study?
2. Did you compare the effects on males and females?
3. Did you consider that the deaths may have been caused by other factors like diseases?
4. The paper can be drastically improved through incorporation of different variables.

- For example the deaths in a research station are documented do this variable can bring an interesting aspect in the paper.
- Thank you for the comments. However, most of the questions raised can be answered by data found at KALRO Naivasha.

Topic: Impact of climate variability on water resources in semi-arid parts of Kenya; community perceptions and adaptation mechanisms for agricultural production

1. Where there no impacts of climate change those were positive?
 - There were, unfortunately my research focused on the impact of the negative impacts and adaptations mechanisms.

Topic: Climate Variability and Gross Primary Production in Rangelands: A Case Study of Lower Ewaso Ngiro South River Watershed

1. It's preferable to use FEWS NET (CHAPS) that has a range of 5km calibrated by local stations, rather than 25km from MODIS.
2. Where is the link between your research and improvements of livelihood?
 - I believe that science should communicate and my research will improve the data that is available for implementation by policy makers.
 - Other factors are usually in play in research; however we cannot cover all the factors in one research.

**SUB THEME 2: LAND CONSERVATION AND MANAGEMENT
(BREAK RM 2)**

Session Chair: Dr. David Mburu

Paper 6: Effect of Adapting Conventional and Conservation Agriculture Farming Practices on Dynamics of Soil Fertility in Humid Areas of Embu County

By Alfred Micheni

Soil nutrient depletion is a key challenge limiting food production in Eastern Kenya. The problem is attributed to unfavourable farming practices adopted by smallholder farmers. A four season field study was conducted to investigate the effect adapting conservation

agriculture (CA) farming methods on soil quality in Eastern Kenya. The trial was at the Kenya Agricultural and Livestock Research Organization (KALRO-Embu) farm that had over 50 years of conventional tillage for maize and beans production. The farming was characterized by seasonal removal of over 75% of crop residues. A conventional (CVT) and two CA tillage practices; furrows/ridges (FR) and zero tillage (ZT) systems were the tillage treatments. The treatments were laid out on a randomized complete block design with three replicates. The plots were every season planted with maize and beans and monitoring done to define the effect of adapting CVT and CA farming practices on soil quality. Composite soil samples were taken at the start and at the end of the four seasons of experimentation and analysed in the laboratory. Soil pH (water) was acidic in nature and averaged at 4.87. The parameter was not significantly affected by adaptation of the various tillage methods. Soil texture was clay-loam, - on average clay, sand and silt particle distribution was 67%, 17% and 16%, respectively. The values did not significantly change resulting from adaption of different tillage methods. Soil bulk density averaged at 1.17kg m⁻³ and significantly decreased to 0.98 kg m⁻³ due to adherence to FR tillage method. Soil organic carbon (SOC) and total soil nitrogen (TSN) averaged at 1.89 and 0.20%, respectively and were insignificantly improved by seasonal residue retention or tillage practices. The average soil phosphorus (P) was significantly higher at 16.60 mg kg⁻¹ at the end of experimentation compared with 4.00 mg kg⁻¹ recorded at the start of the study. The soil microbes (fungi and nematodes) were significantly improved by application of the CA farming methods. The study concluded that the method of soil management has a direct impact on soil productivity (availing the plant nutrients and soil microbes). The importance of relating the improved soil fertility to crop productivity, and also conducting further studies to define the long-term (above 10 years) effect of adapting CA farming methods on soil and crop productivity were the two key recommendations made from the study.

Paper 7: Effects of Tillage and Cropping Systems on Maize and Beans Yield and Yield Components in a Semi-Arid Area of Mwala District, Kenya

By Anne N. Karuma

A study to evaluate the effects of tillage practices on maize and bean yields was conducted in Mwala District, Eastern Kenya, in the long (LR) and short rains (SR) of 2012/13. The tillage treatments were: Disc Ploughing (DP), Disc Ploughing and Harrowing (DPH), Ox-ploughing (OX), Subsoiling & Ripping (SSR), Hand hoeing with Tied Ridges (HTR) and Hand hoeing (H) only. There were three cropping systems of Sole Maize (SM), Sole Bean (SB) and Maize

- Bean intercrop (M + B), which were investigated in a Split-Plot Design field experiment with four replications. Data on maize and bean yield and yield components were monitored throughout the four cropping seasons. Maize plant height, cob length, number of cobs, cob weights, leaf area and leaf area index, maize and beans grain and biomass yields were significantly affected by tillage ($P < 0.05$). However, maize harvest index and the LER did not differ significantly during the growing seasons. No significant effect of cropping systems on the maize height and the number of cobs was observed. Higher maize grain yields ($P < 0.05$) were obtained in the sole maize plots in LR 2012 (5.01 Mg ha^{-1}), SR 2012 (4.19 Mg ha^{-1}) and in the SR 2013 season (2.82 Mg ha^{-1}). There was a 3.6 % increase in maize grain yields in the intercropping systems as compared to the sole maize in the LR 2013 season. A three - season bean grain yield average by tillage shows that $\text{DPH} > \text{SSR} > \text{DP} > \text{OX} > \text{HTR} > \text{H}$, with values ranging from 0.75 Mg ha^{-1} to 1.46 Mg ha^{-1} ($P < 0.05$). Intercropping reduced the seasonal means of bean grain yields ($P < 0.05$) with a 54 % decrease by intercropping (0.73 Mg ha^{-1}) compared to the sole bean (1.6 Mg ha^{-1}). Thus, the DP and DPH improved crop yield and yield components and can be recommended as tillage practices in the semi-arid Mbiuni Location, Mwala District, Kenya

Paper 8: Community Contracting Approach In Sustainable Land Management and Climate Change Adaptation and Mitigation in ASAL Areas of Kenya

By Elijah M. Mutungi

The Community Support Trust (CST) is a Public Trust established to succeed the Community Development Trust Fund (CDTF), to offer services in grants management and capacity support for project development, management and implementation of community-based project. The Community Development Trust Fund (CDTF) was founded as a programme in 1996 by the Government of Kenya, European Union and DANIDA, and has implemented over 1000 projects in all 47 counties, 248 focusing on environmental conservation, targeting conservation of threatened ecosystems, sustainable management of natural resources, livelihood improvement, climate change adaptation and mitigation; and, promotion of renewable energy. CST addresses gaps in development planning at the community level and catalysis bottom up development, which ensures responsiveness to priority needs resulting in sustainable social and economic benefits. This is executed through a unique model, the Community Contracting Approach which promotes public participation in development planning and implementation, a strategy developed and tested over the years, with successful

outcomes. In ASAL areas of Kenya, CST uses also the ecosystem based approach, institutional strengthening approach and value chain development approach among others to address sustainable land management and climate change adaptation and mitigation challenges. The paper explains in detail how CST has developed and used these approaches in sustainable land management and climate change adaptation and mitigation, achievements, lessons learnt, and best practices for up scaling and replication in other projects and programmes.

Paper 9: Community Resource Mapping for Sustainable Management of Loita Landscape

By Faith Milkah Wakonyo Muniale

Community resource mapping is a process that enables community members to identify and share information regarding occurrence, distribution, access to and use of their resources. It examines relationships between community's natural resources, topography, human settlements, and activities. It graphically shows the significance attached to their resources; identify problems, possibilities, and opportunities in their landscapes. It forms a basis for landscape development planning and is handy for targeting interventional projects. If carried out periodically, it shows impacts of development activities on landscapes. Loita represents a community, lifestyle and landscape. The landscape lies between Nguruman-Magadi Escarpment and Maasai Mara national game reserve. It encompasses a variety of ecosystems predominantly semi-arid extensive grassland and Loita forest which is classified as dry upland forest. The community is a mixture of agro pastoral people with well-developed traditional ecological knowledge system that they have used over the years to manage the landscape. With objective of developing a community resource inventory atlas, Loita community members listed all their resources and located them on a digital map using Participatory Geographic Information Systems and Google mapping. They mapped their social and natural landscapes specifically; administrative boundaries, infrastructure, cultural sites, hydrologic system, forest and other natural resources and wildlife habitats. They also identified challenges of sustainable landscape management and development using the maps they produced. The process raised awareness and downloaded the mental pictures of Loita landscape which is packaged as an Atlas.

Paper 10: Impacts of Climate Variability and Change on Livestock Production in Marigat and Mogotio in Baringo County, Kenya

By Muriithi G.M

In the Arid and Semi-arid Lands (ASAL) the pastoral communities are hardest hit by the adverse effects of climate variability and change. In the study area, pastoral and agro-pastoral are the major livelihoods. The communities in the former livelihood are shifting to the latter as a safety net from the adverse effects of climate variability. From the study finding, there has been an increase in the introduction of new livestock breeds in the last 10 years. Ninety eight per cent of respondents felt that livestock production has been affected by climate change. Major changes to livestock herds were in deaths, livestock pests and diseases and loss of market value. The introduction of improved breeds calls for more interventions to control pests and diseases, and also meet nutrition requirements. Respondents identified increased costs of production as one of the major effects of climate change. Sixty nine per cent of respondents perceived that there had been significant change in livestock herds in the last 10 years.

Plenary Discussion

Questions and Answers

Topic: Effect of adapting conservation Agriculture Farming Methods for maize- Bean production on soil quality in Humid areas of Embu County

Questions/Comments/ Responses

1. Crop yield figures were missing
 - The major concern was what happens to the soil.
2. Since intercropping is practiced in Embu, why was a treatment on manure absent?
 - The study was interested in looking at the residual.
3. What were the changes in organic carbon?
 - Organic carbon did not change with application of residual because it takes time to decompose.
4. Why use 3.0 dilution factor rather than 2.5?
 - 2.5 is the recommended, but decided to round off because of calibration.
5. Nematodes and fungi count show an improvement on conservation agriculture. What about the harmful nematodes and fungi in the soil?

- The study was focused on the number/ presence of nematodes and fungi. It is however a research gap that should be explored to check for beneficial and harmful nematodes and fungi.

Topic: Effects of Tillage and cropping systems on maize and beans yield and yield components in a semi-arid area of Mwala District, Kenya.

1. Why the use of old administration naming, that is districts instead of sub-county and can it be changed?
 - It will be incorporated in the paper.
2. Is maize bean intercropping only better when rains are better?
 - Based on the study's data, actually intercropping worked well during moisture-stressed environment which in my case was in the long rains of 2013. In this season the rains were depressed.
3. What are the recommendations of your research?
 - Crop response to tillage varied from season to season, which can be attributed to rainfall differences that played a significant role toward the final crop yields.
 - High productivity by the LER under intercrops will promote increased income and availability of diverse diets for farmers and thus should be advocated in the semi-arid areas, including Mwala Sub-County.
 - The apparent inconsistent tillage effects observed per season on maize and bean growth, yield and yield components, may be related to short term soil management effects and this further supports the need for long-term field studies (> 4 seasons) in the study area.
 - Multi-locational studies are also necessary to assess the feasibility of tillage and cropping systems across diverse conditions that prevail in smallholder farms in semi-arid areas. This will provide site - specific recommendations of the appropriate tillage practices and cropping systems for adoption in these semi-arid areas.

