MAINTREAMING SUSTAINABLE LAND MANAGEMENT IN AGROPASTORAL PRODUCTION SYSTEMS IN KENYA

MBEERE NORTH BASELINE SURVEY REPORT
MARCH 2013

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ACKNOWLEDGEMENTS

I wish to acknowledge the role played by several people in making this assignment possible. My gratitudes are to the Project Manager, Dr Zenaibu Khalif for her tremendous support of the undertaking and tirelessly guiding the process and logistics provision. Ms Barbara Ombasa and Mr Solomon Waiganjo assisted in the logistics and field support. Dr Christopher Gakahu, the UNDP Country Assistant Director provided useful insights into the assignment especially in the validation process. Mr Abdullahi Ishmael, the Livestock Deputy Director and Mr Leposo were instrumental in the assignment execution.

The Project team in Mbeere led by the District Livestock Officer Mr John T. Wanjii and very ably assisted by John Kungu, Daniel Muingai Mwangi, Mutegi Magana Zipporah Marei, and the Veterinary department Dr. Lucy Kareithi. The District Commissioner Mbeere North-John Chelimo for mobilizing the chiefs to organize the PRA session.

The District Agricultural Officers- Mureithi Mukungo, Paul Kiige, Josphine Njuki and Wellington Ndaka- KFS made the fieldwork possible in terms of logistics, community outreach and the conduct of PRA sessions. Thanks to the key stakeholder in various ministries and NGOs who despite their busy schedules took time to fill in the targeted key informant questionnaires and attend the validation sessions where their views were critical in targeting the SLM activities.

I am very grateful to Ms Mumbi Mutonga for overseeing the data entry, cleanup and processing for over 2000 questionnaires. The University of Nairobi students lead by Dan Kobia did a commendable job, converting the raw hand written questionnaires to a digital format. Mr Ouma Ms Juliet and Mr. Gitoya tirelessly spent over a month driving over rough terrain for baseline data collection and community consultations. I am very grateful to the communities who left urgent domestic chores pending to participate in the SLM baseline process and frankly and candidly presented their views for the successful implementation of the SLM project objectives.
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EXECUTIVE SUMMARY

Mainstreaming sustainable land management in Agro-pastoral production system of Kenya project was initiated to address land degradation problems in arid and semi-arid areas (ASALs) of Kenya. The degradation of land in ASALs is linked to various factors such as: Inappropriate land uses as a result of unsuitable development models, incongruous farming practices, reduced livestock mobility and over-exploitation of the available pastures, high population growth encroaching on the wet-season grazing areas for pastoralism as well as encroachment of agriculture into marginal land. In addition, the increasing demand for fuel woods, charcoal and timber has led to loss of forest covers exasperating land dilapidation. These man-made crisis coupled with the impacts of climate change has further challenged livelihoods of agro-pastoral communities rendering them perpetual dependents on famine relief. This assignment was part of the SLM key outcomes of knowledge based land use planning as a basis for improving drylands sustainable economic development.

Amongst the pilot districts chosen for mainstreaming SLM, Mbeere North was one of them. Mbeere North is in Embu County in Eastern Kenya. Baseline survey was conducted using questionnaires, community consultation, environmental profiling and Key informant questionnaires were administered to critical GoK agencies and Line ministries and NGOs in the area. Interventions for sustainable land management were derived from the findings.

In Mbeere North, the community was largely agro pastoral in the lower zones with mixed farming in the upper areas around Siakago. The household questionnaires indicated that family size was large with a mean of 4-10 children. Livelihoods revolved around agriculture and livestock with a very low diversity of other livelihood sources, increasing pressure on the land. The lack of alternative income sources has implications on resources mobilizes to make the land more productive. Most of the respondents have less than 5 acres where food crops such as maize, beans, millet and sorghum are grown for subsistence and commercial purposes. Agriculture is constrained by pests, lack of training and expensive inputs.

Livestock is dominated of cattle, goats and sheep comprising mostly of indigenous breeds. Major constraints affecting livestock production include pest and disease, low quality breeds, water and fodder shortages as well as finances for breed improvement and treatment. Poultry keeping was widely practiced using the traditional varieties. Aviculture was practiced by 30% of the respondents using log hives. The community relied on firewood as the major energy source and energy saving devices was not widely used. Charcoal burning was practiced by 30% of respondents, targeting indigenous hardwoods and using indigenous methods. The area had diverse water sources that included piped water, boreholes, rivers and sand dams.

Climate variability was a major problem affecting agriculture and livestock production in Mbeere North with reported increased frequency of diseases and pests. Food insecurity is experienced by 55.7% of the respondents, with August to December being the period with severe shortages. There are few financial institutions in the area Farmer Field Schools are well-established. Environmental problems in the District revolve around soil erosion, overgrazing, removal of indigenous hard woods for charcoal production, hill slope farming and encroachment.
of water catchment areas. Kiangombe, an important cultural and water catchment area is highly encroached and dedicated.

SLM resources are largely controlled by men but accessed by men especially land and livestock. Firewood was largely accessed and controlled by women as well as livelihood potentially transforming aspects such as poultry, food crops and organized groups.

The community indicated that 30% of income is used for purchasing food, validating the household questionnaire findings.

Inadequate water, destruction of pastures and forests, low crop and livestock yields, drought and climate variability were cited as critical problems affecting SLM. Responses from key informants concurred with questionnaire findings and community problem analysis. Interventions were derived from the findings and refined with specific action and target areas.
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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>ASAL</td>
<td>Arid and Semi-arid Lands</td>
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<td>ASL</td>
<td>Above Sea Level</td>
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<td>C</td>
<td>Celsius</td>
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<tr>
<td>DLPO</td>
<td>District Livestock Production Officer</td>
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<td>DVO</td>
<td>District Veterinary Officer</td>
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<td>FFS</td>
<td>Farmers Field School M</td>
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<td>GEF</td>
<td>Global Environmental Fund</td>
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<td>GoK</td>
<td>Government of Kenya</td>
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<td>GPS</td>
<td>Global Positioning System</td>
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<td>HCDA</td>
<td>Horticultural Crops Development Authority</td>
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<td>HH</td>
<td>Household</td>
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<td>KARI</td>
<td>Kenya agricultural Research Institute</td>
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<td>KEBS</td>
<td>Kenya Bureau of Standards</td>
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<td>KEFRI</td>
<td>Kenya Forestry Research Institute</td>
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<td>Kenya Forestry Services</td>
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<td>Kes/Ksh</td>
<td>Kenya Shilling</td>
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<td>KM</td>
<td>kilometre</td>
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<td>KUSCCO</td>
<td>Kenya Union of Saving and Credit Cooperatives</td>
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<td>KWFT</td>
<td>Kenya Women Finance Trust</td>
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<td>LGB</td>
<td>Large Grain Borer</td>
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<td>Meter</td>
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<td>Non-Governmental Organization</td>
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<td>Savings and Credit Cooperative Societies</td>
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<td>SLM</td>
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<td>SPSS</td>
<td>Statistical Programme for Social Studies</td>
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<td>UNHCR</td>
<td>United Nation High Commissioner for Refugees</td>
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<td>WRUAs</td>
<td>Water Resources Users Associations</td>
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<td>Water Resources Management Authority</td>
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SECTION ONE: INTRODUCTION AND BACKGROUND

1.1 BACKGROUND

Mbeere North District was setup 2009 as one of the new districts created in Kenya as part of Government efforts to bring services closer to the people. Mbeere North district borders Embu District to the North West, Meru South to the North, Tharaka to the east, Mumoni District and Tseikuru to the South and southeast respectively and Mbeere South to the west. It has an area of 786.3km² and is subdivided into four Divisions, 16 locations and 31 sub locations. The divisions comprise of Kanyuambora, Evurore, Mutitu and Siakago Divisions. The District has an estimated population of 110,000 people in 21,000 households.

The district slopes in a Northwest to South east direction with an altitude range of 1200m asl to 500m asl along the Tana River Basin. There are 4 perennial rivers rising from the Mt Kenya highlands and series of seasonal rivers and dry river basins that include Ena, Tana, Thuci and Thiba with only Ena flowing within the District.

The district has a bimodal pattern of rainfall with the long rains falling between April and June while the short rains fall between October and December. The short rains are more reliable. The annual rainfall averages range between 640 mm and 1,100 mm. Most parts of the district receive 550 mm of rainfall per year hence making Mbeere a marginal district. The altitudinal variation influences temperatures that range from 15°C and 30°C.

The area is classified as a medium to marginal land with the latter forming the larger proportion of the District. There are differences in soil characteristics in the district the Central belt that includes part of Evurore and Siakago Divisions having blackish grey and red soils with a fertility ranging from moderate to low. The soils in the district are largely sandy, with those around the hills in Evurore being mostly rocky and not amenable to tillage.

The District has been divided into four agro-ecological zones designated as Marginal Cotton Zone (LM4) that covers the upper parts of Siakago and Evurore Divisions, the Lower Midland Livestock Millet Zone covers the central belt of the District. The lowland livestock millet zone covers the eastern part of the district in Siakago and Evurore Divisions. There are pockets of medium agro-ecological zones that include the Cotton Zone (LM5) in parts of Siakago and Evurore divisions and the sunflower/maize zone which is also marginal coffee zone around Siakago Town.

The livelihoods in the District are mixed farming and agro pastoralism with Miraa (Catha edulis) emerging as a cash crop in the Central parts of the District.
1.1 TERMS OF REFERENCE
DEVELOPING A BASELINE SURVEY IN THE PILOT DISTRICT OF MBEERE NORTH

1.1.1 SLM project background
Kenya’s arid and semi-arid lands are characterized by low rainfall, prolonged dry seasons and frequent droughts. Livestock production is the main production system in the area. The ASALs productive capacities continue to dwindle due to inappropriate land use practices that have resulted to land degradation. The areas also suffer from insecurity, poor infrastructure and limited economic opportunities. The impacts of climate change together with other challenges have caused persistent food deficits and food-aid.

The project, ‘Mainstreaming Sustainable Land Management in Agropastoral Production Systems of Kenya’ is a 5 year project borne of partnership between Global Environmental Facility (GEF), United Nations Development Program (UNDP-Kenya) and Government of Kenya (GoK)
through Ministry of Livestock Development. The overall goal of the project is to promote economic development, food security and sustainable land use practices while restoring ecological integrity of the ASALs. The main objective of the project is to provide land users and managers with enabling policy and institutional capacity for effective adoption of sustainable land management (SLM). This will be realized by enhancing the ability of the local communities to mitigate impacts of climate changes by adopting appropriate technologies that promote socio-economic resilience.

The envisaged outcomes of the project are:

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

2. Viability of agro pastoral production system increased through diversification and access finances for SLM

3. Mainstreaming SLM policies into cross-sectoral national and local level decision making processes and support implementation

4. Lessons learnt used to upscale SLM in other ASAL districts.

The project uses a two pronged approach in achieving its goal. At national level, it supports review of policies related to Sustainable Land Management and mainstreaming of SLM in the national planning processes. At the local level, the project activities are implemented in four pilot districts of Mbeere North, Kyuso, Narok North and Dadaab. The lessons learnt from these pilot districts will be used to upscale in other ASAL areas.

1.1.2 Objective of the assignment

The baseline survey information is an important component of Outcome 1: Knowledge-based land use planning provides basis for improving drylands sustainable economic development. The baseline information will provide an up-to-date socio-economic status of the pilot districts that can enable development of appropriate interventions in line with the project’s overall objective. The main objectives of the baseline survey are:

a) To determine baseline information for the pilot districts.
b) To collect data that can be used to evaluate the transformational impact of the project on the ground during the middle and final evaluations.
c) To assist in developing appropriate interventions strategies to inform subsequent Annual Work Plans and set up reasonable targets.
d) To determine available capacity and capacity gaps for the communities and technical staffs.
e) To identify potential partners and their ongoing initiatives in project sites in order to achieve synergy, better use of resources and reduce duplications.
1.1.3 Scope of work
To support evidence based policy making and implementation of project activities in the respective districts, the project will undertake a comprehensive baseline survey to establish current level of production (crops and livestock) in the pilot districts, land-use practices, capacity assessment on sustainable land management practices, identify and support diversification of livelihoods and implementation of the new charcoal rules.

1.1.4 Key activities
The key activities to be undertaken were guided by the tasks given below aimed at providing a comprehensive baseline of Narok project sites to be used in achieving the overall objectives of the SLM project.

Task 1: Develop basic information on the pilot districts
- Comprehensive collation, review and summary of relevant studies and reports such as District Development Plans, District Environment Action Plans, documents of other past, ongoing and pipeline projects related to or on the development and environmental issues in the pilot districts.
- Analysis of the data to establish basic information on the districts including: a) the main economic activities in the district b) available basic social amenities (i.e. schools, type of roads, microfinance institutions d) factories/processing plants c) socio-economic status of the households

Task 2: Assessment of land use practices in the pilot districts
- Provision of relevant information regarding land tenure systems in the respective districts.
- Identification of common land use practices in the districts taking into consideration such issues as, a) farming methods b) irrigation c) water harvesting d) terracing etc.
- Provide analysis of the relationship between land use practices that are prevalent in the districts and their impacts on the environment.
- Provision of details of productive capacities and potential land in the districts and at target project sites, taking into consideration the average farm yields over the last 5 years.
- In the pastoral areas of Narok-North assess the average number of livestock per households and various species owned by the pastoralists.
- Provision of a detailed account of herd management practices by households and establish the relationship between herd management practices and other factors such as livestock mobility and their impact on the pasture lands carrying capacity.
- Assess the various pull and push factors driving pastoralists to undertake farming. The potentials of farming in pastoral areas need should be assessed in light of modernization and on-going sedentarization of pastoralists.
- Explore the economic potentials of crop production in pastoral areas vis-à-vis pastoral production.
- Document food aid distributions intervention strategies in the Arid and Semi-arid areas during droughts and prolonged dry-season and:
  a) Determine frequency of households' reception of food aid
  b) Explore alternatives to reduce dependency on food aid.

**Task 3: Identification of opportunities for diversification of livelihoods**
- Assessment of potentials livelihood diversification the pilot districts e.g. stone quarrying, sustainable charcoal production, horticulture, ecotourism (rock climbing, cultural), aquaculture, dairy-goats, poultry and bee-keeping as an alternative economic activities.
- Identification of the major constraints to livelihood diversification in the pilot districts.
- Provide suggestions on how the economic potentials in the pilot districts can be harnessed and/or enhanced.

**Task 4: Environment and Natural resources aspects**
- Provision of an over-view of environmental conservation practices in the pilot districts.
- Analyze causes and impacts of land degradations in pilot districts
- Provision of information on the main rehabilitation practices undertaken by the various households in the pilot districts.
- Identification of the major sources of energy for the households in the pilot districts.
- Determination of the proportion of households dependent on wood fuel as their main source of energy.
- Map the water sources and wetlands in the pilot districts.
- Determine the proportion of tree cover in the pilot districts (in terms of acreage).
- Estimate of the acreage of denuded land in the pilot districts.
- Provision of information on water issues in the district with regard to:
  a) Source of water consumed by Households and livestock
  b) Average distance to water sources.
- Description of coping mechanisms employed by the Households during water stress periods such as prolonged dry seasons and droughts.
- Discussion of the major environmental challenges affecting the pilot district.
- Exploration of user rights as well as gender-based control and access to natural resources in the pilot district.
- Analysis of the prevalence of charcoal production in the pilot district
- Description of a) purpose of charcoal production b) tree species used for charcoal production c) source of trees used for charcoal production (e.g. farm, forest, communal land etc) in each zone in the pilot district.
• Analyses of the charcoaling chains from source to buyers and briefly describe challenges faced by the producers and sellers.
• Other details regarding charcoal such as: a) the number of charcoal associations aggregated by sites within the districts b) the technology used in charcoal production c) average number of charcoal bags/sacks produced per week in each zone in the district.
• Document sustainable charcoal production by enquiring whether:
  a) members of charcoal associations have been trained on sustainable charcoal production
  b) the association received financial support from any organization.
• Establish awareness by members of charcoal associations of carbon trading and if they have benefitted from carbon-trade.

Task 5: Assessment to identify capacity needs for stakeholders
• Assessment of indigenous knowledge on sustainable land management in the districts, identify the gaps and make recommendations.
• Analyze and quantify range of extension services available to the local communities and take into account knowledge gaps and other challenges affecting extension services. Suggest possible remedial measures.
• Provide details of farmer associations in terms of a) membership b) whether they have received micro-credits c) if they received, how they utilized the funds d) whether they were trained on financial management and entrepreneurship and how they training have benefitted them.
• Analyze opportunities and challenges in accessing micro-finance in the district.
• Give detailed descriptions of the Farmer Field Schools in the pilot district i.e. names of FFS, number of members (specifying gender), years of formation, age-bracket of their members and the main activities undertaken by such groups.

Task 6: Partnerships
• Identification of institutions engaged in SLM matters in the districts, identify their activities, areas of their operation, duration of their projects/activities and potentials for partnership with SLM project.

1.2 BASELINE STUDY EXECUTION

1.2.1 Baseline survey methodology
The baseline survey had three components comprising of household questionnaires, public consultations, key informant responses and environmental baseline documentation.