Topic: Community Contracting Approach in Sustainable Land Management and Climate Change and Adaptation and Mitigation in Arid and Semi-Arid areas in Kenya

1. What is your exit strategy?
2. Does your organization keep monitoring the stats and progress of beneficiary community after the end of support? If so, how long and how often (after final evaluation)?
 - The programmes run for five year after which projects are handed over to the community and the other key partners thus the Partner organization (in this case

mainly an NGO) and the Associates (Relevant line ministries) who were involved in the project design, implementation and M&E. They are responsible for day to day follow up of the project after phase out.

- However, considering that CCA covers the whole county, we also assist in follow up as we support other communities, if the phased out project is nearby or by giving a follow up funding under a new programme phase. We do not specifically have a budget for follow up after end of the project.

Topic: Impacts of climate variability and change on livestock production in Marigat and Mogotio in Baringo County, Kenya

1. How were the respondents able to tell the changes of the variables?
 - The study was a social one and we were able to measure their perceptions
2. What are you attributing your impacts to (the specific drivers of climate change and variability in the area)?
 - They have been included in the paper.
3. Differentiate between climate change and climate variability
 - Climate change is the mean change of rainfall and temperature for a period of 30 years.
4. What was your base information that enabled you to compare and come up with the solution of changes and decreases?
 - Time frame of the data reviewed was 10 and 20 years.
5. There was significant number of respondents answering that the situation is improving, did you take any qualitative assessment to find out why? If not you should and learn from successful experiences?
 - There was nothing like significant number of respondents answering that the situation is improving. In reference to my, presentation it is not the situation that has improved but the significant number of respondents perceived that there more improved livestock breeds than before which could endure climate variability and change.
6. Did you verify the animal numbers decrease by census data?

No, but another study proposed to be done very soon in the same study area will consider that.

SUB THEME 1: CLIMATE CHANGE IMPACTS, ADAPTION AND RESILIENCE IN AGRO-PASTORAL PRODUCTION SYSTEMS (BREAK RM 1)

Session Chair: Dr. Patrick Gicheru

Paper 11: Irrigation in Pastoral Landscapes as a climate change adaptation and intervention strategy. The case of Maasai of Majimoto Group Ranch, Narok County, Kenya

By Patrick Ole Twala

Ilepa Kenya with Utrecht University in Holland are in a 4 year research partnership that seeks to explore the nexus between climate change adaptations interventions and diminishing natural resources in the context of climate change focused in Maji Moto Group Ranch. With advance climate change variability that threaten the livelihoods of the pastoral Maasai, damming the only water source for irrigation, a scarce resource is the central theme of the research. Research has shown that pastoralism is more vulnerable to climate change losses than any other industry. Climate variability sometimes goes hand in hand with conflict situations (e.g. intra-pastoralists, Pastoralist versus Agro-pastoralist), but it can also be reason for solidarity and new types of collaboration. Little is known about the role of interventions in preventing these conflicts and/or offering new perspectives for collaboration, or making livelihood systems more resilient. Our research aims at contributing towards enhanced understanding of the links between community participation in development; local power relations; inter and intra community conflict / cooperation; climate change interventions, and people's adaptive capacity in the context of the local pastoral community. This is through community interactive interviews directed at the sedentarised Agro-Pastoralist and pastoralist who all are competing for the dammed water. Ilepa Kenya is currently undertaking a participatory research to generate in-depth, long-term, comparative and interdisciplinary knowledge on climate change adaptation interventions and its links to conflict and cooperation in the context of pastoral livelihoods. The aim is to analyze to what extent existing sets of interventions help local Maasai pastoralist groups make pastoral and agro-pastoral systems more resilient; support people to better deal with unexpected events and extreme weather conditions, while taking into account that climate variability will potentially generate pressure for livelihoods diversification. Acknowledging the differences in geography and institutional set-up, our research aims to attune climate change adaptation interventions to

local realities. Our project will contribute to the formulation of 'community-smart' climate change adaptation policies, which will be achieved in close connection with the communities, policy makers and practitioners.

Paper 12: Farmers' perceptions, exposure and response to climate variability in Mwea, Kenya

By Mutembei MM

Climate variability is expected to have adverse effects on livelihoods in farming communities. The ability to cope with the consequent risks will depend on the extent of exposure to the climate stresses and the adaptive capacity of households. A survey was carried out to establish the extent of farmers' knowledge and response to climate variability in Mwea, Central Kenya. A semi-structured questionnaire was used to collect data on household and livelihood characteristics through individual interviews. The stratified random sampling technique was used to sample 385 farmers from four Wards in two Sub Counties namely Gathigiriri and Tebere in Mwea East; and Mutithi and Wamumu in Mwea West. Results show that 75.3% of the respondents were aware of climate change. Thus 95.6% perceived changes in rainfall patterns while 98.3% ($p < 0.001$) perceived changes in temperature over the last 20 years. Rainfall variability was described as being more unpredictable (55.7%), decreased in days and amount (41.8%) while only 2.4% were of the opinion that it had increased. Temperature change was described as being hotter by 75.7% of the respondents; more unpredictable (21.9%) and 2.3% thought it had become cooler. This variability had influenced farming among 70.4% ($p < 0.001$) of the respondents. Some of the coping strategies reported were early planting by 65.7% ($p < 0.001$), planting different crops at the same time (24.6%) and planting different crops at different times (9.6%). Drought was the main climate related risk experienced by 69.4% ($p < 0.001$) of respondents in the last 20 years out of whom 97.6% suffered consequent damages. There is need to improve awareness to climate variability and response strategies in this region.

Paper 13: Climate Variability, Land-Use, Pastoral and Agropastoral Livelihoods in Arid and Semi-Arid areas of Kenya

By Amwata D.A.

Kenya's arid and semi-arid lands (ASALs) are experiencing climate variability, especially rainfall and temperature alterations. Rainfall is recognised as one of the critical parameters

influencing land-use dynamics and livelihoods in the ASALs inhabited by pastoral and agropastoral communities. Climate variation coupled with rapid land-use changes have influenced the type of livestock kept, crops grown and diversity of livelihoods. To understand how climate variability and change contribute to land-use changes, questionnaire interviews, focus group discussions and direct observations were used to obtain information from households in Kajiado and Makueni Counties. Also, information was obtained from secondary sources such as reports, previous studies and publications. The study shows that rainfall gradients influences land-use, diversification and adaptation options. Thus, a holistic land-use planning and management is a promising way of increasing resilience to climate risks and other vagaries to pastoral and agropastoral households in the ASALs.

Paper 14: Women's Resilience to climate change variability

By Rotich C. Irene

Exposure to climate change variability often poses risks to people of various regions. Climate Impacts on people's livelihoods economically, politically, socially, ecologically, legally, and technologically. Gender inequality is mirrored greatly in cases of climate change. In developing countries women are the majority in rural areas therefore their food production is limited to rain fed agricultural system which often bears the burden of climate change. When women lose their livelihoods they suffer greater marginalisation. Women's role in climate change adaptation and mitigation is crucial yet they are often not heard. They bear low access to new technologies, credit and assets which limit their ability to adapt. This paper utilised qualitative approach (Grounded analysis) to analyze women's resilience to the effects of climate change in Turkana. Focused group discussion, observation and Interviews were used to collect data.

Paper 14: Influence of Tillage Practices and Fertilizers on Soil Moisture, Nutrient Status and Finger Millet Yield in Lower Eastern Kenya

By Onwonga R.N,

With increasing effects of climate change, traditional crops such as finger millet are among the most suitable for adaptation, particularly in arid and semi-arid regions. This study evaluated the effect of different tillage practices and fertilizers on soil moisture, nutrients (N, P,OC) and finger millet yields. It was conducted in Machakos and Kitui Counties of lower

Eastern Kenya during the short rain season of 2013. Experimental set up was a randomized complete block design with split plot arrangement. Main plots were two tillage practices (TP): oxen plough (OP), ridges and furrows (RF), while split plots were fertilizers: farm yard manure (FYM) and triple super phosphate-TSP Calcium Ammonium Nitrate-CAN. Soil moisture was higher in Kitui than Machakos across all TP and fertilizer inputs. In Kitui RF had higher moisture than OP while the opposite was true for Machakos in FYM treatments followed by TSP+CAN and their control. Effect of fertilizers on soil nutrients was similar across all tillage practices with highest mineral nitrogen and P recorded in TSP+CAN treated plots and highest OC recorded in FYM. RF in Kitui had higher yields than OP while in Machakos OP had higher yields than RF in TSP+CAN treatments, followed by FYM and control. Based on the results, combined use of conservation tillage (RF in Kitui, OP in Machakos) and fertilizers (TSP+CAN) is a feasible method for improved sustainable finger millet production in lower Eastern Kenya.

Plenary Discussion

Questions/Comments/ Responses

Topic: Farmer's perceptions, exposures and response to climate variability in Mwea, Kenya

1. Define clearly Coping and adaptation as used in climate change?
 - Coping includes short term strategies that are put in place to adapt a system to climate change
2. Can the use of Chi square be applied in a statistical analysis to test for association in a population?
 - Population data can be analysed using chi-square to test for association
 - *Knowledge transfer not clear* no response
3. What was the age categorization?
 - Included people of all ages and gender
4. Quote long term and climate change data?
 - Rainfall as well as maximum and minimum temperature data were obtained from the nearby Kenya meteorological stations.
 - Information of farmers' knowledge on climate over the last 10 years was compared with data from Kenya Meteorological Department.

Topic: Climate variability, land use, pastoral and agro pastoral livelihoods in arid and semi-arid areas of Kenya

1. How is climate variability affecting land size?
 - Climate variability is reducing the size of land under potential production as a result of vegetation degradation, soil erosion and escalated temperatures contributing to land use change.

Topic: Irrigation in Pastoral Landscapes as a climate change adaption and intervention strategy. The case of Maasai of Majimoto Group Ranch, Narok County, Kenya.

1. Was there any comparison of data from other counties?
 - No! There was no such kind of comparison.
2. Any conflict mapping?
 - No conflict mapping.