1.2.2 Household Questionnaire
The household questionnaires were administered in February 2012 and aimed at 30% of the target population. The questionnaire captured aspects relevant to Sustainable Land Management at the household levels. The questionnaire was divided into the following areas:

i) **Household profile**
Information sought was on the location of interviewees and the main economic activities in the area. The section also captured details on the household head, the number of persons in the household, their education levels and age groups. Information on household head sources of income was also obtained.

ii) **Agriculture**
In this section, information was obtained on farm size, yields and income from agricultural activities, food storage and any value addition activities undertaken. The farming practices, land husbandry, soil and water conservation activities were documented. Information on the use of meteorological information in agricultural and livestock production, type and frequency of extension services and education on SLM training was also sought.

iii) **Livestock**
Information on livestock categories, presence of improved breeds, production and grazing areas were documented including relevant aspects for poultry.

iv) **Mobile pastoral production system**
Mobile pastoral production systems were queried for Dadaab and Narok North where herd mobility is an important feature of livestock management. Herd size, management strategies, production levels and challenges were documented.

v) **Farming in pastoral**
Information was obtained on land size, ownership and tenure system in place. Respondents were requested for information on farming history, farming uptake reasons and farming history. The type of crop, yield over a five year period and corresponding income were tabulated. The synergies that may exist between pastoralism and agricultural as well as the challenges/opportunities of pastoralism were investigated.

vi) **Environment and natural**
Information on natural resources such as water, pastures, forests and other resources was sought from the respondents including conflicts emanating from resource utilization and their resolution. Agro forestry and energy aspects were also documented.

vii) **Charcoal production**
Charcoal production has emerged recently as a major short term drought coping mechanism in ASALs. The baseline survey sought information from respondents on the species used; source of
trees, trade chain, technology used, the presence of charcoal associations, their composition and management structures.

viii) Farmer associations, Microfinance and Farmer/Pastoral Field Schools
Financial institutions are important in acquisition of resources that eventually impact on land use. Presence of these institutions and their relationships with agro-pastoralists were investigated through structured responses sought from the Household questionnaire surveys. As part of documentation of Farmer Field schools and Pastoral Schools, respondents were queried on membership, school history and activities undertaken.

1.2.3 Household Questionnaire Data analysis
The data from household questionnaire was subjected to statistical analysis using SPSS after entry, cleaning and clustering using Microsoft Excel. Various statistical tests were conducted and the results generated presented as Tables and Figures alongside specific statistical tests undertaken.

1.2.4 Environmental baseline information collection
Environmental baseline data was collected in the vicinity of sites where SLM activities have been initiated and other proposed sites. In addition to these sites, areas that were deemed to have critical and urgent SLM interventions needs were identified and profiled. The short duration for field activities hindered district wide environmental profiling and representative sites of environmental conditions were identified through consultations and profiled. The identified sites were geo-referenced for future visits and photographic records of the environmental conditions made.

Quadrats were used to determine the density of tree species found in area with standard 20m² quadrats being used. Tree and bush species were identified and the numbers of each determined. The height, diameter at breast height, canopy ground projection and density were measured. 1m² plots were used to determine the percentage cover by herbaceous plants, which where possible were identified to species level. Other indicators such as range condition, presence of invasive species and signs of erosion were recorded. The soil composition, debris cover and animal dung and feaces were also noted and wildlife encountered was recorded.

1.2.5 Community consultations.
Information obtained from household questionnaires was household specific. Complimentary information on community characteristics, perceptions, challenges and utilization of resources potentially impacting on sustainable land management was needed. Community level activities have landscape scale level of impacts requiring a similar range of interventions. To supplement household questionnaires information, community consultations were conducted where aspects of resource control and access, community expenditure and SLM key problems analysis were profiled (Plate 2). The community problems, root causes and solution were given as shown in appendix 2. In Mbeere North District, the consultations were held in:
i. Kirie
ii. Nthawa
iii. Iria-itune

The facilitation was through the provincial administration with the DLPO playing the lead role and assisted by the Ministry of agriculture officers.

1.2.6 Key Informants Responses
The Household Questionnaire data focused mostly on individual responses in a given area. The questionnaire could not capture data and information in possession of key government ministries, agencies and other development stakeholders whose activities impinge on sustainable land management. To mainstream SLM activities, information from these sources was deemed important and special key informant questionnaires targeting such stakeholders were designed. The questionnaires were sector specific and collected information on ongoing activities and planned activities that were SLM oriented. The questionnaires were administered after a stakeholder analysis and profiling had been conducted in the District.

1.2.7 Key informant Questionnaires target
i. Ministry of Livestock Development
ii. Ministry of Agriculture
iii. Ministry of Gender and Social Services
iv. Kenya Wildlife Service
v. Kenya Forest Service
vi. SACCOs and Banks
vii. Provincial Administration
i. Ministry of Fisheries Development
ii. NEMA
iii. Ministry of Special Programmes
iv. Ministry of Northern Kenya Development
v. UNHCR and NGOs Operating in Dadaab Refugee Camp Complex

1.2.8 Environmental baseline information collection
Environmental baseline data was collected around the sites where SLM activities have been implemented. In addition to these sites, areas that were deemed to have critical and urgent SLM interventions were also visited, where they were identified. The short period of field activities did not allow for complete district coverage but the sites visited were found representative of the prevailing environmental conditions. The identified sites were geo-referenced for latter repeat visits and photographic records of the environmental conditions made.

Quadrats were used to determine the density of tree species found in area with standard 20m² quadrats being used. Tree and bush species were identified and the numbers of each determined. The height, canopy projection and density were measured. 1m² plots were used to determine the percentage cover by herbaceous plants, which where possible were identified to species level.
Other indicators such as range condition, presence of invasive species and signs of erosion were recorded. The soil composition, presence of debris and animal dung and feces were also noted. Any wildlife or signs encountered was recorded.

1.2.9 SLM intervention derivation
Key SLM interventions in Mbeere target areas were derived from information yielded from Household questionnaires analysis, baseline environmental information, community consultations, key informants’ responses and interrogations of the findings at the validation and feedback workshop.
SECTION TWO: RESPONDENTS ATTRIBUTES AND AGRICULTURE

2.1 RESPONDENT ATTRIBUTES

2.1.1 Sample population profile
Mbeere is part of ASAL areas in Kenya. The area is largely agricultural although some practice sedentary agropastoralist. From community consultations and key respondents, the study area has predominantly agricultural and agropastoralism land use types, with the former being main.

The baseline survey sought information on several aspects at the household level as this is where SLM interventions will be ultimately domesticated. A total of 601 questionnaires was administered in the project target area of Mbeere with 201 respondents in Iria-itune, 200 Kirie and 200 in Nthawa. The number of respondents was well distributed in the study area. In the households visited, 523 were headed by males, 78 by females while 588 of these were adult-headed, with 5 of the households being headed by a child. It was in Iria-itune that these child-headed homes were. Data on demography in the target area, occupation, children's education levels and household size are shown in Tables 1a, 1b and 1c below.

2.1.2 Education
Information on the education situation at household level was sought from respondents. Analysis of the responses yielded the results shown in Table 1a. A high number of children are in primary level (50%) followed by those who are out of school between the age of 18-25 years (23.3%) as shown in table 1a. The number of school dropouts is low as only 3.7% of schools going age children do not attend school.

The high number of children in primary and secondary school could be attributed to the free education. The community possesses adequate education skills to be potentially receptive to SLM interventions. Overall, the average level of education is at secondary school level in all the areas, From consultations, school dropout was due to; peer pressure, food shortage and Miraa. Most of the income was spent on education which took 60% of the community financial resources.

Table 1a: Education level of Children in the study area

<table>
<thead>
<tr>
<th>Child's gender</th>
<th>Primary</th>
<th>Secondary</th>
<th>Polytechnic</th>
<th>Tertiary</th>
<th>Out of school going children</th>
<th>Out of school youth</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boy</td>
<td>Boy</td>
<td>Boy</td>
<td>Boy</td>
<td>Boy</td>
<td>Boy</td>
<td>Girl</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boy</td>
<td>Girl</td>
<td>Girl</td>
<td>Girl</td>
<td>8</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>232</td>
<td>241</td>
<td>41</td>
<td>70</td>
<td>59</td>
<td>53</td>
<td>842</td>
</tr>
<tr>
<td>Kirie</td>
<td>195</td>
<td>221</td>
<td>54</td>
<td>40</td>
<td>5</td>
<td>7</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>9</td>
<td>14</td>
<td>9</td>
<td>12</td>
<td>8</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>67</td>
<td>732</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
In terms of knowledge, the youth had the highest level of access and control of theoretical aspects, implying a good basis for sustainability and a need to involve the youth in SLM interventions. The practical applicability of new knowledge was in the hands of adult men and women at 100% emphasizing their control over the land resource and homesteads where any new interventions would be applied.

Table 1b: Household Size for respondent families

<table>
<thead>
<tr>
<th></th>
<th>1-3</th>
<th>4-6</th>
<th>7-10</th>
<th>&gt;10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>11.8</td>
<td>52.5</td>
<td>32.4</td>
<td>3.3</td>
</tr>
<tr>
<td>Kirie</td>
<td>10.6</td>
<td>45.7</td>
<td>37.2</td>
<td>6.5</td>
</tr>
<tr>
<td>Nthawa</td>
<td>11.6</td>
<td>53.6</td>
<td>32.6</td>
<td>2.1</td>
</tr>
</tbody>
</table>

The questionnaire respondents were requested to indicate the number of dependants in their households. The proportions were a proxy indicator of household sizes that correlate with pressure on livelihood resources. The respondents within the study area had moderately large families with 53.6% having between 4-6 dependants followed by those with 7-10 at 32.6% and 1-3 at 11.6%. This distribution of dependants show a growing population that would in the future exert pressure on land resources if land parcels continues to decrease in size through subdivisions. The large number of dependants will most likely consume a large proportion of farm produce diminishing the amount of surplus production that could be sold to generate income. Thus compromising the ability to fund other household needs like education, food and health precipitating pressure on alternative resources like trees for charcoal production to bridge income shortfalls. Migration to urban areas to seek for employment further constrains the labour pool available for farming. Designed SLM interventions will need to take these prevailing circumstances into consideration for the majority of people rely on land derived resources.

2.1.3 Economic activities in the area

The nature of livelihoods in the survey area is important in determining the land and natural resource pressures. The diversity of economic activities in an area shows the potential for income stream augmentation and synergies relieving exploitation pressures on land and other natural resources. The majority of respondents relied on farming placing pressure on the environment through crop and animal farming. From this survey, the majority of the respondents were farmers and there was low diversification of socioeconomic activities with very few people engaged in business, employment or any other source of livelihood activities. The predominant land use is mixed farming in Iria-itune, Kirie and Nthawa at 91.8%, 96.6% and 87.3% respectively (Table 1c). The other proportion of respondents carried out crop farming with only a few undertaking livestock rearing. The prominence of these two types corresponds to cultural practices and climatic conditions in Mbeere.
Assets ownership and control was wholly vested in men at 100% and women at 66% and as such, interventions that would require asset acquisition and deployment should focus more on men.

Combining crops and livestock also has the potential to maintain ecosystem function and health and help prevent agricultural systems from becoming too brittle, or over connected, by promoting greater biodiversity, and therefore increased capability to absorb shocks to the natural resource base (Holling, 1995).

Environmentally, mixed farming systems:

- Maintain soil fertility by recycling soil nutrients and allowing the introduction and use of rotations between various crops and forage legumes and trees, or for land to remain fallow and grasses and shrubs to become reestablished;
- Maintain soil biodiversity, minimize soil erosion, help to conserve water and provide suitable habitats for birds;
- Make the best use of crop residues. When they are not used as feed, stalks may be incorporated directly into the soil, where, for some time, they act as a nitrogen trap, exacerbating deficiencies. In the tropical semi-arid areas, termite action results in loss of nutrients before the next cropping season. Burning, the other alternative, increases carbon dioxide emissions; and
- Allow intensified farming, with less dependence on natural resources and preserving more biodiversity than would be the case if food demands were to be met by crop and livestock activities undertaken in isolation.

Crop-livestock systems can separate into specialized crop or livestock activities. If there are improved market opportunities, and as human population pressures continue, which is the case in many developing countries, the arable land part of the system will experience increased rates of nutrient depletion (and therefore flora and fauna biodiversity loss) and soil erosion. This can, in turn, lead to a downward spiral of mono-culture with lower quality food crops, increased under-nutrition and famine (Cleaver and Schreiber, 1994; Christiansen et al., 1995).

**2.1.4 Household head occupation**

Household head occupation consisted of agricultural produce at 31.5%, on farm casual 26.2% other casual work 13.7%, livestock production 11.3%. Other occupations were permanent employment, charcoal production and business at 5.7%, 3.2% and 6.1% respectively. The low levels of wage-based employment diminish the capacity to mobilize financial alternative financial resources and increasing dependence on the land and natural resources. This renders the communities, especially the poor, highly vulnerable to multiple adverse effects.
<table>
<thead>
<tr>
<th></th>
<th>Crop farming</th>
<th>Mixed farming</th>
<th>Pastoral production</th>
<th>Trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-Itune</td>
<td>6.99</td>
<td>91.82</td>
<td>1.26</td>
<td>0</td>
</tr>
<tr>
<td>Kirie</td>
<td>2.45</td>
<td>96.57</td>
<td>0.49</td>
<td>0.49</td>
</tr>
<tr>
<td>Nthawa</td>
<td>10.68</td>
<td>87.38</td>
<td>1.94</td>
<td>0</td>
</tr>
</tbody>
</table>

**Table 1c:** Main economic activities undertaken by respondents in the target area

2.1.5 Farm size
There was a significant difference in farm size between the three areas in Mbeere when an ANOVA test was performed (F= 3.524, p<0.050). Most of the respondents had parcels less than 5 acres and a small proportion had >10 acres as shown in Figure 2. In Iria-Itune there was a considerable number of respondents who owned >10 acres (17.3%) as compared to the other areas. Few respondents possessed large parcels indicating that land size a crucial factor in the target areas. Given the small size of the plots, farmers would not ordinarily adopt the option of diversifying, accounting for the decreasing land productivity. Growing population pressures exacerbates this problem, which leads to further sub-division and unsustainable livelihoods and environmental degradation.

Women had the highest access to land compared to men and youth. Control over the resource was vested in men at 66% implying that any SLM intervention which have to involve the men and women.

![Figure 2: Farm size in the study area](image-url)
2.2 AGRICULTURE

2.2.1 Agriculture background

The predominant land use type in Mbeere is agriculture (Livestock keeping, crops production and Agroforestry). The food crops grown are; maize, beans, sorghum, pearl millet, cowpeas, green grams, cowpeas, mangoes, pawpaw, kales, tomatoes grown both for sale and consumption while the cash crops are cotton and proso millet.

The major constraints faced by farmers in crop production are low and erratic rainfall, low soil fertility, high cost of farm inputs, pests, poor infrastructure and lack of markets. The other limiting factors are exploited by brokers, inadequate extension services and lack of storage facilities resulting in huge post-harvest losses.

The average farm sizes in the area are 2-5 acres which are individually owned and are used for mixed farming. The alternative suggestions for land use in the area include, Agroforestry, poultry production, horticulture and planting high value crops and bee keeping. The communities are hindered from adopting the suggested land use plans by lack of funds, inadequate water resources, lack of technical know-how, trained personnel in the area are few, and cultural attitudes towards some practices. There are no land use plans in the area but in Siakago division there are some ongoing programs like SHDP whose implementation plan is from 2008-2013, NMK which is a continuous program, ASDSP implementation period 2012-2017, Traditional high value crops project which is continuous and upper Tana catchment NRM to be implemented in five years.

Plate 2 Arable land suitable for agriculture are being converted into Miraa compromising nutrition and consequently food security in the area.
2.2.2 Crop Production

The crops grown in the area are as shown in Figure 3 and comprise of maize, beans, cowpeas, green grams, millet, sorghum, nuts, tobacco and miraa. Maize is the most widely grown crop with 568 of the total respondents indicating its cultivation, compared to nuts with only 5 respondents cultivating it. Among the legumes, 203 respondents cultivate beans, with 423 growing cowpeas and 305 growing green grams. Other widely grown crops were sorghum and millet with 286 and 367 respondents respectively.

![Figure 3: The proportion of crops grown in the study area](image)

Comparison of the crops grown in the three areas showed that most respondents from Iria-itune rated maize as the most popular crop. In Kirie, especially maize and cowpeas recorded the highest scores (Fig 3). While in Nthawa beans and maize were the most grown crops. Nuts, pigeon peas, tobacco and miraa recorded relatively higher scores in Nthawa than in other areas.

The high number of respondents producing sorghum and millet in the area could be attributed to crops such as maize failure to perform well and due to their fairly high tolerance to dry conditions, farmers in these regions may find better use of their farms.

Control over food crops and access was in the hands of women with men only having a moderate control at 66%. Food insecurity issues and projects should therefore target the women who also were in charge of nutrition and poultry. SLM interventions affecting food security and income based on food crops have to take into account the predominant role of women in this area.

2.2.3 Crop Yield

Change in climatic conditions in the area has affected the production of maize, beans, sorghum, and green grams leading to decrease in amounts produced due to low rainfall levels that are erratic in nature and soils becoming infertile (plate 3). This has led to changes in crops grown since 2009 reported officers in Siakago. In Nthawa location for example, cowpeas and green
grams replaced beans from 2000 acres to 1500 acres and sorghum replaced maize from 3000 acres to 2000 acres. Tissue culture bananas have also been introduced in the area while the yellow passion is replacing the purple passion. The reasons for the change in crop type according to the farmers is that; the new crops are more drought tolerant, diversification purposes, the introduction of irrigation schemes and high pest and disease infestation on the former crops. In Ishiara location, the officer noted that overgrazing and charcoal burning have played a role in climate change.

Plate 3: Failed millet and maize crop due to extreme dry conditions

Data on crop yield over five years from the household survey is shown in the table below. Bumper harvests by the respondents were realized only in 2007, with the lowest harvests in 2010 corresponding to a prolonged drought. This indicates that food security is highly variable with some periods being food deficit (Table 2).

Table 2: Average annual crop yield (kilograms) in the study area

<table>
<thead>
<tr>
<th>Type of crop</th>
<th>2011</th>
<th>2010</th>
<th>2009</th>
<th>2008</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>159</td>
<td>116</td>
<td>123</td>
<td>109</td>
<td>173</td>
</tr>
<tr>
<td>Beans</td>
<td>105</td>
<td>79</td>
<td>82</td>
<td>77</td>
<td>82</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>87</td>
<td>63</td>
<td>72</td>
<td>68</td>
<td>85</td>
</tr>
<tr>
<td>Green grams</td>
<td>66</td>
<td>60</td>
<td>58</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>Millet</td>
<td>105</td>
<td>72</td>
<td>68</td>
<td>71</td>
<td>90</td>
</tr>
<tr>
<td>Sorghum</td>
<td>94</td>
<td>74</td>
<td>58</td>
<td>67</td>
<td>95</td>
</tr>
<tr>
<td>Nuts</td>
<td>42</td>
<td>43</td>
<td>27</td>
<td>47</td>
<td>23</td>
</tr>
<tr>
<td>Peas</td>
<td>47</td>
<td>42</td>
<td>41</td>
<td>47</td>
<td>59</td>
</tr>
<tr>
<td>Tobacco &amp; miraa</td>
<td>572</td>
<td>412</td>
<td>705</td>
<td>1216</td>
<td>2889</td>
</tr>
<tr>
<td>Total</td>
<td>1277</td>
<td>961</td>
<td>1234</td>
<td>1772</td>
<td>3571</td>
</tr>
</tbody>
</table>

The general crop yields are shown in table 2 above. Interventions on increased food security in the areas are therefore a priority. The more productive areas will need interventions on sustainable high production, value addition and diversification. The income from food crops to respondents' households are shown in Table 3 below.

Table 3: Average estimated income from crop sale (Shs) in the study area
Majority of the respondents stated they usually have food in the store in the months of February-August, with the highest number having food in the months of March, February, July and April. The months of September – December is when there is least food in the store, the worst month being October (Figure 4).

### Table 2.1

<table>
<thead>
<tr>
<th>Type of crop</th>
<th>2011</th>
<th>2010</th>
<th>2009</th>
<th>2008</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>3096</td>
<td>2103</td>
<td>3210</td>
<td>1892</td>
<td>3831</td>
</tr>
<tr>
<td>Beans</td>
<td>2042</td>
<td>1786</td>
<td>1603</td>
<td>1006</td>
<td>1249</td>
</tr>
<tr>
<td>Cowpeas</td>
<td>2827</td>
<td>2584</td>
<td>2483</td>
<td>3034</td>
<td>3896</td>
</tr>
<tr>
<td>Green grams</td>
<td>3447</td>
<td>3345</td>
<td>3163</td>
<td>3234</td>
<td>4136</td>
</tr>
<tr>
<td>Millet</td>
<td>2701</td>
<td>2178</td>
<td>2512</td>
<td>2347</td>
<td>2596</td>
</tr>
<tr>
<td>Sorghum</td>
<td>2336</td>
<td>2089</td>
<td>1682</td>
<td>2294</td>
<td>2885</td>
</tr>
<tr>
<td>Nuts</td>
<td>0</td>
<td>320</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Peas</td>
<td>370</td>
<td>70</td>
<td>85</td>
<td>50</td>
<td>45</td>
</tr>
<tr>
<td>Tobacco &amp; miraa</td>
<td>24333</td>
<td>19166</td>
<td>11600</td>
<td>20400</td>
<td>15800</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>41152</td>
<td>33641</td>
<td>26338</td>
<td>34257</td>
<td>34438</td>
</tr>
</tbody>
</table>

#### 2.2.4 Food storage

Comparison between the areas showed in Iria-itune February, March and July are the months when the majority of respondents has food in the store (50.7%, Figure 3). 57% of households in Kirie have food in the store in March, April, February and May. In Nthawa, October is the month when no one has food in the store. 32 respondents stated they never have food in the store and another 19 had food over a year ago. A few household had food in the store all year round.
2.2.5 Food processing
There were fewer respondents, 11.4%, who undertook value addition in the area. The type of processed food includes fruits (mangoes, pawpaw, watermelon and lemon), cereals and vegetables, although processing method was not indicated. In Kirie there was no food processing. Water shortage, lack of fruits and knowledge/skills were the most frequently cited constraints to food processing, accounting for 83.3% of the respondents. Other constraints such as lack of finances, processing facilities, old age and lack of market accounted for about 16.7% of the constraints responses reported.

Comparison of constraints by area revealed that most respondents felt that water shortage was the major constraints in food processing in all areas. Lack of skills/knowledge was considered a threat to food processing in Kirie while in Iria-itune and Nthawa lack of fruits were rated as the second greatest impediment.

2.2.6 Water and soil conservation
Water and soil conservation is important because there are two key components to sustaining life and more so since the area has a fragile environment. The respondents were asked about soil and water conservation activities that they undertake on their farms (Table 4). The low levels of soil and water conservation needs to be taken into account as part of SLM interventions.

<table>
<thead>
<tr>
<th>Measures in the study area.</th>
<th>Surface water harvesting</th>
<th>Irrigation</th>
<th>Terracing</th>
<th>Farm records</th>
<th>Crop rotation</th>
<th>Composting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>18</td>
<td>6</td>
<td>84</td>
<td>16</td>
<td>87</td>
<td>51</td>
</tr>
<tr>
<td>No</td>
<td>82</td>
<td>94</td>
<td>16</td>
<td>84</td>
<td>13</td>
<td>49</td>
</tr>
</tbody>
</table>

2.2.6.1 Water harvesting
Surface/road water harvesting was done by 25% and 23% in Iria-itune and Nthawa respectively, but only 4.5% of the respondents' community members harvested water in Kirie. Overall there were few people practicing water harvesting in the study area (Table 4).

Lack of skills/knowledge and accessibility were mentioned as the major hindrances to water harvest in all the areas studied especially in Kirie with 85% being the main reason for not harvesting.

Other reasons for not harvesting water were financial constraints, water quantity, and lack of storage facilities with 9.4%, 6.5% and 4.5% respectively. Some of the respondents said they are not interested while others did not see the need with 5.8% to harvest water.
2.2.6.2 Terraces
Assessment on terracing among the people indicated 84% of the respondents practiced terracing. However, only 31% of them had their land wholly terraced while 69% had it partially terraced. Kirie had the majority of the respondent undertaking terracing at 93% while in Iria-itune and Nthawa had 80% and 79% respectively. Finances, Land quantity/quality and lack know how were the biggest constraints in practicing terracing accounting for 83% of the respondents. Constraints such as use of alternative method, planning to, combined accounted for about 17% of the constraints reported. Land quantity/quality constraints included reasons like land is flat or rocky and small farm size.

2.2.6.3 Crop rotation
The respondents within the study area know the importance of crop rotation with 87% practicing it and only 13% not undertaking it. The reasons for not practicing crop rotation were stated as low yields, farm size, subsistence farming and respondents who do not practice agriculture. Low yield and farm size accounted for the 90% of the reasons given. It is apparent that the size of the farm plays a big part in making the decision to crop rotate or not.

2.2.6.4 Composting
51% of the respondents practiced composting and the other half did not. Lack of knowledge/skills was mentioned as one of the major reasons for not composting in all the areas studied especially in Kirie with 83.9% citing it to be the problems. In Nthawa 40.1% of the respondents do not use compost because they use fertilizers/manure. In Iria-itune major reasons for not using compost were; they use manure/fertilizers, lack knowledge/skills to prepare it as well as inadequate materials all combine accounting for 90.2%. The other reasons for not composting were given as that it is time consuming and that the land is fertile as shown in figure 5.

![Composting Graph](image)
2.2.6.5 Other soil and water conservation measures

Due to the dry condition in the study area water and soil conservation is important if the resource use has to be sustainable (Plate 4). The majority of the respondents used cover crops and gabions as a soil conservation measure. Presence of gabions in the area was said to be embellished and did not represent a true picture during validation. The other measures undertaken were Planting grass strip and trees, contour farming, use of manure, water storing and cropping systems (Figure 6).

![Graph showing soil and water conservation measures](image)

**Figure 6:** Soil and water conservation measures undertaken by respondents in Mbeere North.

In Iria-itune, the major soil conservation measures undertaken were planting cover crops and grass strip and making gabions all accounting for 64.4%. Gabions and planting cover crops were the measures taken by Kirie accounting for 90.7%. In Nthawa, the respondents practiced planting cover crops, grass strips and trees with 70.5%. The least used measure in all areas was water storing and using manure.
2.2.7 Irrigation

There is little irrigated agriculture in the district except in Iria Itune location. In the micro irrigation schemes, the crops grown are tomatoes, watermelons, tissue culture bananas, French beans, kales, passion fruit and green maize. Introduction of micro-irrigation schemes in the area is hindered mainly by lack of adequate water sources, soil types, high initial cost of installation and cultural/social practices and attitudes. It is recommended that micro-irrigation schemes should be established along permanent rivers Ena, Thuci or Tana, where soils are appropriate. The water for this project in the area would either be sourced from rivers and springs, wells, surface water harvesting or roof catchment. Some officers indicated that use of water for agriculture would induce conflicts with livestock keepers but would be resolved through dialogue. Apart from Iria Itune, all the other locations have the potential for irrigated especially along River Ena and Tana that are permanent water sources and there are good soils for irrigation. The most suitable crops in the micro-irrigation schemes would be tomatoes, green maize and melon which have high returns and have ready market; Vegetables that will improve the nutritional status of the community; bananas which have low labour requirement; French beans since markets can be organized and fruits like passion and pawpaw that are disease tolerant and have quick returns.

At the household level, 94% of the respondents in the area do not irrigate their crops with only 6% undertaking irrigation. Out of the 21 respondents who practice irrigation; 3 of them used drip irrigation method, 7 flood method and 11 spray method.

Information on why respondents do not practice irrigation showed that insufficient water is the main reason with 69%, followed by lack of knowledge/ skills with 20%. Lack of tools/materials for irrigation, financial constraints and land quality/quantity were some of the other reasons given by the respondents having 6.6%, 2.9%, and 1.9% respectively (figure 7).
Comparison of the reasons why the respondents in the three locations do not practice irrigation showed water as the major culprit. In Kirie lack of knowledge/skills was stated as an impediment to irrigation. Nthawa rated Lack of irrigation materials and tools as the second major reason (fig 7).

### 2.2.8 Farm records

The majority of the farmers do not keep farm records; only 16% do as shown in table 4. Out of 84% of the respondents who do not keep farm records; 52% stated lack of knowledge/skills as the reason why they do not. While 37.7% stated low yields as reason and 7% said they did not see its importance. 3.3% stated they had never thought of it (Figure 8).

There is need to train farmers on how to keep farm records, its importance so as to improve their income and for accountability purposes cause as indicated in figure 8, the majority do not know how to do it.
Figure 8: Reasons advanced for not keeping farm records

2.2.9 Storage facilities
The presence of a grain store in the study area was investigated as it is an important insurance against hunger and food shortages. 45% of the respondents had storage facilities with the rest, 55%, did not. Reasons for lack of storage facilities ranged from low yields, finances and security as the biggest hindrance, while others store food in the house, are not yet fully settled and lack of space for construction of storage facilities (Table 5).

In Iria-itune and Nthawa, insecurity was rated high than in Kirie at 14.3%, 18.8% and 5.9% of the respondents respectively (table 5). There was a high number of people storing food in the house in Nthawa (17.2%) than in other areas.

Table 5: Proportion of respondents and reasons for not having crop storage facilities

<table>
<thead>
<tr>
<th></th>
<th>Low yield</th>
<th>Security</th>
<th>Store in the house</th>
<th>Financial</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>49.7</td>
<td>14.3</td>
<td>7.9</td>
<td>20.6</td>
<td>7.5</td>
</tr>
<tr>
<td>Kirie</td>
<td>42.6</td>
<td>5.9</td>
<td>10.3</td>
<td>30.9</td>
<td>10.3</td>
</tr>
<tr>
<td>Nthawa</td>
<td>34.4</td>
<td>18.8</td>
<td>17.2</td>
<td>23.4</td>
<td>6.2</td>
</tr>
</tbody>
</table>

2.2.10 Harvest threats
Storage losses were one of the major constraints to those farmers who produce sufficient for their domestic needs and would want to wait for better prices, and would like to store are clearly experiencing problems in doing so, largely as a result of the arrival of the lesser grain borer (LGB), a pest whose attack is both unpredictable and devastating. Pests, diseases and rodents were the second greatest threat to harvest at 23.3 % and 16.6% respectively. Other threats to harvest were; rainfall, termites, borers, theft, poor storage facilities, financial and theft all combined accounting for 28.8%. (Table 6)
Table 6: The proportion of respondents citing threats to their harvest by area

<table>
<thead>
<tr>
<th></th>
<th>Weevils</th>
<th>Rodents</th>
<th>Pest &amp; diseases</th>
<th>Termites</th>
<th>Rainfall</th>
<th>Borers</th>
<th>Financial</th>
<th>Theft</th>
<th>Poor storage facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>34.6</td>
<td>24.5</td>
<td>23.3</td>
<td>8.6</td>
<td>1.4</td>
<td>4.9</td>
<td>0</td>
<td>2.6</td>
<td>0</td>
</tr>
<tr>
<td>Kirie</td>
<td>22.7</td>
<td>11.3</td>
<td>24.5</td>
<td>4.5</td>
<td>15.2</td>
<td>5.6</td>
<td>0</td>
<td>1.7</td>
<td>14.5</td>
</tr>
<tr>
<td>Nthawa</td>
<td>39.6</td>
<td>15.8</td>
<td>21.7</td>
<td>2.2</td>
<td>11.5</td>
<td>1.5</td>
<td>4.0</td>
<td>3.7</td>
<td>0</td>
</tr>
</tbody>
</table>

Poor storage facility was only a reason in Kirie while finance was only a constraint in Nthawa as shown in Table 6.

2.2.11 Meteorological data
The climate of Mbeere District is characterized by unpredictable and erratic rainfall interspersed with drought periods of variable longevity. Access to weather forecasts by farmers would contribute immensely to efficient food production and crop loss avoidance. Majority of the respondent stated they do not use meteorological forecasting in determining when to grow crops. They gave the reason for not using meteorological data as being unreliable, inaccessible and that they use indigenous knowledge to determine weather. The ones that use meteorological data use it to determine when to plant and type of crop to plant (Figure 9).

**Figure 9:** Use of meteorological data in different divisions of Mbeere North

A good number of the respondent gave reasons for using or not using meteorological data as to know when to plant and it is unreliable. Especially in Nthawa, 49%, of respondent use meteorological data to know when to plant and which crop to grow while in Kirie 61% say it is unreliable. 20% of the respondents in Iria-itune used indigenous knowledge to determine weather patterns as compared to 6% in Kirie and 12% in Nthawa.

2.2.12 Government extension services
Skill and knowledge are critical in the management of fragile ASAL ecosystems. To achieve the objectives of SLM interventions, farmers and pastoralists have to be equipped with on land management and livestock husbandry. There are several GoK line ministries with extension officers on the ground for sectors such as livestock, agriculture, veterinary, forestry, water, education, sanitation and health and drought monitoring amongst those with SLM oriented activities. The officers render extension services and training to the community as indicated during key informant discussions. A major problem in extension services provision was reported as staff inadequacy, lack of facilities, financial hindrances and in some cases community attitudes.

When asked if they have benefited from government extension services, 61.5% of the respondent stated yes while 38.5% said no. In Kirie location, more respondents at 78% have benefited from these services as compared to 52% and 56% in Iria-itune and Nthawa respectively. Majority of the respondent stated they have received these services 1-2 years ago (65.5%), followed by those who stated they received this year (2012) with 32.2%. The knowledge obtained from extension services was stated to be; improved crop farming and better crop disease/pest management. Others reported accessing better seed varieties, knowledge on soil/water conservation, animal husbandry, marketing farm produce and good storage (Table 7).

Table 7: Information and services obtained from GoK extension services in Mbeere North

<table>
<thead>
<tr>
<th></th>
<th>Soil/water conservation</th>
<th>Seed varieties</th>
<th>Crop diseases &amp; pests</th>
<th>Improved crop farming</th>
<th>Animal husbandry</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>17.9</td>
<td>24.1</td>
<td>2.1</td>
<td>36.4</td>
<td>4.6</td>
<td>14.9</td>
</tr>
<tr>
<td>Kirie</td>
<td>7.6</td>
<td>12</td>
<td>40.8</td>
<td>35.9</td>
<td>1.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Nthawa</td>
<td>19.2</td>
<td>27.4</td>
<td>8.2</td>
<td>31.5</td>
<td>6.8</td>
<td>6.8</td>
</tr>
</tbody>
</table>

It is apparent that the government has put some effort in improving crop farming in these areas by disseminating the information through extension services. This might boost the community knowledge and contribute to food security in the area. In Kirie, 41% of the respondents stated that they learnt about crop diseases and pests, prevention, identification and treatment as shown in Table 8. The respondents stated they were taught about the importance of using certified seed, a variety of seeds suitable for the area and planting disease and drought resistant crops.

2.2.13 Sustainable Land Management training (SLM)
The SLM project aims to instill knowledge based sustainable land management practices in the pilot districts. The community consultations showed that SLM management aspects were fragmented under diverse sector initiatives, reducing their impacts and prominence on the ground. At household level 82% of the respondents stated that they have not received any
training on SLM. Out of the 18% who were trained on SLM; 72.3% were trained in soil conservation, 20.2% on improving farming methods and only 7.5% on the importance of using manure. Some of the soil conservation measures impacted were digging terraces, crop rotation, maintaining soil fertility and planting trees.

2.2.14 Improving crop production

In the key informant and community consultation sessions, the factors contributing to low agricultural production were enumerated and they spanned climatic, pests and diseases, financial, agricultural practices, skills and knowledge and availability of appropriate seeds and varieties. Addressing these issues would considerably boost crop production and alleviate constantly looming famine.