SUB THEME 2: LAND CONSERVATION AND MANAGEMENT

(BREAK RM 2)

Session Chair: Dr. Alfred Micheni

Paper 15: Tree species composition and diversity in areas of high charcoal production in Kitui County: a case in Ikutha and Mwingi sub-Counties

By Gitehi Giathi

A socio-economic study on the trends and impact of production and use of biomass energy was undertaken in Kitui County. It was complemented by a plant inventory in the remnant woodlands in Ikutha and Mwingi sub-counties. The objectives of the study were to; document the technologies used in charcoal production, preferred tree species and assess how charcoal production may have impacted on species composition in the remnant woodlots. Plant inventory was undertaken in the relatively undisturbed and disturbed woodlots. The preferred charcoal producing trees are *Acacia spp*, *Terminalia spp* and *Senna abbreviata*. Charcoal is produced using the traditional earth kilns. The tree species diversity using Shannon-Weiner Index for the relative undisturbed woodlots was 2.87 and for the disturbed 2.67. The structure and composition of vegetation in the disturbed woodlots consisted of 228 stems ha⁻¹ (21 species), 3600 (6) saplings, 2500 (1) seedlings, 134 (27) stumps per ha⁻¹ and basal area of 3.3 m² ha⁻¹. In the relatively undisturbed woodlots, there were 388 stem (30 species), 5600 (6) saplings, 10000(4) seedlings, 19 (5) stumps ha⁻¹ and 8.6 m² ha⁻¹ basal areas. These woodlots are declining in species composition and density and cannot sustainably support wood

extraction without appropriate interventions. The study concluded that the traditional earth kilns were the preference in charcoal production. Trees harvesting for charcoal and other uses have affected the species composition and reduced diversity in the remnant woodlots. The study recommends capacity building of the local community on efficient charcoal production technologies, sustainable woodlands management and propagation of the preferred tree species for establishment of woodlots.

Paper 16: Rangeland rehabilitation using micro-catchments in Turkana County

By Jesse Owino

Turkana County is prone to perturbations and famine owing to the prevailing climatic conditions. Owing to degradation through anthropogenic activities, over time existing woodlands have been degraded necessitating rehabilitation. Several drylands adapted plant species that have been studied over the years and which responds aptly to the needs of the communities have been identified and isolated. They include *Cenchrusciliaris*, *Tamarindusindica*, *salvadorapersica*, *Moringaoleifera*, *Aloe turkanensis* and *Acacia Senegal*. The study's main objective was to improve survival rates of tree species grown in arid areas that have had annual rainfall amounts below 300mm. The methodology was adapted from proving phase provenance trials using nested intensity design to give the best measurements that measure native and exotic plant species. The major results of this study was found in site with micro-catchments had higher mean heights and root collar diameters for each species tested. The results indicating the usefulness of micro-catchments especially in arid and semi-arid areas.

Paper 17: Land degradation indicators to support rehabilitation and conservation of woodlands in Kiang'ombe Landscape, Embu County

By John N. Kigomo

Land degradation is mainly driven by inappropriate land use which is caused by many interrelated factors such as inadequate technologies and rapid increase in human population. This study was undertaken to provide a valuable tool for assessing land degradation risk and analyzing the effectiveness of the various woodland rehabilitation practices through empowering local community to identify indicators of degradation. This was achieved

through informal discussions and key informant interviews with local community. Moreover, local and scientific knowledge was integrated through remote sensing techniques, digital photos and vegetation data collection. Satellite images of the study area dating way back in 1986 and as recent as 2014 were analyzed to delineate degradation gradients. Sample plots were laid to characterize and enumerate vegetation along vegetation gradient. Major land degradation processes prioritized by local people were overgrazing, unsustainable charcoal production, wildfires, uncontrolled sand harvesting and soil erosion. Key land degradation indicators identified by local community were reduced mature tree, high number of tree stumps, reduced vegetation cover, low species diversity and increased cultivation of *Catha edulis*. Results on vegetation data collection revealed a significant differences in stocking density and tree diversity along degradation gradient ($p < 0.05$). *Protea gaugedi* was identified as wildfire tolerant tree species due to its high occurrence in fire prone areas. In addition, *Croton macrostachyus*, *Acacia hockii* and *Faurea saligna* were dominant in degraded areas. The study indicated a significant overlap between scientific and local knowledge in most instances and this iterative process can lead to both accurate and relevant periodical monitoring of woodland degradation.

Paper 18: The Land Potential Knowledge System: Application of Earth Observation data for Sustainable Land Management

By Lilian W. Ndungu

Africa is facing numerous challenges including a rapidly growing population, soil erosion, declining soil fertility and climate change. In the face of all these problems, the need to feed the growing population has led to expansion of land for agriculture and pasture production rather than increasing productivity. Available land must produce more food and pasture to meet the growing demand while conserving soil resources, reducing erosion risk, and improving the overall resilience of the land to produce and sustain current and future ecosystem services. Due to climate change, systems and phenologies are changing. With already stressed coping strategies, decision makers at management and policy levels; and local communities are often forced to make serious land use decisions with incomplete knowledge and information. SERVIR-Eastern and Southern Africa and its host organization, the Regional Centre for Mapping of Resources for Development (RCMRD), have been working together with the US Department of Agriculture- Agricultural Research Services (USDA-ARS) to develop the United States Agency for International Development (USAID) funded Land Potential Knowledge System (LandPKS) (LandPKS). LandPKS is a suite of integrated, modular applications connected to cloud-based analytics and user-accessible cloud

storage that will allow users to access share and interpret global knowledge and information relevant to the unique potential of each piece of land. LandPKS will provide individual users simple tools for assessing land potential based on the integration of simple, geo-tagged user inputs with cloud-based earth observation data. To enable predictions at the point level, LandPKS has heavily relied on advances in technology and availability of earth observation data which provide inputs for modelling productivity and degradation risk (with initial focus on soil erosion risk). This paper focuses on the development of earth observation datasets and their role in assessing LandPKS and its ability to inform sustainable land management decisions. Through the implementation of LandPKS, the role of Geoinformation in collecting site based site characterization information and providing site based information for decision making to support sustainable land management efforts has been invaluable. Geoinformation allows predictions to be made from any point globally providing a universal method that allows for the land potential to be evaluated and will in future form a platform where users facing similar land management problems can share local working knowledge on indigenous knowledge that they have successfully applied to sustainably manage their land. The potential of the LandPKS applications to crowd source for data will provide a much required approach and data for validating remotely sensed datasets while providing secure data storage and manipulation through the cloud storage system.

Paper 19: Soil Moisture Variability and Cropping Systems along the Toposequence of a Terraced Vertisols in Machakos, Kenya

By Mbugua Wairimu

Vertisols offer opportunities for better crop production in semi-arid areas with erratic rainfall compared to other soil types in the region. This is mainly due to their high soil moisture holding capacity which allows crops to grow or survive for longer periods. Investments in soil and water conservation and cropping system diversification is a key sustainable land management (SLM) measure in coping with soil moisture stress in semi-arid areas. This study was conducted in 2014 to investigate the effect of slope positions and cropping systems on soil moisture distribution along a toposequence of a terraced *vertisols*. Soil and crop samples were collected from the lower (deposition), middle and upper (loss) slope positions of the terrace at a depth of 30 cm. The test crops were sole maize, sole bean and maize bean intercrop. The results of the study both long rain and short rain seasons showed significant

($p < 0.05$) differences in soil moisture content, crop height, above ground biomass and grain yield as influenced by slope positions. Results of this study indicates that soil moisture variability within the terraced *vertisols* field was as a result of the nature of soils in this study, amount of seasonal rainfall received and different slope positions (upper, middle and lower) and not the interaction of slope position and cropping systems.

Paper 20: Temporal Relationship Between Climate Variability, *Prosopis Juliflora* Invasion and Livestock Numbers in the Drylands of Magadi, Kenya

By R K Kyuma

A study was conducted to determine the association of climate variability, *Prosopis juliflora* spread, and other vegetation trends with livestock population dynamics in Kajiado County, Kenya. Monthly rainfall, mean monthly temperatures, cattle, sheep and goats populations from January 2000 to December 2014, were analyzed to determine time series trends. Normalized Difference Vegetation Index (NDVI) data derived from moderate resolution imaging spectroradiometer (MODIS) 250m satellite imageries for 2000-2014 were used to determine the temporal dynamics of *P. juliflora* invasion in the study area. Both temperature and rainfall trends showed marked variability over the period under study. The mean monthly Temperatures during the long dry season increased erratically from 33°C in 2000 to 37°C in 2014. Moreover, the rainfall during the wettest season were 600mm in 2000 and 250mm in 2014. During the study period, divergence from the long term mean rainfall (450mm) decreased from 585mm to 403mm. At the same time cattle population decreased, sheep and goats populations remained static. *P. juliflora* invasion correlated positively ($r = 0.2$; $P < 0.05$) with mean monthly temperature and negatively ($r = -0.4$; $P < 0.05$) with rainfall and other vegetation cover in drier parts but not in the higher altitude and wetter parts of the study area. It also correlated negatively with cattle populations ($r = -0.4$; $P < 0.05$). In the 1980s, bushlands and woodlands constituted 95% and 5% of the land cover, while in 2008, herbaceous vegetation, shrublands, and open trees together with bare areas constituted 50%, 30% and 22% respectively; out of which 70% had been taken over by *Prosopis* in 2014. This study demonstrated that even though the trends showed that cattle population decreased as climate variability and *Prosopis* invasion increased, there was no significant correlation among the attributes, over the period under study.

Paper 21: Potential for Water Harvesting and Storage in Sandy Riverbeds: Case Study of Calama Location, Machakos County, Kenya

By Mburu David Mwehia

In the arid and semi-arid lands of Kenya, shortage of water poses the greatest challenge in agricultural development. Water shortage is due to low and unreliable rainfall that is made worse by the impacts of climate change. The communities living in the arid and semi-arid areas develop innovative ways of solving the water shortage problems. Most rivers in these areas are seasonal, where surface water flow is only during the rains. The riverbeds usually have high sand deposits which is eroded from the surrounding catchment and transported in the surface runoff. Along the riverbeds are sections with large rock formations across the valley that traps sand transported in the runoff. Water is held in the pore spaces of sand and during the dry period when there is no water flow people dig in such places to get water for domestic use and for the livestock. The technology of constructing sand dams was developed to increase the volume of water that can be harvested and stored along the sandy riverbeds. A study was carried out to determine the potential water storage capacity and the extractable volume in one sand dam. The volume of stored sand was determined by probing a number of cross sections of the sand dam. The surface evaporation loss and extractable volume were determined at the site of sand dam. The results show that the potential water storage depends on the porosity of sand. Extractable volume was 37 % of the total volume of sand stored. Evaporation loss was almost insignificant at beyond 45 cm from the sand surface. The study concludes that there is great potential for water harvesting along the dry riverbeds where the geology of the catchment yields coarse sand.

Paper 22: Land Use and Land Cover Changes and Implications on Gully Erosion in Mount Suswa Catchment, Narok County.

By Charity Konana

This study investigated land use and land cover change for the last 40 years in Mount Suswa Catchment, Narok County using satellite imagery. Changes in land use and land cover for 1985, 2000 and 2011 was analysed. Results showed that there was no significant ($p < 0.05$)

changes in built up areas, agricultural land, bareland and shrubland during the period. It was observed that built up area, shrubland, bareland, agriculture land increased over the 16 years (1985-2011) period, while grassland decreased during this the same period due to change to other land uses. An increase in built up area, bareland and agriculture and a decrease in grassland are therefore likely to be drivers of gully erosion which is affecting the area. The future prediction indicate a significant increase in built up area, agriculture and bareland and a decrease of grassland in the Mount Suswa Catchment which will lead to more gully erosion. Land use and land cover maps produced help to explain the driving forces of gully erosion in the study area.