On household level, the respondents were requested to give measures they professed essential in improving crop production. Provision of water was stated to be important in enhancing crop production as the District is an ASAL area and successful irrigation would require adequate water resources. A good number of the respondent would want to be taught in appropriate farming methods for the area, soil conservation, sustainable land use. Offering extension services would be helpful to the farmers especially in pest and disease control, identification and treatment (Table 8). Other ways to improve production were stated as use of manure /fertilizer, provision of farm inputs, better seeds and improved farming methods. The respondent said there is need to avail certified and drought resistant seeds to the farmers both physically and financially.

Table 8: Proportion of respondents indicating the requirements for food production enhancement in Mbeere District

<table>
<thead>
<tr>
<th></th>
<th>Use manure/ fertilizer</th>
<th>Educating farmers</th>
<th>Farm inputs provision</th>
<th>Soil conservation</th>
<th>Water Provision</th>
<th>Better seeds</th>
<th>Improved farming</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>15.5</td>
<td>14.5</td>
<td>11.4</td>
<td>7.7</td>
<td>40.4</td>
<td>2</td>
<td>5</td>
<td>3.4</td>
</tr>
<tr>
<td>Kirie</td>
<td>11.6</td>
<td>21.7</td>
<td>8.1</td>
<td>20.4</td>
<td>29.5</td>
<td>1.8</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Nthawa</td>
<td>18.6</td>
<td>16.2</td>
<td>12.6</td>
<td>7.7</td>
<td>10.4</td>
<td>16.7</td>
<td>17.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

Better seeds and improved farming methods accounted for 34% in Nthawa and were higher in all the three areas (table 9). Provision of water was lowest in Nthawa in comparison to the other areas while Iria-itune had the highest number of 40.4%. Soil conservation was the third most important measure according to Kirie respondents.
SECTION THREE: LIVESTOCK AND OTHER ANIMAL BASED PRODUCTION

In Mbeere district, 70-90% of the people in this region are sedentary agro-pastoralists, who rear beef cattle, dairy cattle, dairy/local goats and poultry majority of which are free range apart from dairy cattle and goats. The profitability of livestock differs with the area with the higher areas benefiting mostly from dairy cows while the lower regions rely on indigenous goats. Farmers in areas with irrigation water grow fodder like Napier, calendar, Rhodes grass for their use or for sale. Zero grazing is more profitable for milk production is higher up ten liters per day as compared to 2 liters produced by free ranging cows. The pasture land is not enough for all the free ranging livestock and this leads to overgrazing, land degradation and soil erosion, loss of indigenous tree species and conflicts over pasture and water resources.

Livestock farmers in this area are faced with constraints like frequent droughts, high cost of animal feed, poor breeds, pests, diseases and inbreeding. There is little intervention by the government during severe drought by providing livestock relief.

The livestock in this region is grazed on foot of hills as farmers rarely grow fodder on their farms. Livestock farmers are constrained by the large herds they keep and pasture is not enough (plate 5a &5b), erratic and low rainfall experienced in the region and poor quality ranges for grazing. This has necessitated livestock relief and off take interventions in the area from the government.

The range area in this region is inadequate with over 50% of pasture degraded. To avoid overexploitation by overgrazing, there are pastures like *Cenchrus ciliaris* and *Eragrostis superba* in Karambare, Kathanje, Kirie, Mutitu, Gitiburi and Muminji which can be domesticated to supplement natural pasture. There are efforts to rehabilitate the range in Kiangombe, Mutitu, Karamburi, Kiria, Iria itune, Ndurumori and Muminji through reseeding in approximately 10 acres of land.

During the dry season, some parts of the district experience an influx of livestock from neighbouring districts transiting to highland areas. This influx results in the transmission of pests and diseases (CBPP, CCPP, PPR, and FMD), conflicts over pasture and overgrazing. The impact has been severe in the region affecting the quality and quantity of water, animal health and productivity, and increase in pest incidences leading to losses of up to 40%. This resulted in years with intense prolonged droughts witnessing a decline in numbers especially 2010 and 2011. Cattle are usually affected for prolonged periods compared to goats which are able to recover after short periods as shown in Figure 10a and 10b.
Figure 10a: Cattle trends in Mbeere North from 2007 to 2011

Figure 10b: Number of sheep and goats and sheep in the Mbeere North District

Plate 5a and 5b: 5a showing a goat trying to reach for fodder while 5b shows fodder stored in a tree to avoid termite destruction.
3.1 LIVESTOCK TYPES
The types of livestock reared by respondents at household level comprised of goats, cattle, poultry, sheep, and donkey. Only a few individuals indicated pigs as forms of livestock (Figure 11:Plate 6).

![Figure 11: Livestock types reared by farmers in the study area](image)

The highest number, 699 respondents, had cattle; indigenous livestock owners were 109, while dairy cow owners were 275 and 315 respondents listed bull as their cattle. Across Mbeere North, local cattle breeds were more in Nthawa with 20.3% of respondents having them and the distribution of bulls in the three areas was relatively similar with Iria-itune having 12%, Kirie with 17% and Nthawa with 18%. Iria-itune and Kirie had the highest numbers of dairy cows and the lowest number was in Nthawa with 15%, 17% and 2% respectively. The predominance of indigenous cattle in Nthawa may accrue from cultural norms and as an adaptation to the harsher livestock production environment prevailing in this region, with a preference to the hardy low maintenance indigenous breeds.

The number of livestock in the target area is variable as shown in table 9. The highest number of livestock is found in the Iria-itune and Kirie areas. Lower numbers of livestock in the Nthawa indicate challenges in livestock production with implications on livelihoods, nutrition and improved organic farming that may utilize animal manure. The challenges in the arid areas for livestock production needs to be addressed as they impact on other aspects of the survey and their resolution will in build interactions into other interventions that will be designed. The highest number of livestock in all the areas is goats and poultry and the lowest is pigs (Table 9).
Table 9: Livestock numbers reported by respondents in the study areas of Mbeere

<table>
<thead>
<tr>
<th></th>
<th>Local cattle</th>
<th>Donkey</th>
<th>Goats</th>
<th>Sheep</th>
<th>Bulls</th>
<th>Pigs</th>
<th>Poultry</th>
<th>Dairy cows</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>72</td>
<td>164</td>
<td>1575</td>
<td>417</td>
<td>157</td>
<td>3</td>
<td>1075</td>
<td>294</td>
<td>3757</td>
</tr>
<tr>
<td>Kirie</td>
<td>51</td>
<td>4</td>
<td>1913</td>
<td>527</td>
<td>134</td>
<td>21</td>
<td>608</td>
<td>383</td>
<td>3793</td>
</tr>
<tr>
<td>Nthawa</td>
<td>203</td>
<td>148</td>
<td>418</td>
<td>13</td>
<td>146</td>
<td>25</td>
<td>1264</td>
<td>16</td>
<td>2081</td>
</tr>
<tr>
<td>Total</td>
<td>336</td>
<td>320</td>
<td>3906</td>
<td>957</td>
<td>437</td>
<td>49</td>
<td>2947</td>
<td>593</td>
<td>9631</td>
</tr>
</tbody>
</table>

Plate 6: Showing different types of livestock at a watering point

3.2 CROSS BREED

Cross breeds combine aspects of hardiness of the indigenous stock and higher yield from exotic breeds. Improvement in livestock productivity is enhanced by taking the resilience and productivity of the two types. The issue of crossbreeds was investigated at the household level through the questionnaire administered in the SLM target areas. only 26 respondents had cross breed cattle. The number of respondents with cross breed cattle in the area is 44. The total amount of milk produced is 109.5 litres and the average milk yield per cow is 4.9 litres. The greatest number of respondents did not practice Zero grazing in the area and neither did they have improved pastures or paddocks for their livestock (Table 10). Financial constraints and lack of knowledge about cross breed maintenance were the reasons majority gave for the lack of cross breed cattle with 51% and 18% respectively. The other reasons were stated as water and fodder shortage, lack of breed to interbreed and environment being not conducive accounting for 14%, 12% and 5.3% respectively.
Table 10: Improved cattle keeping and alternative animal production in Mbeere North

<table>
<thead>
<tr>
<th></th>
<th>Cross-bred</th>
<th>Zero grazing</th>
<th>Pasture plots/paddocks</th>
<th>Pasture plots</th>
<th>Improved poultry</th>
<th>Dairy cows</th>
<th>Aqua culture</th>
<th>Bee hives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>No</td>
<td>96</td>
<td>96</td>
<td>99</td>
<td>96</td>
<td>96</td>
<td>91</td>
<td>100</td>
<td>61</td>
</tr>
</tbody>
</table>

Financial constraints, lack of knowledge on cross breed maintenance and lack of breed to interbreed were the three greatest hindrances to why respondents in Kirie did not keep cross breed cattle accounting for 63%, 31% and 21%. In Nthawa and Kirie the greatest impediments were finance (72%, 63%) and water & fodder shortage (21%, 13%). In the entire areas, a less conducive environment was the least of the reasons for not keeping cross breed cattle (Figure 12).

Dairy goats are a recent introduction in the area according to the livestock sector key informants and that might explain why it was not popular in the area with only 41 respondents keeping them (table 11). The total number of dairy goats in the study sample is 78 with an average of 1.8 litres of milk produced per goat per day.

![Figure 12: Reasons advanced for not keeping cross breed cattle by area](image)

The majority of the respondent did not have improved poultry units (Table 11). Only 20 respondents had improved poultry units with an average of 2.5 units. The highest number of improved poultry was 150 and the least was 2. While the highest number of indigenous chickens was 300 and the least being 1. There was a high standard deviation in both the improved and
indigenous poultry. The average estimated annual egg production per bird is 86 with the most productive bird having 720 and the least 0.

3.3 **NON TRADITIONAL ANIMAL-BASED PRODUCTION**

3.3.1 **Aqua culture**
The district has both the capture and aquaculture fishery resources. The capture fishery is more profitable as the harvesting of up to 732,291 kg is done daily from Tana River/dams as compared to 35,491 kg from aquaculture harvested after 7-8 months. Fish farmers feed fish on fish pellets, bran and natural food but are constrained by lack of capital, inadequate water sources and lack of ready markets.

There was no fish farming reported in the household survey. Water and lack of knowledge/skills to keep them were the main reasons why the respondent did not practice fish farming accounting for 51% and 37% respectively. Finances, farm size and no fish species were the other deterrents in fish farming all combined accounted for 12%.

Comparison of the reasons for not practicing fish farming in the three areas showed that respondents in Iria-itune and Nthawa considered water as the greatest impediment while those in Kirie stated lack of knowledge/skills. Financial reason was also more pronounced in Nthawa and Iria-itune than in Kirie (Figure 13).

![Figure 13: Reason proffered for not practicing aqua culture](image)

3.3.2 **Bee keeping**
Bees are important pollinators in the ecosystem and produce honey which is medicinal and source of food. A good proportion of respondents, 39% owned bee hives. The beehives types owned by respondents were log hives 96% (Plate 7b) 3.4% KTBH and 0.4% others (Plate 7a). The average kg of honey harvested per hive per season is 15 with the highest production being
70 and the least 1. 10 respondents stated they have not yet harvested honey. There were more respondents in Nthawa who had KTBH beehives than in any other area as shown in Table 11. Potential apiculture interventions would have to target men as they have the most control and access over honey.

Table 11: Proportion of respondents and the type of beehives owned in the area

<table>
<thead>
<tr>
<th>Area</th>
<th>Long hives</th>
<th>KTBH</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>96.1</td>
<td>3.1</td>
<td>0.8</td>
</tr>
<tr>
<td>Kirie</td>
<td>98.8</td>
<td>1.2</td>
<td>0</td>
</tr>
<tr>
<td>Nthawa</td>
<td>87.5</td>
<td>12.5</td>
<td>0</td>
</tr>
</tbody>
</table>

Carpenters specialized in making improved hives were not known by 97% of sampled household interviewees.

Plate 7a and 7b: types of bee hives found in the area a) top bar hives b) log hives
SECTION FOUR: NATURAL RESOURCES, FOOD SECURITY, CHARCOAL PRODUCTION AND COMMUNITY ORGANISATION

4.1 NATURAL RESOURCES
The natural resources in Mbeere district include rivers, forests, land and hills which benefit the community with water for domestic and livestock, pasture for grazing, firewood and farming. These resources are accessed when needed and on a daily basis for water and firewood. Accessibility of these resources is affected by distances from community land, scarcity of these resources and conflicts over the use of the resources especially during the dry season. The areas mostly affected by the conflicts are Iria itune, Gituriri, Rwanyoga &Maririle Rivers and Kiangombe hills for pasture. These conflicts affect everyone in the community but women are the most affected. When they occur, the conflicts are resolved through the administration offices, peace committees and educating the community on conservation of the environment to avoid scarcity. Other government institutions involved in mitigating the conflicts are NEMA, KFS Agriculture and livestock offices.

Human wildlife conflicts are experienced in community areas of Iria itune and Nthawa locations characterized by crop destruction by wild animals, wild animals killing livestock and snake bites on humans.

SLM activities in the area revolving natural resources are dominated by who have both access and control, whereas pastures were the preserve of men. Firewood collection is the preserve of women. Charcoal is accessed and controlled mostly by men, underlying its importance as a ready cash source. Potential conflicts exist between sustainable charcoal production and firewood collection.

4.1.1 Forest and agroforestry
Mbeere North has diverse forest derived natural resources that include water, honey, wild fruits, medicinal herbs and grass. The community benefits from these resources and uses them as fuel, building material, grazing and medicine. There is frequent community access to the resources but most of the resources are designated as private resources. The general community can only access trust resources but in controlled frequency to avoid destruction. There are challenges in accessing these resources, especially those arising from legislations restricting use of forest resources. Threats to forest based natural resources arise from the fact that they are not replenished at the rate of usage and indigenous trees are becoming extinct with time. Farmers in the area grow multipurpose agroforestry trees for boundary marking and water conservation.

Target areas for agroforestry and afforestation are on farm tree planting to cover 4000ha in 20000 households, Hill top planting for 2000ha and rehabilitation of degraded areas aimed at 120ha. This would however require reinforcement of laws against tree cutting, awareness creation and provision of seedlings for planting. In Nthawa, Ishiara and Siakago locations, there
are farmers involved in carbon trade with up to 3000Ha trees but there are no companies/organizations sponsoring this activity.

The forest benefits farmers through livestock grazing, in forest reservation, especially cattle and goats. In addition farmers grow fodder trees on farm that include Calliadra, mulberry, leucona and combrettum. There is ecotourism potential in the forest reservations such as mountain climbing, camping and scenery watching.

The questionnaire investigated agroforestry practices at the household level. A good number of respondents had planted trees in their farm and only 4.9% had tree nurseries with only 9% being group nurseries. Most on farm trees were exotic trees (Plate 8a and 8b) although there were a considerable number of respondents who planted indigenous trees. In area like Iria-itune and Kirie there were more people with indigenous trees than exotic trees (Table 12).

**Table 12:** Proportion of respondents. and their on farm forestry activities and energy saving devices in Mbeere North District

<table>
<thead>
<tr>
<th></th>
<th>On farm trees</th>
<th>Tree nurseries</th>
<th>Group nurseries</th>
<th>Exotic trees</th>
<th>Energy saving jiko</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Iria-itune</td>
<td>70</td>
<td>30</td>
<td>6</td>
<td>94</td>
<td>8</td>
</tr>
<tr>
<td>Kirie</td>
<td>88</td>
<td>12</td>
<td>4</td>
<td>96</td>
<td>11</td>
</tr>
<tr>
<td>Nthawa</td>
<td>87</td>
<td>13</td>
<td>2</td>
<td>98</td>
<td>10</td>
</tr>
</tbody>
</table>

Plate 8a and 8b shows *Grewia robusta* as some of the exotic tree planted in the area 7b. Some of the alternative Agroforestry methods undertaken by the community using fruit trees.
4.1.2 Energy source

Energy sources in rural areas are ideal indicators of socioeconomic status and pressure on fuel wood sources. Information on energy sources and use are most appropriately captured at household levels and this was included in the questionnaire administered. Information on the energy source used showed that an overwhelming number (90.7%) of respondents use firewood and 5.1% using charcoal. Another source of energy used by a considerable number of respondents was kerosene with 3.5%. Electricity, solar energy and gas were the least source of energy in the area all accounted for 0.6%. None indicated use of biogas.

Comparison of energy source used in the three areas showed there were more respondents in Nthawa who use kerosene (12%) and charcoal (8%) than in other areas (Table 13). Those who stated they used electricity and gas where from Iria-itune though they were only 2 respondents. There was a preponderance for not using energy saving jiko in the area with the greatest number using coming from Nthawa (Table 13).

Owing to the high dependency on trees for firewood and charcoal it is essential to encourage the farmers in the area to venture into Agroforestry and to start using energy saving Jiko.

Table 13: Proportion of respondents and the various energy sources in Mbeere North District

<table>
<thead>
<tr>
<th></th>
<th>Electricity</th>
<th>Solar energy</th>
<th>Gas</th>
<th>Kerosene</th>
<th>Firewood</th>
<th>Charcoal</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>0.3</td>
<td>0</td>
<td>0.3</td>
<td>1.9</td>
<td>93.4</td>
<td>4.1</td>
<td>0</td>
</tr>
<tr>
<td>Kirie</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1.4</td>
<td>93.2</td>
<td>5.3</td>
<td>0</td>
</tr>
<tr>
<td>Nthawa</td>
<td>0</td>
<td>0.9</td>
<td>0</td>
<td>12</td>
<td>77.8</td>
<td>8</td>
<td>1.3</td>
</tr>
</tbody>
</table>

4.1.3 Water Source

The water resources in Mbeere district are rivers, streams, wells, boreholes and earth dams. Most of the water is fresh and is regulated by the Water Resources Regulatory Authority (WRMA). The distance to the water source is huge forcing the community to travel distances of more than 3km in search of water. The water in the district is adequate for livestock and domestic use only during the wet season but is inadequate during the dry season. The water is also not adequate for irrigated agriculture (Plate 9). Due to the high demand upstream thus the community downstream hardly gets enough for their use. The scarcity of water resources causes conflicts in the area which have been reduced through formation of water resources users Associations (WRUAs). The community stores water in tanks and earth/sand dams.
Plate 9: Water access challenges in Kirie with the collapsed sand dam and river bed water sourcing exposing communities to water bourne diseases

The water sources and access points were diverse as shown in Figure 14; plate 10. In Iria-itune, the highest proportions used river water sources while in Kirie and Nthawa; water was sourced from wells and rivers. Boreholes, dams, streams, piped water and rain water harvesting were some of other the water sources the respondents in the area had access to. Boreholes were not popular in Kirie while rain water harvesting was the least source of water in Iria-itune and Nthawa (Figure 14).