Plenary Discussion

Questions/Comments/ Responses

Topic: Tree species composition and diversity in areas of high charcoal production in Kitui County: Case study in Ikutha and Mwingi sub Counties

1. Highlight other activities that could have compounded the problem of land degradation.
 - Accepted to include them in his paper.

Topic: Rangeland rehabilitation using micro-catchment in Turkana County

1. What is the community perception on the use of these micro-catchments?
2. Use of micro catchments hinders mobility, how did you solve this?
 - The community is on the process of adopting these micro catchments

Topic: Land degradation indicators to support rehabilitation and conservation of woodlands in Kiang'ombe landscape

1. How did you choose your stratus?
2. Explain his design of stratified random sample plots.
 - Highlighted on how he chose the different stratus

Topic: Land potential knowledge system: Application of observation data for SLM in Northern Central Kenya

1. What were the combination factors of all factors bearing in mind Northern Kenya is large?
 - Used all types of data available

Topic: Relationship between soil moisture variability and cropping systems along the toposequence of a terraced vertisol, Machakos Kenya

1. Could other soil types behaved differently?

2. Was time a factor?
3. Effect of *Fanya Juu* on soil moisture?
 - Yes, other soil types could have responded differently. This is based on other studies done by other scholars.
 - Time was a factor yes.

Topic: Temporal relationship between climate variability, prosopis invasion and livestock numbers in the drylands of Magadi Kenya.

1. What is the correlation of *prosopis* and livestock numbers?
2. Is prosopis N-fixing
3. At what point is there a significant effect
4. How did you isolate prosopis using NDVI
5. What are the solutions or rather recommendations for SLM to the community?
 - Yes it is N- fixing
 - My study was on climate variability on prosopis and not livestock.

Topic: Potential for water harvesting and storage in sandy river beds: Case study of Kalama location

1. Are there any technologies that can reduce evaporation?
2. How can we increase the rate of water recharge in sand dams?
3. Are there any methodologies to map potential areas of sand dams?
 - Cases where sand dams have not worked
 - Yes there are other technologies.
 - Recharge rate will depend on the ecology of the area.
 - There are other cases where these sand dams have failed due to the geology of the basement rock.

Topic: Land use and land cover changes and implications on gulley erosion in Mt. Suswa catchment Narok County

1. Where is data for livestock number?
2. Is fire a factor in gulley erosion
3. Is it possible to use chi square in cover analysis
 - My presentation only covered one object. The missing information is on other documents
 - Chi square was only used to show correlations.

SUB THEME 3: INTERGRATED CROP AND LIVESTOCK PRODUCTION SYSTEMS AND MANAGEMENT IN THE DRYLANDS (BREAK AWAY 1)

Session Chair, Dr. David Mburu

Paper 23: Agricultural transition within the ASAL rural-urban continuum in Kenya: A case study of Kajiado County

By Mary Kerubo Morara

Diversification into intensive livestock and crop production systems is replacing pastoral way of life in peri-urban Kajiado North Sub- County due to declining land holding sizes. This study assessed the transition in two ways (1) What were the current land holding sizes, physical location and agricultural production systems adopted with respect to origin of household owner. (2) What challenges were they experiencing in adoption and household food security? Data was obtained from cross section surveys, focus group discussions and key informant interviews. Size of land owned and origin of household influences livestock and crop production system adopted. Intensification in livestock production systems that aim to achieve higher returns from declining land sizes like various types of improved breeds and methods of husbandry have been adopted, whereby 90% of the indigenous and all immigrants have improved livestock breeds. Livestock alien to the area like; fish, pigs and poultry and other emerging ones like ostriches and quails have been adopted. Currently 69.1% of indigenous pastoralists practice crop production to ensure food security while the immigrants practise commercial horticulture under irrigation in greenhouses and along rivers. Competition for resources has culminated into conflicts, degradation and low resilience from natural shocks. The continuous adoption and diversification of agricultural systems including the adoption of alternative income-generating activities needs to be guided through capacity building to enhance and ensure ecosystem sustainability given the fragile nature of the arid and semi- arid area that serves as a wildlife corridor.

Paper 24: Dry matter accumulation and nutrient composition of three early maturity forage sorghum varieties grown for feeding ruminants in semi-arid Kenya

By Robert Irungu

Sorghum (*Sorghum bicolor* (L.) Moench) is suitable fodder to alleviate feed shortage in semi-arid tropics as it is drought tolerant. Three early maturity varieties of forage sorghum were studied to determine their dry matter accumulation and nutrient composition at various ages when grown to feed ruminants in semi-arid Kenya. Varieties BJ 28, Cow candy and Hay grazer, planted in randomized complete block layout with three replicates, were sampled for dry matter yield and nutrient composition at 52 days (first thinning) and thereafter, every 21 days up to 156 days. The data was subjected to analysis of variance and means separated using least significant difference procedures. Dry matter accumulation increased with increased age in all the sorghum varieties. However, there was a plateau in dry matter accumulation in all sorghum varieties between 115 and 156 days. At 115 days Cow candy

accumulated the highest (9311.3 kg DM/ha) DM and BJ 28 the lowest (4957.7 kg DM/ha) while Hay grazer recorded 7674.6 kg DM/ha. In all sorghum varieties DM, OM and ADL increased with age while CP decreased. However, NDF and ADF decreased with increased age in BJ 28 although these nutrients increased with increased age in Cow candy and Hay grazer. Generally, BJ 28 recorded the lowest NDF and ADF and Cow candy recorded the highest values in these nutrients. The values of DM, OM, ADL and CP at 115 days ranged between 266.9 to 316.1; 911.7 to 921.5; 44.0 to 48.3; 108.2 to 134.5 g/kg DM, respectively. The range in values of NDF and ADF were 476.8 to 607.4 and 294.3 to 377.4 at 115 days respectively. These DM and fibre values were lower than those recorded in the literature because the varieties in the current study were harvest at young age. The young sorghum produced highly nutritious feed for ruminants hence these sorghum varieties should be harvested not later than 115 days of age to optimize their dry matter accumulation and nutritive value.

Paper 25: Camel Agribusiness in Kenya's ASALs

By C.R. Field

The recent dramatic increase of the human population in Kenya's ASALs has been matched by a five-fold increase in camels through reproduction and immigration. The authors combined traditional knowledge with scientific training to improve camel husbandry for the benefit of the rural ASAL population. Forty years ago camels were not regarded by Government as being sufficiently important to include in the Veterinary schedule for livestock. They are now included and their health and diseases are better understood and treated as a result of FARM-Africa's training program which combined demonstration herds and community training in a unique mobile outreach approach. Increased productivity led to a surplus beyond household needs with a demand for market outlets. Camel milk from a large catchment is now sold in many supermarkets. Camels cope with climate change and do not exacerbate overgrazing as they use range vegetation far beyond the reach of all other more water dependent stock. Nevertheless on ranches, camels have been shown to be complementary browsers to conventional domestic stock. Camel agribusiness now includes milk, meat and hide production, ploughing and ecotourism. The combined effect is a mean annual income equivalent to 12-15% of the purchase price of the initial herd. With the emergence of pastoralist age sets there is a need to train their new leaders in the camel skills needed to benefit the rural population sustainably. Camels, with their unique adaptations, are

better suited than most livestock to the predicted climatic change trends forecasted over much of Africa.

Plenary Discussions

Questions/Comments/ Responses

Topic: Agricultural transition within the ASAL rural-urban continuum in Kenya: A case of Kajiado County

1. Is it possible to use the mentioned invasive especially to rehabilitate rangelands?
 - No! Caucandes can be used to rehabilitate rangelands due to their high re-growth speed.
 - Opuntia can be used to rehabilitate rangelands
2. Why peri-urban and not other system of production?
 - To capitalise on limited space available and optimum production, cross breeds necessitated the move *not clear*

Topic: Dry matter accumulation and nutrient composition of three early maturity forage sorghum varieties grown for feeding ruminants in semi-arid Kenya

1. Based on forage yield and nutrient, what is the maximum growth period?
 - 3 months to grow and mature
2. How much water was required?
 - No exact volume of water used was stated but it was reported that the crop has high water use efficiency.
3. Assess and compare the performance sorghum with other crops (maize and or nappier)?
 - Sorghum was introduced in Naivasha because studies done on maize in the same area showed that sorghum does better than maize.
4. What is the main objective of the study?
 - To compare different varieties of sorghum with regard to dry matter accumulation and nutrient composition.

Topic: Camel Agribusiness in Kenya's ASALs

1. How can we still continue business in camel production without struggling (markets)?
 - A highway to be established to improve marketing (Nanyuki)
2. Who is manufacturing chopsticks and milk?
 - Nanyuki and Marsabit (milk)
 - Chopsticks are being curved in Kibera and exported to Canada
3. Has there been any intense conflict between Kenya and Somalia?
 - *No response*
4. Compare camel with other livestock in different ecosystems -assess performance
 - More returns from camels compared to other livestock enterprises
 - More drought tolerant than others livestock in ASALs

**SUB THEME 4: POLICY AND SOCIAL-ECONOMIC ISSUES IN LAND
MANAGEMENT SUPPORTIVE OF CLIMATE CHANGE ADAPTATION IN
DRYLANDS (BREAK AWAY 2)**

Session Chair Dr. Amwata D.A and Dr. Onwonga

**Paper 26: Uptake of IWM Technologies: Experiences of Machakos and Makueni
Counties of Eastern Kenya.**

By Anastasia W. Kagunyu

Agriculture is the backbone of Kenyan economy and 80 % of the agricultural land in Kenya is under rain-fed agriculture, with generally low yield levels and high on-farm water losses. As a result of this Kenya Agricultural and Livestock Research Organisation (KALRO) introduced a total of 50 IWM technologies in Machakos and Makueni county of Eastern Kenya. However, the uptake of these technologies was not known therefore this led the researchers from KALRO to initiate this study which was guided by these objectives; to examine the farmers awareness on the existing IWM technologies in the two Counties; to established the most popular IWM technologies with farmers and why some were not and to identify the constraints faced by the farmers while implementing the introduced IWM technologies. Semi-structured questionnaires and focus group discussions were used to collect data. Quantitative data was analysed through the application of SPSS software and it was presented in frequencies and percentages. The study findings indicated that the farmers were aware of IWM technologies and the level of utilization was high in both counties. Most popular technologies identified included; terracing, tree planting, manuring, use of grass strips, crop rotation and tied ridges among others. Main constraints related to the implementation of IWM technologies included inadequate extension services, capital, labour and skills. This study recommends training of farmers on appropriate IWM technologies. There is need for the government and other stakeholders to improve the extension service, to link farmers to financial institutions which could give loans.