Figure 14: Diversity of water sources and access points in study area

An estimate of the distance to these facilities from the respondent's home showed that majority of these water sources were less than 5 Km. In Kirie and Iria-itune the majority stated water sources are 1-5 Kms away. In Nthawa most respondents said water sources were less than 1Km at 63.7% (Table 14). In Iria-itune water facilities were 1-10 Km. It was only in Nthawa that respondents stated the water facilities are within the home compound (Table 14).
Plate 10: Measures implemented to alleviate water shortage in the area by providing tap water

Table 14: Estimated distance from homestead to water facilities in kilometres

<table>
<thead>
<tr>
<th>Location</th>
<th>&lt;1 km</th>
<th>1-5 Km</th>
<th>6-10 Km</th>
<th>Within home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>14.5</td>
<td>63</td>
<td>22.5</td>
<td>0</td>
</tr>
<tr>
<td>Kirie</td>
<td>19.2</td>
<td>72.2</td>
<td>8.6</td>
<td>0</td>
</tr>
<tr>
<td>Nthawa</td>
<td>58.2</td>
<td>26.5</td>
<td>9.7</td>
<td>5.6</td>
</tr>
</tbody>
</table>

Over 81% of all respondents in the area had no access to piped water, with the highest access proportion being in Nthawa at 24.4% and Kirie at 21.5% and the lowest in Iria-itune at 16.1%.

Over half of the respondents did not have roof harvesting tanks, with the highest numbers coming from Kirie at 61.5% and Nthawa at 59.5%.

Location of water points in ASAL areas influences household time budgets and time allocation for other livelihood activities. The majority of the respondent (72%) had to trek between 1 Km to 10 Km to access the closest piped water. In Iria-itune 93% had to travel 1 Km to 25 Km (Table15). It was only in Nthawa that respondents had the water facilities within the home compound and thus making people with access to piped water at less than 1Km at 27.3%, the highest in the area.

Table 15: Estimated distance from homestead to piped water in kilometres

<table>
<thead>
<tr>
<th>Location</th>
<th>&lt;1</th>
<th>1-5</th>
<th>6-10</th>
<th>12-25</th>
<th>Within home</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>7.1</td>
<td>30.5</td>
<td>40.3</td>
<td>22.1</td>
<td>0</td>
</tr>
<tr>
<td>Kirie</td>
<td>17</td>
<td>34</td>
<td>41.8</td>
<td>7.1</td>
<td>0</td>
</tr>
<tr>
<td>Nthawa</td>
<td>21.7</td>
<td>46.9</td>
<td>21.7</td>
<td>4.2</td>
<td>5.6</td>
</tr>
</tbody>
</table>
4.1.3.1 Water coping strategies
To cater for water shortages majority of the respondents fetch from nearby sources especially respondents from Nthawa at 64% and Iria-itune at 54%. In Kirie they cope by reducing the water consumption both in the household and by livestock and by allocating time to fetch water (Table 16). Increasing water source through the digging of boreholes and wells was predominant in Kirie and Iria-itune. Other measures they assumed to cope with water shortages were buying water, using donkey to fetch water and storing water which accounted for 2.3 %, 10.1 % and 12.1% respectively (Plate 11).

Table 16: Various coping strategies adopted by respondents to curb water shortages

<table>
<thead>
<tr>
<th></th>
<th>Nearby sources</th>
<th>Consumption reduction</th>
<th>Boreholes/wells</th>
<th>Buying water</th>
<th>Using donkeys</th>
<th>Water storage</th>
<th>Boreholes</th>
<th>Increase time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iria-itune</td>
<td>53.8</td>
<td>2.5</td>
<td>11.9</td>
<td>1.6</td>
<td>13.2</td>
<td>13.8</td>
<td>3.1</td>
<td>0</td>
</tr>
<tr>
<td>Kirie</td>
<td>17.6</td>
<td>32.2</td>
<td>12.6</td>
<td>2.7</td>
<td>7.6</td>
<td>7.6</td>
<td>0</td>
<td>19.6</td>
</tr>
<tr>
<td>Nthawa</td>
<td>64.1</td>
<td>1.9</td>
<td>2.8</td>
<td>3.8</td>
<td>7.6</td>
<td>19.8</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Plate 11: Some of the water coping strategies adopted by the community

4.1.4 Resources ownership
The community reported that the public owned 44.2% of the resources, individuals 39.9%, government and a group of people owned 15% and 0.8% of the resources, indicating a high sense of ownership of the resources by the community. This provides an opportunity to develop community-based intervention to address issues of quality, quantity, equitable access, conflict resolution and management of these resources. The resources that were reported as owned by the community included water, while those of individuals were land and some water sources and the government owned the forests and some land.
In Iria-itune majority of people believed that most resources are owned by individuals at 42.4%. It was comparatively similar in the three areas as to who owns the resources because most stated community and individuals as the major stakeholders and the government coming as the third.

4.1.5 Environmental challenges
The area experiences prolonged drought leading to low yield or total crop failure. These effects are severely affecting the water quality and quantity in the area, crop diseases and health, planting seasons, livestock productivity and vermin/pests. To cope with the current conditions, farmers have adopted drought tolerant crop varieties, reforestation, use of improved breeds, and applying water conserving practices in their farms. Climate variability has brought up a cascade of other effects like soil erosion, forest fires and loss of species and introduction of new species, pests and diseases in the ecosystem.

The major environmental challenge affecting the community is climate variability which accounted for 71.3% of the respondents followed by crop diseases & pests at 12.8%. Challenges like deforestation, soil erosion, wildlife and lack of pastures accounted for 2.7%, 4.8%, 2.2% and 2.6% respectively. Some of the other challenges mentioned include land infertility, sand harvesting, illicit brew, poor infrastructure, pollution and socioeconomic related issues all combined accounting for 3.7%. Issues like soil erosion and deforestation were more prominent in Kirie and Nthawa than in Iria-itune. While challenges like crop diseases & pests, wildlife and lack of pastures were more noticeable in Iria-itune (Figure 15).

![Figure 15: Environmental challenges faced by the community.](image)

4.1.6 Resource Conflicts and resolutions
Resource conflicts influence sustainable livelihoods, and by considering how managing these conflicts relates to broader collaborative natural resource management approaches might offer a lasting solution. Community-based resource conflicts often have many causes that are closely
linked - some form the core, others are underlying or contributing. The various factors causing conflict can be divided into four principle types: 1) growing competition for natural resources; 2) structural causes; 3) development pressures; and 4) resource management policies, programmes and projects.

From the household survey, the majority of the respondents had not experienced violent conflicts. Of the forty one percent of those who have; 38% stated land as the main cause of these conflicts followed by domestic reasons at 22.8% and thirdly by water at 14.3%. Additional reasons for conflict were pasture, wildlife, sand harvest, food aid and women's groups. Domestic conflicts were prevalent in Kirie with 42.5% respondents While water conflicts were most prevalent in Iria-itune (20.3%) and Nthawa (23%) and least in Kirie at 6.7%. Wildlife conflict and livestock invasion were experienced in Iria-itune and Nthawa but not in Kirie (Figure 16).

![Figure 16: Occurrences of conflicts and their causes in Mbeere north.](image)

Some of the conflict resolution measures used by the community are local authority, courts and elders. A great number use local authority (42.2%) and elders (38%). While the least used is courts at 3.3%. Increasing water sources, scaring animals away and fencing were the other measures given by the respondents accounting for 7.1% and 4.2%. When asked if the measure was effective 76.4% said yes it was while 23.6% said it is not effective. Local provincial authority was perceived to be the most effective by 84% of those who used it.

The communities were asked at the household level the nature of the interventions they would suggest (Figure 17). Provision of amenities like water and extension services by government was the most preferred action across the target area followed by legal/policy actions. Legal and policy actions included proper surveying, clear land boundaries, enforcement of law, proper distribution of resources and government to stop wildlife conflict. A substantive number of respondents felt that improvement of livelihoods and civil education was indeed important to safeguard peace in the community. In Iria-itune, legal/policy action and civil education were
highly ranked, while in Kirie, provision of amenities and improving livelihoods were the most preferred. In Nthawa, action preferred for long term peace is provision of amenities, legal/policy actions and culture & tradition all accounting for 64.4% of the respondents (Figure 17). The other measures the community would like to see were; improving security and forming community based groups to deal with these problems. Managing conflict is one important element to be integrated into a broad framework of collaborative management. Collaborative management is effective when institutions and processes that regulate resource use are able to anticipate and respond to stakeholders’ different interests over resource use, and can seek solutions of mutual gain.

![Nature of interventions desired by the community](image)

**Figure 17:** Nature of interventions desired by the community

### 4.2 FOOD SECURITY ASPECTS

#### 4.2.1 Relief food aspects background

Relief food distribution coverage and frequency in an area mirrors its food security status and crop failure events. The SLM baseline profiled the food security situation in Mbeere area for appropriate interventions to be devised. The key informants consultation revealed that the area is prone to recurrent droughts necessitating widespread interventions targeting a large proportion of the community. The community indicated crop failure is a persistent problem and food acquisition consumes 30% of their income.

#### 4.2.2 Household level food security aspects

Food shortages are most acutely felt and experienced at the household level and this information constituted part of the questionnaire information generation. Food aid reception was indicated by 55.7% of the respondents in the sampled area of Mbeere North. A large proportion of respondents in Kirie (76%) get food aid while in Nthawa and Iria-itune, only 32.2% and 49.2% respectively.
The study revealed that out of the 55.7%, those who receive food aid twice a year were the majority at 49%. 41% once in a three month suggesting that there was reliance on food aid by the communities. The others received every month and once a year at 1.2 % and 8.8 %.

The study showed that the majority of the respondents received food aid in the months of August, September, October and November at 20.6%, 14.7%, 22.6% and 16.9% respectively. February, May, June and those who received all months were the least (Figure 18).

4.2.3 Reasons for relief food interventions
It was found that food shortage was the main reason for food aid in all the areas especially in Kirie and Iria-itune at 99.3% and 97.5% respectively (Figure 19). Thus, it is important to improve food security in these areas by improving farming or diversifying socioeconomic activities. In Nthawa, a substantial number of people receive food aid because of poverty at 14% while others stating it is routine at 6%.

Figure 18: The months in which respondents reported food aid to be received.

Figure 19: Reasons for receiving food aid dependence
4.2.4 Proposed interventions for food security

If these areas are to become food secure, training farmers on appropriate farming methods, provision of water and farm inputs (24%, 23.5% and 16.3%) will play a big role in achieving this goal indicated the respondents. A considerable number stated that storing food (15%) and improved farming methods (5.3%) can help in reducing this dependency. Soil conservation, better seeds, provision of extension services and equitable distribution of resources were some of the measures they would like to be taken all accounting for 11.6%. Financial support (1.9%) and alternative source of income (2.6%) are the least measures the respondents reported.

Respondents in Kirie would like the provision of farm inputs, training farmers and food storage to be the measures taken to reduce food aid dependency (Table 16). While in Iria-itune water and training farmers are what the majority (62%) of them stated would improve food security. Water, training farmers, food storage and provision of farm inputs all at 64.8% are some of the measures respondents from Nthawa would prefer to be taken to curb food aid reliance (Table 17).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Iria-itune</th>
<th>Kirie</th>
<th>Nthawa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of farm inputs</td>
<td>8.2</td>
<td>23.53</td>
<td>11.4</td>
</tr>
<tr>
<td>Water</td>
<td>40.9</td>
<td>10</td>
<td>24.1</td>
</tr>
<tr>
<td>Education on good farming methods</td>
<td>21</td>
<td>27.8</td>
<td>16.5</td>
</tr>
<tr>
<td>Soil conservation</td>
<td>0.7</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Better seeds</td>
<td>5</td>
<td>1.34</td>
<td>2.5</td>
</tr>
<tr>
<td>Food storage</td>
<td>5.3</td>
<td>22.6</td>
<td>12.7</td>
</tr>
<tr>
<td>Alternative source of income</td>
<td>3.6</td>
<td>1.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Improved farming practices</td>
<td>5.7</td>
<td>5.7</td>
<td>2.5</td>
</tr>
<tr>
<td>Extension services</td>
<td>5.3</td>
<td>0</td>
<td>6.3</td>
</tr>
<tr>
<td>Financial support</td>
<td>1.8</td>
<td>1.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Stop discrimination</td>
<td>2.5</td>
<td>0</td>
<td>16.5</td>
</tr>
</tbody>
</table>
4.3 CHARCOAL PRODUCTION

According to KFS officers in the area charcoal production in the area is widespread especially in the Evuore, Kirie, Kiambere where Acacia spp, delonix sp and Combretum spp species are used and produce 4000bags monthly. The trees for charcoal burning sourced from farm and community area, mostly for sale and domestic use. The methods used are indigenous mounds and kilns. The community has formed organizations for charcoal production and they have been trained in charcoal production technology which was conducted locally at home for 2days only.

Charcoal production has immediate impacts on livelihoods as it solves immediate financial needs and helps pay school fees but in the long term it degrades the environment rapidly through deforestation, leading to soil erosion, siltation and declines in pasture yields. The production is not sustainable at current rates and there is a need to improve on production methods. Better technology can be deployed, fast growing trees for charcoal production can be planted and improvements on marketing strategies. The community is unable to benefit from carbon trade as such activities are not yet established in the district.

Thirty percent of the respondents produced charcoal and 70% of them did not. In the three areas the highest number of the respondents produced charcoal for domestic and commercial purposes followed by commercial purposes then domestic use only with percentages of 49%, 43%, and 8% respectively. The majority of them used indigenous trees (90%) to produce charcoal only 10% used exotic trees. The seventeen respondents who used exotic trees came from Iria-itune area while in Kirie and Nthawa, they used exclusively indigenous trees. All respondents used traditional method to produce charcoal.

4.3.1 Charcoaling preferred species and sources

Terminalia brownii (Muruuruku), Delonix elata (Mwarange), T. perioloidis (Mutororo) and Acacia spp. were the most preferred species for charcoal production at 21%, 17%, 15% and 13% respectively. Other species that were mentioned considerably often were Neolonia sp., Eucalyptus, Ficus thoningii, Tarmirindus indica and Combretum sp. The list of species used for charcoal production in the study areas is given in appendix 1; with their local names, scientific name and number of mentions.

A great proportion of the respondents (84%) said they prefer a particular species because it produces the best quality of charcoal followed by those who stated availability as the reason for preferring (14%) and finally it’s marketed at 2%.

Comparison of reasons for preference of a particular species within the areas showed that there were more respondents in Kirie who stated availability (22%) than in Nthawa and Iria-itune which had 14% and 12% respectively.

In all the areas the charcoal producers harvest trees from own farm with the highest number coming from Kirie at 100% followed by Nthawa at 95% finally Iria-itune at 77%. Eighteen
percent of the charcoal producers in Iria-itune harvest trees from communal land while the rest buy trees from their neighbors or brokers. In Nthawa, 5% stated they get trees from the forest.

4.3.2 Charcoal sale points
The majority of the respondents sells their charcoal within the village 58% (plate 12) followed by those who sell in the nearby urban centers at 23% and finally by those selling in the main market at 19%. Ninety four percent of the charcoal producers sell their produce individually only 6% sell through a partnership. It was only in Kirie and Iria-itune that they sold their produce through a partnership. In Iria-itune a total of 208.5 bags were produced per week while in Kirie and Nthawa, it was 168 and 18 bags respectively.

Plate 12: Roadside salepoint for charcoal

4.3.3 Charcoal association
Friends of Kiangombo in Ndurumori is a registered group dealing predominantly with charcoal in Mbeere North. This group is trained on charcoal production technology and sustainable land use by KFS. There is also an NGO that promotes sustainable land use management (Carbon Mania) that deals with energy saving jikos in this area.

Only seven respondents stated they belonged to a charcoal association and none of them stated the name of their organization, which year it was formed, members’ composition & number and presence of official or even reasons for lack of officials. Out of the seven, three said their chairman is called Emilio Njue Ngari and election of officials is by secret ballot. None of the organization was registered and all used traditional method to produce charcoal. They also indicated that they have neither received training on sustainable charcoal production nor carbon financing from any organization or government. They also said they do have group nurseries and did not list the challenges they face in the group or the kind of support they would require.
4.4 FARMERS ASSOCIATION AND MICROFINANCE

4.4.1 Access to Finance
Farmers apply for finances from Saccos, SISDO, ACK diocese of Mbeere, cooperative banks, KUSCCO Ltd, SMEP, Youth enterprise funds, Women Enterprise Fund, commercial banks, and KWFT. They are usually hindered by lack of security and guarantors, high interest rates charged and lack of information on the availability of these services. Farmers prefer borrowing from Saccos, self-help groups, friends and relatives, chamas and merry go rounds due to their low interest rates, have fewer requirements and accessibility. If credit was affordable farmers would use the money to improve their production systems, invest in their children's education, or start new businesses. This affordability can be achieved through relaxing the requirements for loan application, formation of common interest groups of farmers and the financial institutions working with farmers in marketing. Group borrowing is hindered by poor management of the group and lack of proper financial records or business plans to enable banks finance their activities. Lower interest rates from financial institutions would make credit more affordable to farmers and reduce the number of defaulting borrowers.