**Paper 27: Financial Returns of Maize and Bean Production under Selected Tillage
Practices in Semi-Arid area of Mwala District, Kenya**

By Anne N. Karuma

An on-farm experiment was carried out to assess the short term financial returns over four cropping seasons of selected tillage practices and cropping systems in semi-arid Mwala

District of Kenya. The tillage treatments were Disc Ploughing (DP), Disc Ploughing and Harrowing (DPH), Ox-ploughing (OX), Subsoiling ó Ripping (SSR), Hand hoeing with Tied Ridges (HTR) and Hand hoeing (H) only. There were three cropping systems of Sole Maize (SM), Sole Bean (SB) and Maize - Bean intercrop (M + B), which were investigated in a Split-Plot Design with four replications. Input and output prices were obtained from the local markets and used to compute the financial returns. A four - season average maize grain yield by tillage showed a trend of DPH > DP > H > OX > HTR > SSR, with values ranging from 2.9 Mg ha⁻¹ to 3.8 Mg ha⁻¹ ($P < 0.05$). The bean grain yield average values by tillage was DPH > SSR > DP > OX > HTR > H, ranging from 0.78 Mg ha⁻¹ to 1.46 Mg ha⁻¹ ($P < 0.05$). Intercropping significantly reduced ($P < 0.05$) the mean grain yields in maize by 10.1 % and in bean by 54 %. Across the tillage practices, higher net benefits were realized in DPH (KES 102 727), DP (KES 87 537) and SSR (KES 75 939). In the cropping systems, the intercrop (KES 92 452) and sole bean (KES 83 912) reported higher benefits than sole maize (KES 60 092). On the basis of marginal analysis, DP, DPH and SSR with sole bean systems are economically viable to recommend to farmers in Mwala District as they produced the highest BCR (> 1), MRR (> 100 %) and higher crop yields.

Paper 29: Housing Scheme for Residents: The Centre Nerve of Drylands Conservation and Management, Kenya

By Ben Musonye Akala

Governments have the moral responsibility of guarantee descent living conditions for their citizens as enshrined in the second United Nations Conference on Human Settlements (Habitat II). Consequently, developing countries like Egypt and Libya in the Arid and Semi Arid Lands (SALs) had prioritised the housing agenda. Unfortunately, Kenya's slum renewal remains misplaced, discriminative and contrary to the Habitat II first theme, 'adequate shelter for all' as it excludes the more vulnerable ASALs residents. Thus this paper examines the influence of settlements on household welfare; establishes the effect of permanent and temporary homes on land conservation practices and formulates criteria constructing descent houses for residents in the ASALs. Residence and land use practices of the ASALs communities was examined. A tripartite cost-sharing criterion involving the National Government (NG), County Governments (CG) and residents based on the *Nyumba Kumi* initiative could cost-effectively enhance the program implementation. If the NG established infrastructure; CG surveyed the area and constructed houses; while the residents constructed the Kitchens, toilets and livestock sheds program could be complete. This could be done in

three equal phases for nine years to ensure that all resident had at least a roof over their heads; two bed-roomed semi-permanent houses and finally a permanent house. The permanent homes reduced harsh weather oriented humans sufferings. Consequently, residents will concentrate on the production agenda that might prompt the m to prioritise land conservation. The paper concludes an elaborate housing might redefine the land rights and prompt a framework for sustainable drylands conservation.

Paper 30: Attitudes and Perception towards Ecotourism as a Form of Land-Use Diversification among Pastoral Communities in Laikipia County, Kenya

By Rono B. J.

The Kenya rangelands are characterized by low income, poverty, low and unreliable rainfall and conflicts. Pastoral communities in these areas have developed land use diversification and livelihoods mechanisms to help them cope with these challenges. Ecotourism is one of the strategies these communities engage in with the aim of conserving the environment as well as generate income. However, there is little information on attitudes and perceptions of local communities towards ecotourism, especially pastoral communities. The main objective of the study was therefore to assess the attitudes and perception of pastoral communities towards ecotourism in Laikipia, Kenya. The study used a sociological survey research design with 232 community members and 20 stakeholders. The research relied on primary and secondary data for information from which the analysis was conducted and conclusions generated. Primary data was collected through one-on-one interviews using structured questionnaires and focused group discussions using checklists. Findings indicated that 74% of the respondents had a positive attitude towards ecotourism (measured by chi-square indicator variables) while 79% perceived it as beneficial to the pastoral communities. In terms of best opportunities for future economies, pastoralism was the priority (43.5%) while employment was the second (19%) and tourism third 18.1%. Pastoralism is the main source of income for communities in this region with 32.8% responding positively. However the results also show that 63.7% of pastoralists households have diversified their sources of income to other activities including business, employment and agriculture while only 36.3% practice only pastoralism. The main conclusion of this study is that community's attitudes and perception towards ecotourism as a form of land use diversification are positive as proxies of employment creation and source of income.

Paper 31: Ilchamus Pastoralists' Indigenous Knowledge and Its Use In Coping With And Adapting To Climate Change In Marigat, Baringo- Kenya

By Clement I. Lenachuru

In view of present and future changes in weather and climate, documenting how pastoralists use their indigenous knowledge (IK) in coping with and adapting to climate change in their localities is increasingly important, as this knowledge may inform climate adaptation policies and practices. The objectives of this study were: 1) to document the Ilchamus pastoralist IK about weather and climate; 2) to establish how the Ilchamus acquire, share and transmit their IK over generations; and 3) to investigate how their IK informs Ilchamus decision-making in their livelihood production systems. I conducted four focus groups discussions and administered a questionnaire to 331 households in Marigat Sub-County, Kenya in 2011. Findings show that the Ilchamus possess rich traditional knowledge on weather and climate, and use a variety of physical and biological indicators to detect likely environmental change. They observe changes in these indicators, and attribute many of the changes to climate change and other environmental natural processes. Results show that indigenous knowledge is not evenly distributed in the community, and Ilchamus often consult local experts in addition to using their experiential knowledge. This knowledge is passed from parents to children through daily interactions and folklore, and is shared within the community through social networks and organizational structures. Traditional means of IK transfer remain intact, but face a challenge from young and educated members of the community, who disregard or dismiss IK and value foreign cultures and practices over local traditions and lifestyles. However, the elders also support formal education for the community's children, which they see as providing more livelihood options for the future. Ilchamus use a number of customary coping and adaptation strategies to deal with a variable and changing climate. They are aware of the possible consequences of climate change on their production systems and make livelihood decisions based on this knowledge coupled with their experience. However, a majority fail to take timely action in response to changing conditions. This study demonstrates that Ilchamus community members hold extensive indigenous knowledge of weather and climate and that this knowledge has been used over time to inform livelihood decision-making in the community. I therefore recommend that the Ilchamus indigenous knowledge system be recognized by scientists and policy makers for its potential value as a source of adaptations in the face of climate change.

Paper 32: Agro-Pastoral Communities' Perceptions on Indigenous Browse Resources of the North Central Rift Region, Kenya

By Sitiene, J.K.

A survey of indigenous browse resources and their utilization by the agro pastoral communities of the north Rift region of Kenya was carried out by KARI ó Perkerra, between the months of June and December, 2012. The main objective of the survey was to obtain the agro pastoral communities' views on their perceptions regarding the indigenous browse resources which they normally resort to during the dry seasons to feed their livestock. The agro pastoral communities covered in the survey include the Tugen (in Baringo Central and Mogotio sub-counties), the Samburu (in Samburu Central sub-county), the Pokot (in East Pokot sub-county) and the Il Chamus (in Marigat sub-county).. All the agro pastoral communities covered in the survey generally keep cattle, goats, sheep, camels, donkeys and poultry to varying degrees. The survey used the focused group discussion (FGD) methodology in gathering information from the field. Each agro pastoral community has an assortment of indigenous browse resources for use during the season of forage scarcity. The components or parts fed to livestock range from the bark, twigs, shoots, leaves, flowers, pods and fruits. Other than use as forage, the indigenous browse resources have a myriad other uses among the agro pastoral communities, such as: medicinal uses, use as famine food, use as beverages, commercial uses in trade, socio-cultural uses, use as concentrate feed and finally, wood uses. Of great concern is the rapid decline of these resources.

Paper 33: Economic Value of Climate Change Adaptation Strategies at Community Farm-Level in Semi-arid Ijara, Garissa County, Kenya

By Mwaura JM

Semi-arid Ijara experienced erratic and declining rainfall whereas temperature increased, triggering extreme weather events shocks. Given the shocks that outwitted traditional coping mechanisms, agro-pastoralists spontaneously took to water harvesting pans, pasture enterprises and aloe crop as adaptation strategy. The spontaneity translated into unclear cost benefits which the study isolated for analysis for clarification and also to measure the strategy's viability. The design used was costs-benefit-analysis, complemented by the financial market-driven 15% discounting rates. Also co-ordinated regional downscaling experiment models were used to ascertain climate performance and projection. A household questionnaire was administered to 240 respondents from an estimated population of 9000 farmers. Up to 57% pastoralists had embraced agro-pastoralism to incorporate Aloe, and on-

farm rain-fed Sudan grass, whose input costs were Kshs 120,000/ha/season with estimated yields of 1.8 tons/ha of dry matter. Cash flow across three rain-fed seasons netted Kshs 1,925,091, 4,069,234.55 and 6,103,851.83 per hectare from one, two and three seasons respectively. About 50% agro-pastoralists produced fodder that cushioned against the high costs on inter-county importation. Land size inadequacy and the communal tenure upset 86.26% producers whereas 53%, of the farmers lacked requisite skills. Other challenges were feed deficit (30.4%), and diseases (20.4%) in that order. Aloe crop netted Kshs 37,500/ha/season. The benefits compared favorably with investment of Kshs 125,000/ha given that some capital costs e.g. fencing were a one-off payment. Annual water pan cash flow netted present value Kshs 512,349.25. Considering costs based on limited adaptation capacities, disease control and feed deficit, policies need to focus on formulating climate-smart water harvesting technologies and improved feed to include revitalizing traditional grazing management practices. Other pertinent investment opportunities included strategic value-chain linkages and infrastructure as well enriched soil stabilization using multi-benefits crops and generation and use of weather data.

Paper 34: Feasibility of green credit as an incentive for natural resource management in Kenya

By Obadiah H. Ngigi,

The greatest challenge smallholder farm enterprises in Kenya face is soil degradation through soil erosion. Past command and control and other incentive based approaches to avert soil degradation have not been successful; they have focused on the downstream interests, while ignoring the value of good soil management practices within the farming enterprises. Farmers could potentially benefit from improved soil conservation and are interested in restoring and ensuring sustainable productivity of their soil asset, but they cannot afford initial costs and sometimes lack technical knowledge of establishing the appropriate technologies. Additionally, smallholder farmers lack incentives to invest in sustainable agricultural practices. Existing credit services providers do not consider soil as an asset and therefore do not have provisions for supporting its amendment. Appropriately designed green credit can provide both incentive and impetus for farmers to invest in sustainable soil and water management practices which reduce soil erosion and in the long run ensure restoration of soil fertility and land productivity. This feasibility study reveals that there is demand for environmental conditional credit among small holder farmers in Kenya and that green credit can be a strong incentive for behavior change towards natural resource management.