4.4.2 Farmers Association/Groups
Ninety eight of the respondents stated they belonged to farmers' group/association. Out of the 98 respondents 39 of them are from Nthawa while 58 belong in Kirie and only one from Iria-itune.

Respondents from Nthawa belong to various associations and are members of financial institutions where they obtain credit and loans (Table 18).

Table 18: Operational farmers' groups and financial Institutions to which respondents belong

<table>
<thead>
<tr>
<th>Name</th>
<th>Respondent Members</th>
<th>Name</th>
<th>Respondent Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastermind</td>
<td>1</td>
<td>Thurumuu</td>
<td>1</td>
</tr>
<tr>
<td>Chipkizi</td>
<td>1</td>
<td>Kianjara</td>
<td>4</td>
</tr>
<tr>
<td>Fountain</td>
<td>2</td>
<td>Kenfarm</td>
<td>2</td>
</tr>
<tr>
<td>Gatitu mango growers</td>
<td>1</td>
<td>KWFT</td>
<td>2</td>
</tr>
<tr>
<td>Group saving loan</td>
<td>3</td>
<td>Kumbaro</td>
<td>1</td>
</tr>
<tr>
<td>Jijenge</td>
<td>3</td>
<td>Kageri women group</td>
<td>1</td>
</tr>
<tr>
<td>Rukira gatitu furaha</td>
<td>5</td>
<td>Muiruri farmers association</td>
<td>10</td>
</tr>
<tr>
<td>Kabachi</td>
<td>1</td>
<td>Wendi microfinance</td>
<td>2</td>
</tr>
</tbody>
</table>

Only 3 members from Nthawa had received credit for agro processing, two were from Muiruri farmers association. One received Kes. 5,000 credit from the Association and used it to buy farm inputs while the other one did not state the details of this transaction. The third received Kes. 200,000 credit from equity to start up a business for buying and selling livestock.

Financial management/entrepreneurship was trained to 14 respondents in this area by the Ministry of Agriculture, farmers' association officers, Equity banks and Mbeu. The benefits
received from the training were not listed. The women had the largest access to organizations at 100% compared to men at 66% and youth at 33%, although the control over organizations to belong to was equally at 100% amongst all the categories. As such target group formation aimed at addressing SLM issues would be easily achieved amongst all categories.

Kirie area of Mbeere North has potentially a large number of community groups as indicated by the respondents Table 19). A thorough inventory of these groups needs to be undertaken as they can ideal entry vehicles for livelihood improving SLM activities.

**Table 19: Community self-help groups mentioned by respondents in Mbeere North**

<table>
<thead>
<tr>
<th>Name of group</th>
<th>No of respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matta workers SHG</td>
<td>37</td>
</tr>
<tr>
<td>Kamugane water project</td>
<td>1</td>
</tr>
<tr>
<td>Kivairi SHG</td>
<td>1</td>
</tr>
<tr>
<td>Kine machari</td>
<td>1</td>
</tr>
<tr>
<td>Nguthi wendo</td>
<td>1</td>
</tr>
<tr>
<td>Kianjogu SHG</td>
<td>2</td>
</tr>
<tr>
<td>Ngumbato Group saving loan</td>
<td>2</td>
</tr>
</tbody>
</table>

Two respondents received credit for agro processing, one from Kenya care and the other from MOA. The credit received from MOA was in term of knapsack which was used to prevent crop pest and disease.

Six respondents said they have trained on financial management/entrepreneurship. Five were trained by IRDP trainers and the other one by KWFT officers. The benefits accrued from this training were not stated.

**4.4.3 Farmer Field Schools**

Farmer field schools are active in the area although there are some with membership problems that need to be addressed (Table 20). Part of the SLM activities can be channeled through the FFSs and capacity enhanced for them to participate in the land use transformation for sustainability. Men are particularly inactive in the Field Schools and reasons for their low representation need to be sought.

**Table 20: Farmers Field School in the area sampled, activities and their composition**

<table>
<thead>
<tr>
<th>FFS Name</th>
<th>FFS year of format ion</th>
<th>Setting organizatio n</th>
<th>Initial members</th>
<th>Current member s</th>
<th>No of women</th>
<th>No of men</th>
<th>Age range</th>
<th>Main activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Village / Women</td>
<td>Year</td>
<td>Organization</td>
<td>Age</td>
<td>Education</td>
<td>Activity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>------</td>
<td>--------------</td>
<td>-----</td>
<td>-----------</td>
<td>----------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kilguari women</td>
<td>2009</td>
<td>Forester</td>
<td>19</td>
<td>25</td>
<td>0</td>
<td>28-55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kanjara</td>
<td>2006</td>
<td></td>
<td></td>
<td></td>
<td>25</td>
<td>10</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Rukira kwirutira</td>
<td>2007</td>
<td>MOA</td>
<td>35</td>
<td>14</td>
<td>9</td>
<td>5</td>
<td>27-79</td>
<td></td>
</tr>
<tr>
<td>Muiruri FFS</td>
<td>2004</td>
<td>MOA</td>
<td>30</td>
<td>13</td>
<td>10</td>
<td>3</td>
<td>35-71</td>
<td></td>
</tr>
<tr>
<td>Kathinhiuku FFS (Kirie)</td>
<td>2005</td>
<td>KFS</td>
<td>60</td>
<td>35</td>
<td>20</td>
<td>15</td>
<td>27-73</td>
<td></td>
</tr>
<tr>
<td>Njiga FFS (Iria itune)</td>
<td>2006</td>
<td>KFS</td>
<td>17</td>
<td>22</td>
<td>19</td>
<td>3</td>
<td>30-60</td>
<td></td>
</tr>
<tr>
<td>Rukira FFS (Nthawa)</td>
<td>2007</td>
<td>KFS</td>
<td>35</td>
<td>21</td>
<td>9</td>
<td>12</td>
<td>27-75</td>
<td></td>
</tr>
</tbody>
</table>
SECTION FIVE: ENVIRONMENTAL BASELINE

5.0 BACKGROUND AND SITES SELECTION

Environmental baseline data was collected around the sites where SLM activities have been implemented. In addition to these sites, areas that were deemed to have critical and urgent SLM interventions were also visited and profiled. The short period dedicated to field activities constrained complete district coverage and discussions with key informants and communities enabled selection of representative for environmental conditions documentation.

The identified sites were geo-referenced for future repeat visits and photographic records of the environmental conditions made.

Quadrats were used to determine the density of tree species in an area and 20m² quadrats were used. Trees and woody herbaceous species were identified and the densities of each established. The height, stem diameter, canopy projection and density were measured. The 1m² quadrats were used to determine the percentage cover by herbaceous plants which, where possible were identified to species level in the field. Voucher specimens were collected for identification later in the Herbarium for unidentified species. Other baseline indicators used were range condition, presence of invasive species and signs of erosion. The soil composition, presence of debris and animal dung and feces were also noted. Any wildlife encountered was recorded.

5.1 Mixed farming Area Gitiburi Location, Gwita Village

The area has a hilly terrain and predominated by mixed cultivation, where farming on average took 80% of the farms and 20% was designated as paddocks and pastures. The farm size ranged between 3 and 4 acres. Maize was the crop predominantly grown in the farms taking 20% of the cultivated land. Miraa was extensively grown with some farms largely used for its cultivation but the mean proportion under miraa was 15%. Other crops included beans, cowpeas, cassava and dolicots. Fruit trees were dominated by mangoes that were grown on most farms, avocado and pawpaw.

Napier grass was the most predominantly grown fodder crop along with Caliadra and mulberry. Amongst the trees used for agroforestry, Grevilia robusta was the most common, alongside Combretum, Mellia volkensii and Cordia africana. Avocado and Ficus thoningii were also used for feeding livestock during drought according to the residents.

Livestock comprised mostly of indigenous breeds of goats, sheep and cattle. Some households had donkeys primarily for transportation.

The range condition where it existed was good and dominated by Arisrida that had a 90% cover. Indigenous trees on farms included Acacia, Combretum, Terminalia brownii and Mellia volkensii. Invasive species observed that were widely spread were Lantana camara, Solanum incanum and Ocimum suvae. Some farms had good soil conservation measures in place comprising of ditches and terraces.
The area relied mostly on piped water and roof catchment. There were gullies along roads and some farms. Earth dams in the area were few and located on individual farms where they were used for watering miraa crops. Termite activity was high in the area posing problems to farmers over storage structure and consumption of crop stovers. A shallow well was encountered along the seasonal river that yielded mildly alkaline water in Mbingoni Village. The surrounding river bed had signs of severe past erosion with an *Acacia tortilis* tree left standing on a soil pedestal 2.5m high. The area had a well-developed riverine forest *Acacia tortilis* and *Ficus sur* with a woody shrub community dominated by *Croton dichogamous*, *Lantana camara*, *Aspilia mosambicensis* and *Acacia mellifera* saplings. *Sansevieria robusta* was also encountered.

The farm with an earth dam had a preserved pasture comprising of *Eragrostis superb*, *Aistida keniensis*, *Panicum maximum* and *Cenchrus ciliaris*. The bulk height was 65 cm indicating a high potential for use as fodder crops.

Location 0062000 E 037 64117 Altitude 1122m asl
GPS of Area: 0060083 E 037 64193 Altitude 1209m asl

**Plate 13:** Gully formation in Gitiburi area
Plate 14: Historical erosion episodes along the river bed leaving an A tortilis tree on soil pedestal in Gwita village

5.2 Nthawa Location Gatitu Village
The baseline area consisted of a confluence between two river valleys, with a moderately steep topography. The area is typically used for subsistence farming, with an observed average farm size of 3 acres. Maize was the major crop, occupying 95% of the farm. Some cassava plants and a few pawpaw trees were observed alongside a banana groove. A small section was set aside for napper grass cultivation. The agro forestry tree comprised of *Cordia africana* with one individual, *Acacia kirkii* and *Cobretum molle*.

Kamugu Village, Thwata Sub location GPS S00 62108 E037 65011 Altitude 1122m asl

The area is largely a mixed farming zone where maize, beans, cowpeas, millet and green grams are planted. There is a combination of improved goats and traditional breeds alongside red Masai sheep, with cows free ranging in the pastures. The average farm size is 3 acres, with an incursion of Miraa growing as a cash crop, with some farms dedicating its cultivation to 95% of the cultivated land. Traditional long hives were observed in trees on the farms with a yield of 15kg of raw honey according to a community member. In some farms, the Miraa crop covered 75% of the cultivated area with the rest used for growing maize, beans, cow peas and green grams.

The most notable agroforestry trees in the area were *Mellia volkensii*, *Acacia tortilis* and *Terminalia indica*. Fruit tree were mostly mangoes, oranges and paw paws.

In the rangelands, the herbaceous layer included annual grass species and dry unidentified forbs.

Invasive species included *Lantana camara* occupying 60% of the rangeland, *Ocimum suave* and *Solanum incanum*.
In Thura village, a streambed was visited to assess riverine areas conditions. The streambed comprised of sand with evidence of sand harvesting. The upper storey trees included *Cassia antihemintica*, *A tortilis* and *Ficus capensis*. The under storey was dominated by *Lantana camara* with a 90% cover, and excluded other undergrowth species.

The river bed is ideal for an earth dam construction.

GPS Location 00 62506 E037 66377 Altitude 1048m asl

5.3 Kirie Location, Kavaere village

GPS S00 56811 E 037 77547 Altitude 760m asl

The area is part of the marginal zone for crop farming in the Mbeere North District. The topography is flat to undulating to flat with predominantly black cotton soils to a depth of 50m. The area is largely pastoral with pasture taking 85% of the land. Most of the farms were devoid of crops but cowpeas and cotton were observed. The average farm size is 5 acres. The woody vegetation was dominated by *Comiphora spp* with a density of 70 trees/ha, Cordia sp with 60 trees/ha and some *A mellifera* bushes with a density of 40 per hectare. Euphorbia caerulia climbers were intertwined with the trees and bushes. Bare ground comprised 90% of 1m² quadrats.

Herds of cattle, sheep and goats were observed in the distance grazing in the pastures.

Invasive species observed included *Cissus rotundifolia*, *Sanseveria*, *Euphorbia inaequilaternia* and *Sansevera robusta*. Charcoal burning is practiced in the area and two bags were observed in a homestead and the odour from traditional charcoal kilns was detected in the air.

Water was sourced from river beds and the few earthen dams found were not operational. A dam constructed by CARITAS was found to have a domestic water drawing and livestock watering designated areas.
Plate 15: Selective removal of indigenous hardwoods in Kirie area

Plate 16 a and b: Maize growing on Rocky soils and steep slopes in Kirie, exposing soils to erosion

5.4 Mugwanjogu River Area
A general survey was conducted in the area along the road from Kavaere village across the Rwanjogu River. The range was 80% bare without a herbaceous cover and bare patches with murrum and gravelly surfaces measuring over 100m² were frequently encountered. Large herds of livestock were documented with a watering point having 300 goats, 30 sheep and 50 cows congregated at the point. Charcoal burning is rampant with stumps of hardwood cutting down for charcoal production encountered along the road and in the bushlands. Along a 500m section
sampled, 12 bags of charcoal in batches of 2 and 3 bags were counted. In Kianjogu village, 6 and 5 bags of charcoal were found in two homesteads. There were 6 active traditional earth charcoal kilns documented. Brick making was in progress along the river bed where *A tortilis* with a stem diameter of 70 cm had been felled for charcoal burning. There were several old kilns observed.

Area documented: Rwanjogu River GPS  S00 57712   E 037 77602 Altitude 750m asl
Rwanjogu Shopping Center  GPS  S 00 55098   E 037 77729 Altitude 798m asl
Kianjogu Village  GPS  S00 59161   E 037 79744  Altitude 796m asl

Plate 17: Poor pastures in Kirie area showing 75% bare ground and *Lantana camara* invasion

Plate 18: **a and b:** Selective removal of hardwoods in Rwanjogu area for charcoal production and the functional Njga sand dam
SECTION SIX: DERIVED INTERVENTIONS, COLLABORATING INSTITUTIONS AND MONITORING INDICATORS

6.1 DERIVED INTERVENTIONS
The Plenary sessions during validation workshops were used to derive interventions needed in the Mbeere North District. The interventions were found important if SLM objectives were to be met in the district. The execution of the interventions is supposed to synergistic between different development partners and GoK line Ministries with the SLM project assisting where possible. The interventions derived were to serve as platforms for mainstreaming SLM related activities and objectives.

6.1.1 Agriculture
The major agriculture drawbacks are lack of water, harsh climate, suitable soils and capacity amongst the people as they are mostly farmers in livelihood orientation. (Table 21)

Table 21: Derived agriculture interventions in Mbeere North District

<table>
<thead>
<tr>
<th>Action</th>
<th>Where</th>
<th>why</th>
<th>responsibility</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought resistant crop varieties</td>
<td>Entire District</td>
<td>Low rainfall Early maturing Market available</td>
<td>Farmers MOA Stakeholders- SALI</td>
<td></td>
</tr>
<tr>
<td>Availing certified seeds</td>
<td>Entire District</td>
<td>Better yields Disease/ pest tolerance</td>
<td>MOA KARI Farmers Stakeholders-including microfinanciers</td>
<td></td>
</tr>
<tr>
<td>Micro-irrigation schemes</td>
<td>Entire District</td>
<td>Diversification from rain fed agric. Yield increase Increased income</td>
<td>MOA/Irrigation KARI Farmers Stakeholders-Amiran And microfinanciers</td>
<td></td>
</tr>
<tr>
<td>Drip irrigation technology</td>
<td>Entire District</td>
<td>Diversification from rain fed agric. Yield increase Increased income Reduced water use</td>
<td>MOA/Irrigation KARI Farmers Stakeholders-Amiran And microfinanciers</td>
<td></td>
</tr>
<tr>
<td>Soil and water conservation</td>
<td>Entire District</td>
<td>To improve soil fertility Increased yields Increased moisture retention Reduced degradation Fodder for livestock on terraces</td>
<td>Provincial Administration MOLD MOA/Irrigation KARI Farmers Stakeholders-CARITAS, ACK-CCS</td>
<td></td>
</tr>
<tr>
<td>Extension</td>
<td>Entire</td>
<td>Improved farming</td>
<td>MOA/Irrigation</td>
<td></td>
</tr>
<tr>
<td>services</td>
<td>District</td>
<td>methods leading to high yields</td>
<td>Provincial Administration MOLD KARI Farmers Stakeholders-CARITAS, ACK-CCS Farm Concern International</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------------------------</td>
<td>---------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Marketing groups formation</td>
<td>Entire District</td>
<td>Ease of access to market</td>
<td>MOA Provincial Administration MOLD HCDA Farmers Stakeholders-CARITAS, ACK-CCS Farm Concern International</td>
<td></td>
</tr>
<tr>
<td>Pre and post harvesting storage facilities</td>
<td>Entire District</td>
<td>Reduce produce loss</td>
<td>MOA Provincial Administration HCDA KARI Farmers Stakeholders-CARITAS, ACK-CCS Farm Concern International</td>
<td></td>
</tr>
<tr>
<td>Value addition</td>
<td>Entire District</td>
<td>Increase product value</td>
<td>MOA, HCDA, KEBS, KARI, Farmers Stakeholders-CARITAS, ACK-CCS Farm Concern International</td>
<td></td>
</tr>
<tr>
<td>On farm agro forestry with indigenous high value trees</td>
<td>Mbeere North</td>
<td>Soil fertility improvement</td>
<td>MOA/KFS Farmers NEMA OP Green belt GEF</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soil and water conservation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Livestock feed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fuel wood/timber/income</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Food production</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Achievement of 10% forest cover</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 6.1.2 Water Resources interventions

Mbeere North is a relatively water deficit District and water quality, quantity and distribution plays a key role in settlements establishment and farming. Water availability and quality have cascade impacts on health, agriculture and communal conflicts on its sharing. It also spawns human wildlife conflict especially in the dry season. Interventions and key areas were identified and are given in Table 22 below.

**Table 22** Derived interventions on water resources in Mbeere North District

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Area</th>
<th>Benefits</th>
<th>Implementing Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation regulation along permanent rivers</td>
<td>Entire District</td>
<td>Equitable distribution of water Reduced siltation in rivers and dams Riverbank protection Reduced pollution Optimal use of irrigation water</td>
<td>MOA Provincial Administration WARMA, HCDA, KARI, Farmers Stakeholders -CARITAS, ACK-CCS</td>
</tr>
<tr>
<td>Surface water harvesting</td>
<td>Mbeere North</td>
<td>Improved water availability for farming Increased crop yields Reduced impact of drought</td>
<td>MOA/Irrigation Provincial Administration KARI, NDMA Farmers Stakeholders-CARITAS,</td>
</tr>
<tr>
<td>Reservoir dams</td>
<td>Mbeere North</td>
<td>Improved water availability for domestic use/farming Increased crop yields Reduced impact of drought</td>
<td>MOA/Ministry of Water Provincial Administration Farmers NDMA Stakeholders-CARITAS,</td>
</tr>
<tr>
<td>Sand Dam construction</td>
<td>Mbeere North</td>
<td>Improved water availability for domestic use</td>
<td>Ministry of Water Provincial Administration Farmers NDMA Stakeholders-CARITAS,</td>
</tr>
<tr>
<td>Roof catchment</td>
<td>Mbeere North</td>
<td>Improved water availability for domestic use/farming (Kitchen garden, drip irrigation)</td>
<td>MOA/Ministry of Water, NDMA Farmers Stakeholders-CARITAS,</td>
</tr>
<tr>
<td>Earth Dam increase</td>
<td>Mbeere North</td>
<td>Improved water availability for domestic use/farming Increased crop yields Reduced impact of drought</td>
<td>MOA/Ministry of Water Provincial Administration Farmers NDMA Stakeholders-CARITAS,</td>
</tr>
<tr>
<td>Climate</td>
<td>Mbeere North</td>
<td>Energy saving device Farm forestry Solar energy utilization Avoid greenhouse emissions</td>
<td>MOA/Forestry NEMA Stakeholders</td>
</tr>
<tr>
<td>Governance</td>
<td>Mbeere North</td>
<td>Genders mainstreaming Especially within the family</td>
<td>MOA, MOLD, Social services</td>
</tr>
<tr>
<td>Vision 2030</td>
<td>Mbeere North</td>
<td>Flagship project in irrigated agriculture, increased forest cover, value addition, mechanization, horticultural production intensified</td>
<td>MOA, Ministry of water, HCDA, Community(farmers), KARI, KIRDI</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td>Kiangombe Hills</td>
<td>Kiangombe</td>
<td>Reseeding, Reforestation, Reduced encroachment, Spring protection/Catchment protection</td>
<td>Community, KFS, MOLD, MCC, MOA, OP, GEF, NEMA, Stakeholders</td>
</tr>
</tbody>
</table>
### 6.1.3 Livestock

The livestock specialist group considered issues including rangelands, wildlife and other emerging issues with a bearing on livestock production in the District. The most critical issues revolved around pasture rehabilitation and breed improvement. Breed improvement was considered important as its improvement would enhance productivity and sale value. Pest and diseases control alongside marketing were high priority interventions, in tandem with community consolations findings. Extension services need to be revamped and SLM interventions have to take this into account. (Table 23)

**Table 23: Derived Livestock interventions in Mbeere North District**

<table>
<thead>
<tr>
<th>Action</th>
<th>Target Area</th>
<th>Why</th>
<th>Responsibilities</th>
</tr>
</thead>
</table>
| Breed improvement    | Entire district                                  | -To increase productivity  
                      |                                                                  | -To avoid inbreeding  
                      |                                                                  | -To increase on food security  
                      |                                                                  | -Better livestock prices and income  
                      |                                                                  | -To reduce land degradation  |
|                      |                                                  | DLPO  
                      |                                                                  | SLM  
                      |                                                                  | DVO  
                      |                                                                  | Community  
                      |                                                                  | Private service providers  
                      |                                                                  | Researchers  
                      |                                                                  | NGOs  
                      |                                                                  | Financial institutions  |
| Zero grazing         | Nthawa, Kanyuambora, Riandu, Gitiburi           | -Reduce land degradation  
                      |                                                                  | -Maximum utilization of available land  
                      |                                                                  | -Disease control  
                      |                                                                  | -Alternative source of energy (Bio-gas)  
                      |                                                                  | -High productivity and income  
                      |                                                                  | -To enhance food security  |
|                      |                                                  | DLPO  
                      |                                                                  | SLM  
                      |                                                                  | DVO  
                      |                                                                  | Community  
                      |                                                                  | Private service providers  
                      |                                                                  | Researchers  
                      |                                                                  | NGOs  
                      |                                                                  | Financial institutions  |
| Pest and diseases    | Entire District with special attention to livestock incursion areas | -To increase productivity  
                      |                                                                  | -To increase on food security  
                      |                                                                  | -Better livestock prices and income  
                      |                                                                  | -Stable market  
                      |                                                                  | -Improve on growth rate  
                      |                                                                  | -Control of zoonotic diseases  |
|                      |                                                  | DLPO  
                      |                                                                  | SLM  
                      |                                                                  | DVO  
                      |                                                                  | Community  
                      |                                                                  | Private service providers  
                      |                                                                  | Researchers  |
| Pasture improvement | Kirie Nthawa Iria itune | - Improve quality and quantity  
- To improve on degraded lands  
- To ensure continuous supply of fodder  
- To reduce conflicts over pastures  
- Source of income and improve on food security.  
- To control overgrazing due to overstocking of animals | DLPO SLM  
Research stations: KARI, KEFRI  
FFS / community |
|---|---|---|---|
| - Reseeding  
- Domestication of local grass species for fodder and harvesting regimes design  
- Fodder storage  
- Utilization of crop residues  
- Establishment of marketing groups  
- Range carrying capacity establishment |  |  |  |
| Extension services | Kirie Iria itune Nthawa | - Capacity building and empowering the FFS and community resource persons | DLPO DVO  
Cooperative |
| Livestock common interest groups | Kirie Iria itune Nthawa | - Resource mobilization  
- Improve marketing  
- Negotiation power | DLPO SLM  
Community |
| Climate change | Entire district | - Frequent and unpredictable droughts  
- Rise in temperatures  
- Inadequate knowledge on climate change by implementers  
- Increased disease incidences | NEMA KFS  
All stakeholders |
| Governance | Local level governance structures | - Weak structures  
- To increase on resource accessibility by gender groups (W,Y) | DLPO SLM  
Social services |
<p>| Vision 2030 | Kiangombe catchment | - Flagship activities in SLM | DLPO SLM |</p>
<table>
<thead>
<tr>
<th>Kiang’ombe Hills</th>
<th>Kiang’ombe hill and its environs</th>
<th>-Conservation of water and utilization downstream for economic and social growth</th>
<th>All stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-To address encroachment, deforestation, disappearance of spring eyes,</td>
<td>DLPO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Loss of biodiversity</td>
<td>SLM</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Boundaries, Ownership</td>
<td>Ministry of water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Controlled access(Fee)</td>
<td>KFS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>County council</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lands</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Community forest</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>associations</td>
</tr>
</tbody>
</table>
6.1.4 Environmental management plan

Kiangombe is a critical catchment area and in dry months a grazing refugee. It has been greatly affected by several years of overgrazing, fires and lack of clear management mandates thus encouraging encroachment. There was need to come up with an environmental intervention plan for areas like Kiangombe and they are given in table 24.

Table 24: Derived environmental interventions in Mbeere North District

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Action</th>
<th>Target Area</th>
<th>Why</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Environment Management for Kiangombe ecosystem E.g. Sustainable NRM</td>
<td>Identify the area and persons who have encroached Demarcation and surveying</td>
<td>Kiangombe Hill and other steep settled</td>
<td>To involve them in any intervention To mark the boundary</td>
<td>Community County council Forestry Nema Provincial administration Ministry of lands Livestock</td>
</tr>
<tr>
<td>Rehabilitation of the degraded areas</td>
<td>Kiangombe forest and ecosystem</td>
<td>To prevent further degradation</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>Community empowerment</td>
<td>Kiangombe catchment and encroachers</td>
<td>To emphasis on the significance of conserving the hill To integrate the aspect of community based national resource management e.g. cfa approach To integrate indigenous knowledge on environmental conservation</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>Springs protection ,fencing and enclosing of the springs ,construction of cattle troughs at watering points</td>
<td>Kiangombe catchment</td>
<td>To protect the catchment To support biodiversity</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Location</td>
<td>Objective</td>
<td>Implementing Authority</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>To establish fodder, pasture and conservation</td>
<td>Kiang’ombe catchment</td>
<td>Keep off the grazing of animals at the hill</td>
<td>Community Livestock department Agriculture department</td>
<td></td>
</tr>
<tr>
<td>Sustainable sand harvesting and quarry practices</td>
<td>Upper Thura, Marivwe river, Cievoyo, Rwanjoga, and Kambaci streams</td>
<td>To make the practice sustainable Increase water security by retention Minimize conflicts</td>
<td>Nema plus above</td>
<td></td>
</tr>
<tr>
<td>Proper farm preparation and practices</td>
<td>Individual farms within Kiang’ombe catchment</td>
<td>To avoid fires Avoid the destruction of vegetation</td>
<td>Community Ministry of agriculture</td>
<td></td>
</tr>
<tr>
<td>To curb Forest fires</td>
<td>Kiang’ombe hill</td>
<td>To avoid destruction of forest cover and biodiversity</td>
<td>Community Kenya forest service County council Provincial administration</td>
<td></td>
</tr>
<tr>
<td>Logging and charcoaling</td>
<td>Kiang’ombe hill and environs</td>
<td>To reduce environmental degradation To curb forest fires</td>
<td>Community Nema Kenya forest service Administration</td>
<td></td>
</tr>
<tr>
<td>Promote energy saving and sustainable charcoal production</td>
<td>Kiang’ombe catchment</td>
<td>Reduce the amount of fuel used per household per day Enhance energy efficiency To improve livelihood</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>Formation and strengthening of charcoal producer associations</td>
<td>Kiang’ombe catchment</td>
<td>To diversify livelihood and income</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>Gazzetement of Kiang’ombe hill</td>
<td>Kiang’ombe hill</td>
<td>To enhance protection To make empower the community on</td>
<td>As above</td>
<td></td>
</tr>
<tr>
<td>Management Issues</td>
<td>Kiangombe Hill</td>
<td>To Publish Issues of Land Management</td>
<td>Everybody</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------</td>
<td>-------------------------------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Mainstreaming land management issues across various legislations and community</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.2 OTHER COLLABORATING ORGANIZATIONS

The execution of SLM interventions is a multidisciplinary amongst GoK Ministries and agencies as a wide range of expertise is involved. Financing available for the SLM project is limited and cannot cover the entire range of projected interventions. The project seeks to build synergies and integration between different agencies and organization that have SLM related activities to increase efficient use of funds and improved targeting of projects areas and focusing on communities. The SLM project envisages partnerships where ongoing projects, pipeline projects and projected future SLM related activities are executed under a joint framework. In the Mbeere SLM project implementation sites, institution with SLM inputs have been identified in the intervention matrices developed. There are other organizations and NGOs with ongoing activities in the area and potential areas of activities harmonization have been identified as shown in Table 25 below.

Table 25: List of potential partners and collaborators operating in the Mbeere SLM project areas

<table>
<thead>
<tr>
<th>Name of NGO</th>
<th>Activities</th>
<th>Area of operations</th>
<th>Potential collaboration opportunities</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALI Project (CCS)</td>
<td>Promote livelihoods through improved agricultural techniques- promotion of drought tolerant crops/ high value crops, alternative Income generating activities (IGAs) - beekeeping, livestock upgrading, pasture bulking</td>
<td>District wide</td>
<td>Alternative livelihoods establishments- Beekeeping Livestock upgrading Pasture bulking Promotion of high value crops</td>
</tr>
<tr>
<td>Farm Concern</td>
<td>Marketing and value addition of mangoes and passion fruits</td>
<td>District wide</td>
<td>Alternative livelihoods establishments ( mango farming &amp; value addition, commercial nursery establishment</td>
</tr>
<tr>
<td>Caritas (CDoE)</td>
<td>Emergency/ relief services, Infrastructure development, Livestock improvement Water development</td>
<td>District wide</td>
<td>Livestock improvement Water development for livestock</td>
</tr>
<tr>
<td>CLUSA</td>
<td>Capacity building on improved agricultural practices, water development, Water development</td>
<td>District wide</td>
<td>Water development for livestock</td>
</tr>
<tr>
<td>SISDO</td>
<td>Credit facilities, Banking facilities, Financial literacy trainings</td>
<td>District wide</td>
<td>Financing of farmers</td>
</tr>
<tr>
<td>KWFT</td>
<td>Credit facilities, Banking facilities</td>
<td>District wide</td>
<td>Financing of farmers</td>
</tr>
<tr>
<td>Cooperative bank</td>
<td>Credit facilities, Banking facilities</td>
<td>District wide</td>
<td>Financing of farmers</td>
</tr>
</tbody>
</table>
Plate 19: other organization working in Mbeere and their projects
### 6.3 INTERVENTION INDICATORS

#### 6.3.1 Livestock and rangelands sector indicators

**Table 26: Monitoring indicators for Livestock and rangelands interventions in Mbeere**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target Area</th>
<th>Reason</th>
<th>Indicator</th>
<th>Monitoring method</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Livestock</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breed improvement</td>
<td>Entire district</td>
<td>-To increase productivity</td>
<td>-Cross-breeds and training on cross-breed management</td>
<td>-Number in given site (10% of total animals)</td>
<td>-Annually (cows), biannually (goats).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-To avoid inbreeding</td>
<td></td>
<td>-Training reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-To increase security on food security</td>
<td></td>
<td>-Percent increase in yield per animal</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Better livestock prices and income</td>
<td></td>
<td>-Farmers' and DLPO records</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-To reduce land degradation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
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</tr>
<tr>
<td><strong>Zero grazing</strong></td>
<td>Nthawa, Kanyuambora, Riandu, Gitiburi</td>
<td>-Reduce land degradation</td>
<td>-Presence of zero grazed animals</td>
<td>-Number of zero grazed animals per site</td>
<td>-Biannual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Maximum utilization of available land</td>
<td></td>
<td>-Acreage under fodder/paddocks</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Disease control</td>
<td></td>
<td>-Field survey</td>
<td>-Annual</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Alternative source of energy (Biogas)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-High productivity and income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-To enhance food security</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pest and diseases</strong></td>
<td>Entire District with special attention to livestock</td>
<td>-To increase productivity</td>
<td>-Disease outbreaks</td>
<td>-Frequency of disease outbreaks</td>
<td>-Quarterly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-To increase on food security</td>
<td></td>
<td>-Disease surveillance reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Based on</td>
<td></td>
</tr>
</tbody>
</table>
| Incursion Areas | -Better livestock prices and income  
-A stable market  
-Improve on growth rate  
-Control of zoonotic diseases | -New diseases detected  
-Reduction in prevalence levels | - Frequency and number of new diseases | Outbreak reports |
| --- | --- | --- | --- | --- |
| Pasture improvement Reseeding Domestication of local grass species for fodder Harvesting regimes design Fodder storage Range carrying capacity determination | Kirie Nthawa Iria itune | -Improve quality and quantity  
-To improve on degraded lands  
-To ensure a continuous supply of fodder  
-To reduce conflicts over pastures  
-Source of income and improves on food security. To control overgrazing due to overstocking of animals | -Acreage of pasture rehabilitated  
-Acreage reseeded  
-Identified local grass species for fodder  
-Technical reports on design and evaluations  
-Capacity building reports on storage and types of storage  
-Technical report on carrying capacity in the area. | -Field verification  
- field verification  
-review of reports  
-review of reports  
-Field verification  
-review of reports  
-Field verification on stocking rate | Biannual during wet and dry seasons |
| Extension service provision | Kirie Iria itune Nthawa | -Capacity building and empowering the FFS and community resource persons  
-Farmer/pastoral group training request received and attended to. | -Reports  
-Household survey  
-Farmer/pastoral group reports | Quarterly |
| Livestock common interest groups | Kirie Iria itune Nthawa | Improvemen t of market access | -Presence of registered common interest groups  
-Documented types of activities by the group.  
-Proposed or implemented marketing chain  
-Proposed or ongoing value addition activities | -Certificate of registration  
-Annual returns  
-Group minutes and reports.  
-Annual financial returns  
-Marketing/business plan proposals developed.  
-Visits and discussion with groups  
-Biannual |
### 6.3.2 Agriculture sector indicators