Paper 35: The Evolution of Collective Land Access Regimes in Pastoralist Societies:

Lessons from East African Countries

By Tim Njagi

This study examines the evolution of collective land tenure regimes in East Africa including how they affect pastoral communities living on these lands. More specifically, we attempt to identify the drivers and impacts of changes in collective land access since the 1900s. We begin by synthesising regional evidence on East Africa's pastoral communities before examining changes among collective land tenure regime in Kenya using existing literature, secondary data and primary data collected in nine communities. We find that land individualisation and privatisation policies implemented during the colonial period and maintained by post-independence governments have not yielded the desired outcomes, especially in areas where land is accessed collectively. We also find that un-adjudicated communal land mainly suffered from challenges associated with common pool resources, such as overuse, while group ranches suffered primarily from mismanagement. Our analysis shows a growing trend towards individualisation of land in pastoral areas triggered by a combination of factors including the potential for change in land use, proximity to urban cities and large-scale infrastructural developments and the nature of community mechanisms for accessing collectively owned land and other resources. We argue for the maintenance of collective access to land especially in pastoral areas where extensive livestock production systems provide economic and social benefits to communities, and bridge the gap with other communities. We commend the inclusion of customary laws in the legal framework, and investments in provision of public goods in pastoral areas as well as strengthening the transparency, accountability and inclusiveness of community governance.

Key words: Pastoral communities, East African Countries, customary laws

Paper 36: Critical Analysis Of Policy Documents in The Context of Integrated Land and Water Management in Kenya for Improved Land Productivity

By Francis. M. Matiri,

In terms of GDP generation and employment creation, agriculture is the single most important sector in the economy. Water and land are vital for humans and economic development of a country. Hence, need to maintain available water and land resources and provide good quality water for optimum development of the country, hence main focus of integrated land and water

resources management (ILWM) system. Agricultural policies in Kenya focus on increasing productivity and income; enhanced food security, emphasizing on irrigation for agricultural output stability, thus underlining the importance of sustainable ILWM through an integrated approach, and therefore a need for an enabling policy environment. Main objectives of the study included critical review of the extent that the existing policies favour or hinder implementation of ILWM practices; and propose interventions and recommendations for improvement. Materials on policies and strategic documents related to ILWM were collected, reviewed and analyzed for strength, weaknesses identification, and propose recommendations on improvement. Results showed that most materials that were reviewed have strong and sustainable indicators of natural resources and environmental management issues. However, from the broader ILWM perspective, most of the materials appeared weak on specificities of ILWM, though may be implicitly embedded in soil, water and environmental management issues. Therefore, there is need to explicitly incorporate ILWM issues in the existing policies and strategic plans, have an enabling legal framework, identify gaps between the proposed policies and actual implementation, as well as lobby the policy makers for enhanced incorporation of ILWM issues in the relevant policies.

Paper 37: Do the current Kenyan policies address the management of our soils sustainably?

By CKK Gachene

Soil is the most important resource in agricultural production. It constitutes the foundation of agricultural development and ecological sustainability and the basis for food production. The main regulating services of soils are nutrient cycling, water release and retention, soil formation, exchange of gases within the atmosphere and degradation of complex materials. These services underpin the delivery of all other soil services and contribute substantially to the benefits that accrue from the natural environment.

Currently there is no legislation in Kenya that focuses exclusively on soil protection, restoration, maintenance and reclamation. A cross-policy analysis was carried out to identify gaps and overlaps in existing Kenyan legislation that is related to soil threats and its support functions. We found that four soil threats, namely; soil compaction, decline in soil biodiversity, salinization and floods were not addressed in any of the 20 legislative policies that were analyzed. Other soil threats, such as erosion, decline in soil organic matter content,

soil fertility and soil contamination were directly or indirectly covered in the existing legislation, but only a few directives provided targets for reducing the soil threats and supporting its ecosystem services. Only one of the proposed policy, the National Agricultural Soil Management Policy, NASMP proposes directives for improving soil functions for sustainable agricultural production. Kenya's soils are in poor state and it raises the question whether existing legislation is sufficient for maintaining the country's soil resources. This paper suggests that a Kenyan Soil Framework Directive would address the existing soil threats so that soils can be managed in a sustainable manner.

SUB THEME 2: LAND CONSERVATION AND MANAGEMENT

Session Chair: Dr. Richard Kyuma

Paper 38: Land Tillage Methods on Common Bean (*Phaseolus vulgaris L.*) Performance in Eastern Kenya

By Micheni A

Common bean (*Phaseolus vulgaris L.*) remains one of the most important food and cash crops for over 90% of Kenyan households. Over the years the annual crop production and demand has lagged behind the Kenyan population. This is attributed to inappropriate land tillage practices, among other challenges. A four season field study was conducted in mid-altitude areas of Eastern Kenya to investigate the effect of land tillage practices on bean growth and grain yields. The trial was laid out on a randomized complete block design with three replicates. A newly released bean variety (*var. Mwende*) was the test crop whose performance was monitored under conventional tillage (CVT) and two conservation agriculture (CA) tillage practices, the furrows/ridges (FR) and zero tillage (ZT). The CVT land tillage involved seasonal 0-15 cm soil depth ploughing using conventional tools, conducting at least two weeding events per season, and removing over 75% of the crop residues after the crop harvest. The FR tillage system had furrows/ridges were made at the beginning and then maintained later on with minimal soil disturbance, weeds were controlled using appropriate herbicides, and over 75% crop residues were returned on the plots at the end of the seasons. The ZT had the plots not ploughed,- only seeds and fertilizer holes were made at appropriate

crop spacing. Otherwise, the weeding and residues management procedures were similar to those of FR. Significantly higher crop growth and grain yields were recorded from the two CA tillage practices compared to conventional tillage method. Seasonal crop residue retention coupled with other good crop husbandry regimes on FR and ZT system was attributed to improved higher bean yields. The study concluded that the crop productivity can be improved through adherence to appropriate tillage practices such as those embracing CA principles. Such tillage practices must therefore be scaled out to smallholder bean farmers in Eastern Kenya.

Paper 39: Evaluation of technologies for sustainable soil salinity management in irrigated semi-arid lands of Taveta sub-County, Kenya

By P. Kathuli

Soil salinity is a constraint to land productivity in semi-arid Taveta irrigation schemes. It affects over 82,000 farm families in over 800 hectares of land. Research was conducted to evaluate use of *Mavuno* NP fertilizer at 60 kg P₂O₅ ha⁻¹, 20 t ha⁻¹ (cattle manure) FYM, FYM plus *Mavuno* NP fertilizer, 40 t ha⁻¹ trash incorporation, 100% gypsum requirement, Rhodes grass, Sudan grass and control (farmers' practice) for salinity management. The experimental design was a CRD with four replication. Mean maize grain yield, cobs and stover weight and TDM (kg ha⁻¹) were measured. Application of 20 t ha⁻¹ FYM + *Mavuno* NP fertilizer at 60 kg P₂O₅ ha⁻¹ and *mavuno* NP fertilizer significantly (p < 0.05) increased maize (*Zea mays* L.) yield compared to farmers' practice in three trials. However after three consecutive experiments, mean maize grain yield, stover and cobs dry weight and TDM (kg ha⁻¹) were significantly (p < 0.05) increased over the farmers' practice by residual treatments of trash plus *Mavuno* NP fertilizer, 100% gypsum requirement and trash incorporation alone. Grass treatments were dropped after initial experiments due to non-preference by farmers. It was concluded that 20 t ha⁻¹ FYM + *Mavuno* NP fertilizer at 60 kg P₂O₅ ha⁻¹ can be recommended for use by farmers in moderately saline-sodic soils of Taveta sub county and trash incorporation with *Mavuno* NP fertilizer at 60 kg P₂O₅ ha⁻¹, 100% gypsum requirement plus *Mavuno* NP fertilizer and trash incorporation alone can be suitable technologies in the long run in sodic-moderately saline soils. Use of 20 t ha⁻¹ FYM plus 60 kg P₂O₅ ha⁻¹ is

recommended for up-scaling in sodic-moderately saline soils while more research is required on use of 40t ha⁻¹ trash incorporation with 60kg ha⁻¹ Mavuno NP fertilizer, 100% gypsum plus Mavuno NP fertilizer and incorporation of trash alone in moderately saline-sodic soils for management of soil salinity.

Paper 40: Terracing and Cropping Pattern Effects on Maize and Bean Yields in Andosols in Suswa, Southwest Kenya

By Ruto, A.

A field experiment was conducted to determine the effect of terracing on maize and bean yields in Suswa, Narok County, during the short and long rains season of 2013-2015. A randomized complete block design was used with maize and bean as the test crops. The study examined the number of bean pods, bean grain yields, maize above ground biomass and maize grain yields at the upper (U), upper middle (UM), middle (M), lower middle (LM) and lower (L) terrace slope positions and on farmers' fields where terraces were not maintained as the control. Soils in the trial site have high silt/clay ratio, low organic matter and high bulk density making them prone to erosion leading to severe soil losses. The results showed that there were significant differences ($P \leq 0.05$) in yields according to terrace slope position and cropping patterns (CP) in all seasons. On average CP 2 recorded the highest (0.8 t ha⁻¹) bean grain yields whereas CP4 (control) had the lowest (0.6 t ha⁻¹) in season I. At the lower terrace slope position CP2 and CP5 had the highest (1.38 and 1.3 t ha⁻¹) bean grain yields in season I whereas CP 4 (control) had the lowest (0.9 t ha⁻¹). Likewise CP3 had the highest (7.2 t ha⁻¹) maize grain yields in lower slope as compared to the upper slope position (3.0 t ha⁻¹) in season II. The research shows that terracing and cropping patterns have effect on crop productivity and the farmers can benefit from the spatial nutrient and moisture variability as a low technology precision farming for increased yields.

Paper 41: Assessment of Soil Erosion Hazard in Kathe-Kakai Catchment, Machakos County in Kenya Using Modified Rusle

By J.W. Wanjiku

Despite soil and water conservation efforts soil erosion remains one of the major cause of soil degradation in Sub-Saharan Africa. Pinpointing erosion risk areas will focus scarce resources on development of appropriate soil and water conservation measures. A modified revised

universal soil loss equation (RUSLE) was used to estimate soil erosion rates in Kathe-kakai catchment. The R factor (rainfall erosivity) was determined by interpolation of rainfall data from 8 stations in Machakos County. The K factor (soil erodibility) was estimated using a locally derived multiple regression equation. The LS factor (slope length and steepness) was calculated from digital elevation model. The C factor (land cover factor) was determined using Landsat imagery for the area and finally P factor (conservation practices) was estimated from commonly used soil conservation measures. A raster based geographic information system (GIS) was used to calculate soil loss and map hot spot areas soil erosion estimates ranged from 0 to 60 t/ha/year. Approximately 54% of the area under study was within the tolerable soil erosion rate (10t/ha/yr). 16% had moderate soil erosion while 24% had high erosion rate, the remaining 6% were classified as having very high to severe soil erosion rates. Poor management systems together with land use changes were the major factors associated with soil erosion. The results highlight the need for soil and water conservation measures in the area especially those mapped as erosion hot spots.

Paper 42: Managing Land Degradation in Kenya: The Role of Agroforestry

By James K. Mutegi

Land degradation remains a major threat to agricultural production in sub-Saharan Africa. Common farming practices in the region have revealed that intensification of land use can become a threat to agricultural sustainability if they lead to an increase in soil erosion. Studies on land degradation highlight the importance of analyzing different options of environmental changes and local people's perception of the role of agroforestry in checking soil erosion and healing gullies. The gullies are common. For example in the Taita Hills, severe gully erosion exceeding 5 metres depth and 100 metres in length are occurring in Mwatate, Chawia and Msau locations. In Baringo, Marigat, Nyando and parts of Kenyan and Ethiopia Rift valley gullies in excess of 5 meters depth and 100 metres in length are common. The common causes of such gullies are human factors and include uncontrolled deforestation, overgrazing and poor land management. The impacts include destruction of grazing areas and contamination of water bodies with sediments and nutrients. For example within the upstream degradation of central and Eastern Kenya results in sediment load of > 2 million tons in the Athi and Tana rivers destroying the usability of water for human and animals. This paper reviews the different effective options for mitigating land degradation, especially due soil erosion and their socioeconomic impacts to farmers. Specifically the review focuses on: a) agroforestry and soil/water erosion control, b) agroforestry and gully control, and c) socioeconomic

impacts of gully control. Although, not much has been documented on the monetary costs and benefits of rehabilitating gullies in sub-Saharan Africa, the various cases presented in this paper provide sufficient evidence to support the claim that the economic benefits of investing in gully rehabilitation can be high.

WAY FORWARD

1. Allow in future project coordinators to share their experiences with an aim of furthering research in more tangible areas/ issues that would impact more on the SLM
2. Summary of key issues from the data and findings consumable to both policy makers and non - soil scientists
3. Need to create awareness about the issues to inform policy development
4. The project to consider include water agenda (wetlands and water bodies in the management of ASALS, include pollution, siltation,
5. Need for establishment of agriculture fund
6. Need to link population growth to SLM and food production

Annexes 2: Conference Programme

ARRIVAL - WEDNESDAY 1ST JUNE, 2016			
TIME	ACTIVITY	FACILITATOR	SESSION CHAIR
2:30 PM ó 6:30 PM	Registration/ Check in at the Sentrim Elementaita Lodge,	Conference Secreatriat / Front Office Desk	Ms. Esther Opande Mr. Joseph Satty Munyao
DAY 1 : THURSDAY 2ND JUNE, 2016			
8:00 AM ó 8:30 A.M	Registration Continues	Conference Secretariat	Ms. Esther Opande
8:30 AM ó 8:45: A.M	Official Opening Remarks	Dr. Zeinabu Khalif Enegrgy Environment and Climate Change Unit	Mr. Julius Kiptarus Director of Livestock Production
8:45 AM ó 9:00: A.M		Mr. Michel Balima UN Resident Coordinator & UNDP Resident Representative	Rapporteur: Dr. Patrick Gicheru
9:00 AM ó 9:15: A.M		Dr. Andrew Tuimur Principal Secretary State Department of Livetsock Ministry of Agric, Livestock & Fisheries	
9:15 AM ó 9:35: A.M		Hon. Willy Bett Cabinet Secretary Ministry of Agric, Livestock & Fisheries.	
9:35: AM ó 9:45 AM	Overview of Mainstreaming Sustainable Land Management in AgroPastoral Production Systems of Kenya Project	Leonard Odi National Project Manager	
9:45 AM ó 10:55 AM	Objectives of the Conference	Dr. Zeinabu Khalif, UNDP	
10:55 AM ó 10:15 AM	Key note address	Malesu Maimbo, ICRAF	
10:15 AM ó 10:25 AM	Plenary	ALL	
HEALTH BREAK			
SUB – THEME	Climate Change impacts, adaption and resilience in agro-pastoral production systems (BREAK RM 1)		
11:50 PM ó 12:05 PM	Spatial assessment of climate based rangeland vegetation variability in Samburu and Marsabit Counties	Charles Kigen	Dr Alice Ruto Rapporteur: Bernice Sainepo

12:05 PM ó 12:20 PM	Rainfall and temperature variability effects on survival of Sahiwal cattle at the National Stud at KALRO Naivasha	Githinji M. G	
12:20 PM ó 12:35 PM	Pathways to building Resilience and Adaptive Capacity to Climate - Induced Vulnerability in Syembeni, Makueni County	Joseph Lwannia	
12:35 PM ó 12:50 PM	Impact of climate variability on water resources in semi arid parts of Kenya; community perceptions and adaptation mechanisms for agricultural production.	Clifford Obiero	
12:50 PM ó 01:05 PM	Climate Variability and Gross Primary Production in Rangelands: A Case Study of Lower Ewaso Ngiro South River Watershed.	Mathew Kiura	
01:05 PM ó 01:20 PM	Plenary Discussions		
SUB – THEME	Land Conservation and Management (BREAK RM 2)		

11:50 PM ó 12:05 PM	Effect of Adapting Conservation Agriculture Farming Methods for Maize-Bean Production on Soil Quality in Humid Areas of Embu County	Alfred Micheni	Dr. David Mburu Jomo Kenya University of Agriculture & Technology Rapporteur: Nyakio Kamau
12:05 PM ó 12:20 PM	Effects of Tillage and Cropping Systems on Maize and Beans Yield and Yield Components in a Semi-Arid area of Mwala District, Kenya	Anne N. Karuma	
12:20 PM ó 12:35 PM	Community Contracting Approach in Sustainable Land Management And Climate Change Adaptation and Mitigation in ASAL Areas of Kenya	Elijah M. Mutungi	
12:35 PM ó 12:50 PM	Community Resource Mapping for Sustainable Management of Loita Landscape	Faith Milka Wakonyo	
12:50 PM ó 01:05 PM	Impacts of Climate Variability and Change on Livestock Production in Marigat and Mogotio in Baringo County, Kenya	Muriithi G.M	
01:05 PM ó 01:20 PM	Plenary Discussions		
LUNCH BREAK			

SUB – THEME	Climate Change impacts, adaption and resilience in agro-pastoral production systems (BREAK RM 1)
--------------------	---

2:30PM ó 2:45 PM	Irrigation in Pastoral Landscapes, a climate change adaptation and intervention strategy. The Case of Maasai of Majimoto in Narok County, Southern Kenya	Twala Patrick	Dr. Patrick Gicheru KARLO
2:45PM ó 3:00 PM	Farmers' perceptions, exposure and response to climate variability in Mwea, Kenya	Mutembei M. M	Rapporteur Mary Ngatia
3:00PM ó 3:15 PM	Climate Variability, Land-Use, Pastoral and Agro-pastoral Livelihoods in Arid and Semi-Arid areas of Kenya	Amwata D.A	
3:15PM ó 3:30 PM	Women's Resilience to climate change variability.	Irene Rotich	
3:30PM ó 3:45 PM	Influence Of Tillage Practices And Fertilizers On Soil Moisture, Nutrient Status And Finger Millet Yield In Lower Eastern Kenya	Onwonga R.N	
3:45 AM ó 4:15 PM	Plenary Discussion		
SUB – THEME	Land Conservation and Management (BREAK RM 2)		
2:30PM ó 2:45 PM	Tree Species Composition and Diversity in Areas of High Charcoal Production in Kitui County: A Case in Ikutha And Mwingi Sub-Counties.	Gitehi Giathi	Dr. Alfred Micheni
2:45PM ó 3:00 PM	Rangeland rehabilitation using micro-catchments in Turkana County.	Jesse Owino	Rapporteur: Ombega JN
3:00PM ó 3:15 PM	Land degradation indicators to support rehabilitation and conservation of woodlands in Kiang'ombe Landscape, Embu County.	John Kigomo	
3:15PM ó 3:30 PM	The Land Potential Knowledge System: Application of Earth Observation data for Sustainable Land Management.	Lilian Ndungu	
3:30PM ó 3:45 PM	Relationship Between Soil Moisture Variability And	Mbugua Wairimu	

3:45PM ó 4:00PM	Cropping Systems Along The Toposequence Of A Terraced Vertisol; Machakos, Kenya. Temporal Relationship Between Climate Variability, Prosopis Juliflora Invasion And Livestock Numbers In The Drylands Of Magadi, Kenya.	Richard Kyuma	
4.00PM ó 4.15 PM	Potential for water harvesting and storage in sandy river beds: case study of kalama location	David Mburu	
4.15PM ó 4.30PM	Land use and land cover changes and implications on gully erosion in mt suswa catchment, narok county	Charity Konana	
4:30 PM ó 4:45 PM	Plenary Session		
HEALTH BREAK			

DAY 2 : FRIDAY 3RD JUNE, 2016

8:45 AM ó 9:15 A.M	Key note address	Mrs. Mary Githaiga, MOAL&F	Prof JW Kimenju, Dean
9.15AM - 9:45 AM	Plenary Session	ALL	Rapporteur John Kigomo
HEALTH BREAK			
SUB – THEME	Integrated crop and livestock production systems and management in the drylands (BREAK AWAY 1)		
10:30 AM ó10: 45 AM	Agricultural transition within the ASAL rural-urban continuum in Kenya:A case study of Kajiado County	Mary Kerubo Morara	Dr. David M. Mburu JKUAT
10:45 AM ó11: 00 AM	Dry matter accumulation and nutrient composition of three early maturity forage sorghum varieties grown for feeding ruminants in semi-arid Kenya	Robert Irungu	Rapporteur: Mathew Kigomo
11:45 AM ó12: 00 AM	Camel Agribusiness in Kenya's Arid And Semi-Arid Lands	Chris R. Field	
12: 00 PM ó 1:00 PM	Plenary Session		
SUB – THEME	Policy and Social-economic issues in land management supportive of climate change adaptation in drylands (BREAK AWAY 2)		
10:30 AM ó10: 45 AM	Uptake of IWM Technologies: Experiences of Machakos and Makueni Counties of Eastern Kenya.	Anastasia Kagunyu	Dr. Amwata D.A
10:45 AM ó11: 00 AM	1 Financial Returns of Maize and Bean Production Under Selected Tillage Practices in Semi-Arid Area of Mwala District, Kenya	Anne N. Karuma	Rapporteur: Angela Wokabi
11:45 AM ó12: 00 PM	Housing Scheme for Residents: The Centre Nerve of Drylands Conservation and Management, Kenya	Ben Musonye Akala	
12:00 PM ó12:15 PM	Attitudes and Perception Towards Ecotourism as a	Betty Rono	