**Table 27: Monitoring indicators for agriculture interventions in Mbeere**

<table>
<thead>
<tr>
<th>Action</th>
<th>Target area</th>
<th>Reason</th>
<th>Indicator</th>
<th>Monitoring method</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity Building/training</td>
<td>Entire District</td>
<td>Poor farming methods Lack of knowledge on suitable crop varieties, fertilizers use etc</td>
<td>Training sessions -Farm visits -Group demonstrations -Farmers’group training request received and attended to.</td>
<td>-Reports -Household survey -Farmer/pastoral group reports</td>
<td>Quarterly</td>
</tr>
<tr>
<td>Drought resistant crop varieties</td>
<td>Entire District</td>
<td>Low rainfall Early maturing Market available</td>
<td>-Presence of drought resistant crops -Training on suitable seed varieties -Improved productivity -Enhanced food security</td>
<td>number in given site (10% of total crops) -Training reports -percent increase in yield per crop type -farmers’and DAO records</td>
<td>Biannual</td>
</tr>
<tr>
<td>Availing certified seeds</td>
<td>All above areas</td>
<td>Use of uncertified seed Improve yields Food security Enhance income</td>
<td>-Certified seeds from a reputable seed company -Recommendation from DAO on seed suitability -Enhanced food production -Reduced food aid reliance</td>
<td>-Seed store visits -Reports from DAO -farmers’ records and visits -Tracking food aid frequency</td>
<td>Biannual</td>
</tr>
<tr>
<td>Micro-irrigation schemes</td>
<td>All areas</td>
<td>Inadequate rainfall Improved Food security Improved nutrition Increased incomes</td>
<td>-Number of newly initiated schemes -Micro irrigation infrastructure in place -Type of crops in irrigated farms -Changes in farmers socioeconomic status</td>
<td>-Target area visit -Socioeconomic survey in targeted areas</td>
<td>Annual</td>
</tr>
<tr>
<td></td>
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<td></td>
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<tr>
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<td>----------------------------------------------------------------</td>
<td>----------------------------------------------------------------</td>
<td>----------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Drip irrigation technology</td>
<td>Entire District</td>
<td>Diversification from rain fed agriculture. Yield increase</td>
<td>Increased income Reduced water use</td>
<td>-Training on irrigation technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Established on farm drip irrigation systems -Training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil and water conservation</td>
<td>Entire District</td>
<td>To improve soil fertility Increased yields Increased moisture</td>
<td>Retention Reduced degradation Fodder for livestock on terraces</td>
<td>-Training reports -Dry season farm visits</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Undertaken soil &amp; water conservation measures</td>
<td>-Enhanced crop production -Reduced soil erosion -Improved</td>
<td>-On farm visits -DAO reports -WRMA reports on the situation and</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>runoff water quality -Training session and reports</td>
<td>floods -Farm records</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All three areas</td>
<td>Inadequate extension Low crop production</td>
<td>-Training sessions -Farm visits -Group demonstrations -Follow</td>
<td>-Reports -Household survey -Farmer/pastoral group reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>up and monitoring on the implementation process. -Farmers</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-group training request received and attended to.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marketing groups formation</td>
<td>Entire District</td>
<td>Ease of access to market High bargaining power Access to credit</td>
<td>Saving in input cost -Presence of registered Marketing groups</td>
<td>-Certificate of registration -Annual returns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Documented types of activities by the group. -Proposed or</td>
<td>-Group minutes and reports -Annual financial returns</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>implemented</td>
<td>-Marketing/business</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to extension marketing chain -Proposed or ongoing value addition activities</td>
<td>plans proposals developed. -Visits and discussion with groups</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>---</td>
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</tr>
<tr>
<td>Pre and post harvesting losses</td>
<td>All the areas</td>
<td>Reduce crop losses in glut periods Opportune sale times for better prices Reduce post harvest losses</td>
<td>-Harvest loss technology developed and in place -Training -Storage facilities in place -Better returns from crop sale</td>
<td>-Farm and facility visits -Review of DAO reports -Farm records</td>
<td>Biannual</td>
</tr>
<tr>
<td>Value addiction</td>
<td>Entire District</td>
<td>Increase product value Increased shelve life Reduce bulkiness Easy to market</td>
<td>-Proposed or ongoing value addition activities -Feasibility study on value addiction opportunities -Training on value addition processes</td>
<td>-Field visits -Surveys -Training reports -Field verification on facilities and processes established</td>
<td>Biannual</td>
</tr>
</tbody>
</table>
### 6.3.3 Water sector intervention indicators

Table 28: Water interventions monitoring indicators in Mbeere North

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target Area</th>
<th>Reason</th>
<th>Indicator</th>
<th>Monitoring method</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation regulation along permanent rivers</td>
<td>Entire District</td>
<td>Equitable distribution of water</td>
<td>-Number of Abstraction points</td>
<td>-WRMA reports</td>
<td>-Continuous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced siltation in rivers and dams</td>
<td>-Proportion of licensed abstraction points</td>
<td>-River baseline survey and geo-referenced abstraction points</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riverbank protection</td>
<td>-Abstractions level relative to base flow</td>
<td>-Registered WRUAs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced pollution</td>
<td>-Established water resource users association (WRUA)</td>
<td>-Hydrological survey and reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimal use of irrigation water</td>
<td>-Water related conflict reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-WRMA license issued</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface water harvesting</td>
<td>Mbeere North</td>
<td>Improved water availability for farming</td>
<td>-Established water harvesting structures and locations</td>
<td>-Field visits</td>
<td>Quarterly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increased crop yields</td>
<td>-Water conservation measures in place</td>
<td>-NDMA/WRMA reports</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced impact of drought</td>
<td>-Nature and ownership of water harvesting structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Use designation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand/earth Dam construction</td>
<td>Mbeere north</td>
<td>Inadequate water. Raise water table. Micro irrigation. Access to domestic and livestock water. Improved water storage</td>
<td>-Number and distribution of boreholes and shallow wells</td>
<td>-Field survey</td>
<td>Biannual</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Nature and ownership of water harvesting structures</td>
<td>-WRMA reports</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>-Water quality and</td>
<td>-Hydrological reports</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Water parameter analysis</td>
<td></td>
</tr>
</tbody>
</table>
## OTHER EMERGING ISSUES

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target Area</th>
<th>Reason</th>
<th>Indicator</th>
<th>Monitoring method</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td>All the Areas</td>
<td>Frequent prolonged droughts, recurrent floods, erratic rainfall, High temperatures and frost</td>
<td>-Meteorological data -Ground impacts by floods, fires, overgrazing, erosion, frost, livestock deaths and crop failure frequencies.</td>
<td>-Forecast and events -Field visits and documentation -Historical data -Extreme weather events alert.</td>
<td>Continuous surveillance</td>
</tr>
<tr>
<td>Governance</td>
<td>All the areas</td>
<td>Community to understand the governing rules relevant to them</td>
<td>-Community understanding of devolved government and its structures -Community understanding of their rights and obligation -Harmonization of</td>
<td>-Field survey -Training reports</td>
<td>Annual</td>
</tr>
<tr>
<td>Vision 2030</td>
<td>All the areas</td>
<td>It’s a road map to achievement of Middle income Industrialized economy</td>
<td>-Alignment of vision 2030 goals with community needs -Community understanding of vision 2030</td>
<td>- Community consultation</td>
<td>-Annual</td>
</tr>
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</tr>
<tr>
<td>Roads</td>
<td>All the Areas</td>
<td>Poor road network, Improved market access</td>
<td>-Roads classification and distribution -Condition of road -Proposed road upgrades and construction -Number of bridges restored in SLM target area</td>
<td>-KERRA reports -Field survey -Community consultation</td>
<td>-Annual</td>
</tr>
</tbody>
</table>
### 6.3.4 Environmental intervention indicators

Table 29: Environmental interventions monitoring indicators in Mbeere North

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target Area</th>
<th>Reason</th>
<th>Indicator</th>
<th>Monitoring method</th>
<th>Monitoring frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify the area and map it Demarcation and surveying River bank protection</td>
<td>Kiangombo Hill and other steep settled</td>
<td>To involve them in any intervention To mark the boundary</td>
<td>-Maps and beckons -River line frontage pegged -Conserved catchment areas</td>
<td>-Field verification and reports</td>
<td>-Biannual</td>
</tr>
<tr>
<td>Rehabilitation of the degraded areas Invasive plant species control</td>
<td>Kiangombo forest and ecosystem</td>
<td>To prevent further degradation</td>
<td>-Acreage identified and rehabilitated -Species specific management strategy development</td>
<td>-Field verification and reports</td>
<td>Annual</td>
</tr>
<tr>
<td>Springs protection</td>
<td>Kiangombo catchment</td>
<td>To protect the catchment To support biodiversity</td>
<td>-Identified springs -Field visits</td>
<td>-Field verification and reports</td>
<td>Annual</td>
</tr>
<tr>
<td>Sustainable sand harvesting and quarry practices</td>
<td>Upper Thura, Marivwe river, Cievooy, Rwanjoga, and Kambaci streams</td>
<td>To make the practice sustainable Increase water security by retention Minimize conflicts</td>
<td>-Regulatory framework developed -Types and number of Resource User association -Training on sustainable practices</td>
<td>-Reports -Survey -Training reports</td>
<td>-Biannual</td>
</tr>
<tr>
<td>Appropriate farm preparation and practices</td>
<td>Individual farms within Kiangombo catchment</td>
<td>To avoid fires To avoid the destruction of vegetation</td>
<td>-Training on appropriate farming practices and land preparation</td>
<td>-Reports -Field survey</td>
<td>-Biannual</td>
</tr>
<tr>
<td>To curb Forest fires</td>
<td>Kiangombo hill</td>
<td>To avoid destruction of forest cover and biodiversity</td>
<td>-Number, Frequency and distribution of fires reported</td>
<td>-KFS reports -NEMA -Farmers Seasonal</td>
<td>-Biannual</td>
</tr>
<tr>
<td>Charcoal production control</td>
<td>Kiangombo hill and environs</td>
<td>To reduce environmental degradation</td>
<td>Uncontrolled charcoal burning</td>
<td>-Charcoal associations established and registered with KFS</td>
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<tr>
<td></td>
<td></td>
<td>To curb forest fires</td>
<td>Lack of registered charcoal associations</td>
<td>-Training on new charcoal production techniques</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Forest destruction by charcoal burning activities</td>
<td>-Documentation of charcoal production &amp; sale chain.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sustainable utilization of forest products</td>
<td>-Establish efficient facility</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>-Certificate of registration</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Field verification and reports on amount and source of charcoal.</td>
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<td></td>
<td></td>
<td></td>
<td>-Training reports</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>-Group and KFS reports</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>-Facilities in place</td>
<td></td>
</tr>
<tr>
<td>Identification of fast growing hardwood trees for charcoal production</td>
<td>All areas</td>
<td>Protection of indigenous forest. Commercialization of charcoal burning for improved economy</td>
<td>-Species identified and available</td>
<td>-Field visits</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Their KEFRI reports on the species</td>
<td>-KEFRI reports analysis</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Once off</td>
<td></td>
</tr>
<tr>
<td>Promote energy saving and sustainable charcoal production</td>
<td>Kiangombo catchment</td>
<td>Reduce the amount of fuel used per household per day</td>
<td>Enhance energy efficiency</td>
<td>Implementation of none destructive harvesting techniques</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>To improve livelihoods</td>
<td>-Production of high quality charcoal from none preferred species</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>-Agroforestry of</td>
<td></td>
</tr>
<tr>
<td>Protection of indigenous trees from charcoal production</td>
<td>Kiangombe</td>
<td>Maintaining forest cover</td>
<td>Implementation of none destructive harvesting techniques</td>
<td>Field verification and reports from KFS and charcoal associations.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Quarterly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kiangombo</td>
<td>To diversify livelihood and income</td>
<td>Presence of registered charcoal association groups</td>
<td></td>
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<td>-----------------------------------------------------------------</td>
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<td>--------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Formation and strengthening of charcoal producer associations</strong></td>
<td>Kiangombo</td>
<td></td>
<td>- Documented types of activities by the group.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>catchment</td>
<td></td>
<td>- Proposed or implemented marketing chain.</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>- Proposed or ongoing value addition activities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gazzetement of Kiangombo hill</strong></td>
<td>Kiangombo</td>
<td>To enhance protection</td>
<td>- Kenya gazette issue</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>hill</td>
<td>To make empower the community on</td>
<td>- CFA &amp; KFS reports</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>management</td>
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</tr>
</tbody>
</table>

- Certificate of registration
- Annual returns
- Group minutes and reports.
- Annual financial returns
- Marketing/business plans proposals developed.
- Visits and discussion with groups.
- Biannual

- Reports
- Once off
REFERENCES


7.0 Appendices
Appendix 1: The list of species used for charcoal production in the study areas of Mbeere, with their local names, scientific name and number of mentions

<table>
<thead>
<tr>
<th>Local names</th>
<th>Scientific name</th>
<th>Mentions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mururuku</td>
<td>Terminalia brownii</td>
<td>63</td>
</tr>
<tr>
<td>Mukema</td>
<td>Greviilea robusta</td>
<td>1</td>
</tr>
<tr>
<td>Mukame</td>
<td>Newlonia</td>
<td>12</td>
</tr>
<tr>
<td>Munyua maii</td>
<td>Eucalyptus</td>
<td>22</td>
</tr>
<tr>
<td>Mutororo</td>
<td>Terminalia peroidis</td>
<td>45</td>
</tr>
<tr>
<td>Mukuu</td>
<td>Ficuss thoningii</td>
<td>10</td>
</tr>
<tr>
<td>Muthithi</td>
<td>Tarmirindus indica</td>
<td>19</td>
</tr>
<tr>
<td>Mugungua</td>
<td>Acacia polycanth</td>
<td>1</td>
</tr>
<tr>
<td>Migaa</td>
<td>Acacia melifera</td>
<td>39</td>
</tr>
<tr>
<td>Migembe</td>
<td>Mangifera indica</td>
<td>1</td>
</tr>
<tr>
<td>Mugereki</td>
<td>Combreful molle</td>
<td>12</td>
</tr>
<tr>
<td>Mivuru</td>
<td>Vitex doniana</td>
<td>4</td>
</tr>
<tr>
<td>Mitoo</td>
<td>Dombeya goetzenii</td>
<td>5</td>
</tr>
<tr>
<td>Mirama</td>
<td>Combreum</td>
<td>11</td>
</tr>
<tr>
<td>Muvava</td>
<td>Combreum</td>
<td>7</td>
</tr>
<tr>
<td>Muraba</td>
<td>Adarisonic digitata</td>
<td>1</td>
</tr>
<tr>
<td>Muveci</td>
<td>Sena siamea / cassia siamea</td>
<td>1</td>
</tr>
<tr>
<td>Mwarange/muarange</td>
<td>Delonix elata</td>
<td>52</td>
</tr>
<tr>
<td>Mukau</td>
<td>Melia volkensii</td>
<td>1</td>
</tr>
</tbody>
</table>
Appendix 2: Community problem analysis with relevance to SLM activities

<table>
<thead>
<tr>
<th>TYPE OF PROBLEMS</th>
<th>ROOT CAUSES</th>
<th>EFFECTS/IMPACTS</th>
<th>MOST AFFECTED</th>
<th>COPING MECHANISM</th>
<th>OPTION/OPPORTUNITIES SOLUTIONS</th>
</tr>
</thead>
</table>
| Inadequate water for domestic use and irrigation | Low rainfall, Sand harvesting, Deforestation, Overstocking/poor land management | - Food shortage  
- Livestock death  
- Water borne diseases,  
- Poor Sanitation  
- Time wastage,  
- Increased disease incidents | Women, Children, Elderly  | Rationing food & water  
Water holes in river courses  
Livestock movement to water point  
Migration to urban centres for labour.  
Re-using water  
Charcoal burning | Water ponds with nylon liners (individually)  
Community Dams ENA River/Tanks  
Reforestation  
Community ownership of public Projects  
Kiambeere water to be shared with community around  
Drilling boreholes  
Protection of springs from Kiangombe Hills  
Encourage roof catchments  
Runoff harvesting  
Training on water harvesting technologies for domestic irrigation  
Extension of Nthawa irrigation scheme |
| High human disease incidences           | Poor protection, Untreated Water, Malnutrition, Poor Sanitation               | Deaths, Suffering, Expenses leading to poverty                                | Children, Women, Aged             | Seeking Medical attention, Herbs, Witch Doctor                                  | Improve hygiene  
Improved nutrition  
Safe water,  
Protection through Vaccination or Immunization  
Construction of more modern health centres. |
| **Destruction of pasture lands and Forests** | Charcoal Burning | Low rainfall, Overstocking, Poor farming systems | -Livestock deaths  
-Soil erosion  
-Poverty  
-Low production and pasture  
-Soil erosion | All | Seeking Labour far away,  
Charcoal burning,  
Sand harvesting,  
Relief food  
Livestock migration  
Livestock off take  
Feeding on unconventional fodder | Tree, planting/Establishment of tree nurseries,  
Paddocks,  
Terracing,  
Improve on livestock breeds  
Reseeding  
Establishment of pasture bulking sites  
Protection of catchment areas  
Training on environmental issues |
| **Low crop yield** | Low rainfall, Poor farming systems, Uncertified seeds, Wildlife (baboons, vervet monkeys, dik-dik, squirrels, francolins and guinea fowl, porcupines)  
Lack of Planting indigenous crops | Hunger, School drop outs, Diversion of income to other things, Family instability  
Family conflicts  
Food rationing | All | -Ration food, skipping meals, relief food, Disposal of other property  
charcoal burning, livestock disposal, Cheaper foods, Men move to work far from home | Water for irrigation,  
dams for irrigation, runoff surface water harvesting, Green house farming,  
Appropriate dry land farming education, preservation of harvesting, Appropriate crops for the area, Restore soil fertility, Pest management, Avoid pre-harvest  
Soil conservation  
Micro credit to assist farmers |
| **Low livestock production** | Low rainfall, livestock disease, inbreeding, overstocking and grazing systems, | Low prices, Low milk production, Malnutrition  
Increase in | All | Stop milking, Sale at low prices  
Livestock migration | Change breed, increase water, fodder production and conservation paddocking, restocking, Upgrading of local breeds |
<table>
<thead>
<tr>
<th>Large human population</th>
<th>Lack. timely. technical assistance,</th>
<th>disease incidences</th>
<th>Train more service providers</th>
</tr>
</thead>
<tbody>
<tr>
<td>poor breeds</td>
<td></td>
<td></td>
<td>Training on modern technology on livestock production</td>
</tr>
</tbody>
</table>