12:15 PM ó 12: 30 PM	Form of Land-Use Diversification Among Pastoral Communities in Laikipia County, Kenya Ilchamus Pastoralistsø Indigenous Knowledge And its Use in Coping With and Adapting to Climate Change in Marigat, Baringo- Kenya	Clement Isaiah Lenachuru	
12.30 PM ó 12.45PM	Agro-Pastoral Communitiesø Perceptions on Indigenous Browse Resources of the North Central Rift Region, Kenya.	JK Sitiene	
12: 45 PM ó 1.00 PM	Plenary Session		
LUNCH BREAK			
SUB – THEME	Policy and Social-economic issues in land management supportive of climate change adaptation in drylands (BREAK AWAY 2)		
2:00 PM ó 2:15 PM	Economic Values of Climate Change Adaptation Strategies at Community Farm-Level in Semi-arid Ijara, Garissa County, Kenya	Mwaura J M	Dr. Onwonga R.N
2:15 PM ó 2:30 PM	Feasibility Of Green Credit As An Incentive For Natural Resource Management In Kenya	Obadiah H. Ngigi	Rapporteur: Betty Rono
2:30 PM ó 2:45 PM	The Evolution Of Collective Land Access Regimes In Pastoralist Societies: Lessons From East African Countries	Tim Njagi	
2:45 PM ó 3:00 PM	Critical Analysis of Policy Documents in The Context of Integrated Land and Water Management in Kenya for Improved Land Productivity	Francis Matiri	
3:00 PM ó 3:15PM	Do current kenyan policies address sustainable management of soils?	CKK Gachene	
3:15 PM ó 3:45 PM	Plenary Session		
SUB – THEME	Land Conservation and Management		
2:00 PM ó 2:15 PM	2 Land Tillage Methods on Common Bean (<i>Phaseolus vulgaris L.</i>) Performance in Eastern Kenya	Alfred Micheni	Dr. Richard Kyuma Rapporteur: Charity Konana

2:15 PM ó 2:30 PM	Developing sustainable technologies for soil salinity reduction in irrigated semi-arid lands of Kenya	Peter Kathuli	
2:30 PM ó 2:45 PM	Terracing And Cropping Pattern Effects On Maize And Bean Yields In Andosols	Alice Ruto	
2:45 PM ó 3:00 PM	Assessment Of Soil Erosion Hazard In Kathe-Kakai Catchment, Machakos County In Kenya Using Modified Rusle.	J.W. Wanjiku	
3:00 PM ó 3:15PM	Managing Land Degradation in sub-Saharan Africa: The Role of Agroforestry	James Mutegi	
3:15 PM ó 3:45 PM	Plenary Discussions		
3:45PM ó 3:55 PM	Effect of land rehabilitation on soil physico-chemical properties and diversity of herbaceous layer in a Kenyan semi-arid rangeland: case study of Suswa in Narok County	Ombega N.J	Prof. C.K.K Gachene <i>Lead Rapporteur:</i> Dr Alice Ruto
3:55PM ó 4:05PM	Assessment of soil erosion hazard and its potential effects on soil carbon dynamics in a rehabilitated gully in Suswa, Narok County.	Bernice Sainepo	
4:05PM ó 4:15PM	Assessment of grass species diversity and their influence on rangeland and gully rehabilitation: a case study of Suswa, Narok County	Nyakio Kamau	
4:15PM ó 4:25PM	Effect of integrating terraces and insitu micro-basins on soil moisture redistribution for optimum maize production in machakos district	Mary Ngatia	
4:25PM ó 4:55 PM	Way Forward		Dr. Zeinabu Khalif <i>Rapporteur:</i> <i>Leonard Odini</i>

HEALTH BREAK
7:00 PM
DINNER/COCKTAIL
CLOSING

DAY 3 : SATURDAY 4TH JUNE, 2016

DEPARTURE TO VARIOUS DESTINATIONS			

Conference Organizing Committee

Dr. Zeinabu Khalif



Dr. Khalif is the Programme Analyst for Environment, Energy and Climate Change Unit, UNDP Kenya and formally the National Project Manager for Mainstreaming Sustainable Land Management in Agro-pastoral Production Systems of Kenya project. She holds PhD in Development Studies from Norwegian University of Life Sciences (UMB), Norway and MSc. In Project Planning and Management from University of Bradford. She has a vast experience in programme development and management drawn from working with United Nations and Non Governmental Organizations. She has a special interest on issues of livelihoods, natural resource management.

Prof Charles K.K. Gachene

Prof. Gachene is currently an Associate Professor in Soil Science, Department of Land Resource Management and Agricultural Technology, University of Nairobi. He has a bias towards soil and water management. He is a member of several professional organizations, has published widely in refereed journals and written reference manuals for farmers and extension staff, and has been involved in reviewing and editing scientific publications. He worked in KARI before joining the University of Nairobi. A holder of BSc and MSc (Soil Science), University of Nairobi, PhD in Soil Science (Swedish University of Agricultural Sciences, Sweden) and an International Diploma at Professional Level in Project Management, University of Cambridge.

Dr. Patrick T. Gicheru.



Dr. Gicheru is a Chief Research Scientist and holds PhD in Land and Water Management. He is currently the Center Director for *Kenya* Agricultural and Livestock Research Organization (*KALRO*) Embu and formally Director of the National Agricultural Research Laboratories of Kenya Agricultural Research Institute. He has an extensive experience in natural resource management with a bias in sustainable land management and environmental impacts on agricultural land use spanning over 25 years. His current research focuses on land and water management linking it with natural resource management and land use planning. He has also

been involved in green water credits issue and payment of environmental services, land degradation, climatic change and how they impact on carbon stocks nationally and internationally. He has published widely in refereed journals and has written several book chapters.

Dr. David M. Mburu



Dr. Mburu is currently the Dean, Faculty of Agriculture at Jomo Kenyatta University of Agriculture and Technology (JKUAT) where he has worked since 1990. Prior to joining JKUAT he worked for twelve years with the Ministry of Agriculture as District Agricultural Officer. He holds BSc degree in Agriculture, Postgraduate diploma in soil and water conservation and MSc in Agricultural Engineering from the University of Nairobi and PhD in Agricultural Engineering from JKUAT. His field of specialization is in soil and water management and environmental conservation. He has written journal articles and conference papers. He has done several consultancies for national and international organizations.

Mr. Leonard Odini



Leonard is the National Project Manager and formally the Communications Officer for for Mainstreaming Sustainable Land Management in Agro-pastoral Production Systems of Kenya project. He holds a Bachelor of Science Degree in Information Sciences from Moi University and currently undertaking a Master's degree in Communication and Journalism at Moi University. He has over 8 years experience in Media, Communications, Publishing, Information Technology and Project Management. Prior to joining UNDP, he worked as a Communications Specialist with Education Development Center Inc. for USAID South Sudan Interactive Radio Instruction and Education Technology Specialist for USAID Health Education and Reconciliation Project in Sudan. He has also worked with Kenya AIDS NGOs Consortium and UK Consortium on AIDS and International Development as an AIDS Portal Project facilitator in Kenya and Moderator in Eastern Africa.

LIST OF PARTICIPANTS – 2nd NATIONAL CONFERENCE ON SLM

1. Andrew Tuimur, PS State Department of Livestock
2. Ruth Kimosop, State Department of Livestock
3. Dominic Rono, State Department of Livestock
4. Julius Kiptarus Director Livestock Production
5. Nicholas Mumo State Department of Livestock
6. Japhet Ngetich State Department of Livestock
7. Shaaban Kipkorir State Department of Livestock
8. Michel Balima UNDP
9. Zeinabu Khalif UNDP
10. Yuko Kurauchi UNDP
11. Judy Ndichu UNDP
12. Fredrick Obade UNDP
13. James Ochweri UNDP
14. Mwenda Kiogora UNDP
15. Leonard Oдини SLM Project
16. Esther Opande SLM Project
17. Satty Joseph Munayao SLM Project
18. Bernard Ouma SLM Project
19. Julieta Muchaho SLM Project
20. Charles Gachene Organising Committee Member
21. David Mburu Organising Committee Member
22. Patrick Gicheru Organising Committee Member
23. Alfred Micheni Organising Committee Member
24. Anastasia W. Kagunyu Author
25. Anne N. Karuma Author
26. Ben Musonge Author
27. Charles Kigen Author

- 28.Clement Isiah Lenachuru Author
- 29.Elijah M. Mutungi Author
- 30.Faith MilkaWakonyo Author
- 31.Chris R.Field Author
- 32.G.M.Murithi Author
- 33.Githinji M.G Author
- 34.Irene Rotich Author
- 35.John Kigomo Author
- 36.Joseph Lwannia Author
- 37.J.K Sitiene Author
- 38.Clifford Obiero Author
- 39.Lilian W. Ndungu Author
- 40.Mary KeruboMorara Author
- 41.Mathew Kiura Author
- 42.Francis Matiri Author
- 43.Mbugua Wairimu Author
- 44.J.M Mwaura Author
- 45.Obadiah H. Ngigi Author
- 46.Peter Kathuli Author
- 47.Jesse Owino Author
- 48.Robert Irungu Author
- 49.Ruto Alice Author
- 50.Tim Njagi Author
- 51.Patrick Twala Author
- 52.J.W.Wanjiku Author
- 53.Betty Rono Author
- 54.Mutemebi M.M Author
- 55.Amwata D.A Author
- 56.Githei Giathi Author

57. Mutegi James Author
58. Yvonne M.M Author
59. Richard Kyuma Author
60. Jamin Ruto Project Coordinator, Narok
61. Henry Anjila Project Coordinator, Dadaab
62. John Wanjii Project Coordinator, Mbeere
63. John Chege Project Coordinator, Kyuso
64. Micheal Mwaura Project Coordinator, Kyuso
65. Ombega N.J SLM Sponsored Student
66. Bernice Sainepo SLM Sponsored Student
67. Nyakio Kamau SLM Sponsored Student
68. Mary Ngatia SLM Sponsored Student
69. Frank Msafiri CSO
70. Malik Aman KAPSLMP
71. Susy Wandrea CSO
72. Christophher Gakau CONSULTANT
73. J.W. Kimenju UON
74. Yuko Kurauchi UNDP
75. Assan Ngombe UNDP
76. Charity Konana UON
77. Malesu Maimbo Key Note Speaker, ICRAF
78. Mary Githaiga Key Note Speaker, MOALF
79. Patrick Omabayе MOALF
80. Ernest Mbogo MOALF
81. Agnes Yobterik MENRD
82. Tysin Kwemboi MENRD
83. Noah Ruto SLM Project
84. Dickson Maina MOALF
85. Stephen Sande Co-Author

86.Ephantus Mugo UON

87.Francis Maundu UNDP

88.Mary Mburu South Eastern Kenya University



Mainstreaming Sustainable Land Management in Agro
Pastoral Production Systems of Kenya Project

Hill Plaza, 7th Floor

P.O. Box 34188-00100

Nairobi

Tel: +254202722258

Email: slm.ke@undp.org

Web: www.slmkenya.org

