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Climate Smart Agriculture Rapid Appraisal (CSA-RA) Report from the Southern Agricultural Growth Corridor of Tanzania (SAGCOT)

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International Center for Tropical Agriculture (CIAT)

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The views expressed herein cannot be taken to reflect the official opinion of these agencies, nor the official position of CIAT or CCAFS. The authors are responsible for any errors and gaps in the report.

List of Acronyms

AGG	Agriculture Green Growth
AGRA	The Alliance for a Green Revolution in Africa
APA	Aids Partnership for Africa
ARI	Agriculture Research Institute
CAMFED	Campaign for Female Education
CCAFS	Climate Change, Agriculture and Food Security
CCT	Christian Council of Tanzania
CDIP	Community Development Initiative Professionals
CHF	Community Health Fund
CIAT	International Center for Tropical Agriculture
CSA	Climate Smart Agriculture
CSA-RA	Climate Smart Agriculture Rapid Appraisal
CVM	Community Volunteers for the World
DANIDA	Danish International Development Agency
FINCA	The Foundation for International Community Assistance
HIMA	Hifadhi ya Mazingira
IFAD	International Fund for Agricultural Development
IHI	Ifakara Health Institute
IOP	Ilula Orphan Program
IPRCC	The International Poverty Reduction Centre in China
Kg	Kilogram
Km	Kilometre
MUVI	Muunganisho was Ujasirimali Vijijini
MVIWATA	Mtandao wa Vikundi vya Wakulima Tanzania
NGO	Non-Governmental Organization
PRIDE	Promotion of Rural Initiative and Development Enterprises Limited
RBWO	Rufiji Basin Water Office
RUDI	Rural Urban Development Initiatives
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
SIDO	Small Industries Development Organization
SRI	System of Rice Intensification
SUA	Sokoine University of Agriculture
TAPP	Tanzania Agriculture Productivity Program
TASAF	Tanzania Social Action Fund
TSH	Tanzanian Shilling
UNICEF	United Nations Children's Fund
VICOBA	Village Community Banks
ZIU	Zone Irrigation Unit

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Executive summary

A Climate Smart Agriculture Rapid Appraisal (CSA-RA) was carried out by CIAT in collaboration with Sokoine University of Agriculture (SUA) for the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) in September 2014. The CSA-RA aimed to assess within and between district variations in farming systems, agricultural management practices, challenges for current agricultural practices, and climate vulnerability, in order to inform targeting of climate smart agriculture (CSA). The CSA-RA used key-informant interviews, participatory workshops, transect walks, farmer interviews, as well as gender-disaggregated methods to gather information on important agriculture-related features and constraints faced by farmers.

The CSA-RA was carried out in four districts: Bagamoyo, Kilosa, Kilolo, and Mbarali. Selection criteria included encompassing the high variability in climate and topography, land management practices, and socio-economic status within SAGCOT, as well as representing the developmental clusters identified by the SAGCOT Centre as having greatest opportunities for pursuing agriculture green growth.

Farmers in Bagamoyo, Kilolo and Kilosa depend on two cropping seasons: the long rains from March to June (referred to as 'masika') and the short rains from October to December (referred to as 'vuli'). The short rainy season is considered a secondary agricultural season, with a high unreliability. While farmers do cultivate during this time, they reduce both the number of crops and area of land to cultivate. In contrast, Mbarali district has only one main cropping season, which runs from December to July. The most important crops are pineapple/maize in Bagamoyo, rice/maize in Mbarali, maize/rice in Kilosa and maize/tomato in Kilolo. Main commercial crops are pineapple in Bagamoyo, rice in Mbarali and Kilosa, and onion and tomato in Kilolo. Commercial crops are mainly associated with men, while subsistence crops are mainly managed by women, across the four districts. Marketing of agricultural produce is considered a man's activity as women are perceived as poor negotiators and unable to effectively source for markets. This suggests the need to empower women with negotiating skills and provide market information.

Farmers in all the four districts perceive climate variability to be a serious challenge limiting agricultural production. More specifically, they cite unreliability of the onset and cessation of the rains, uncertainty about the duration of the rainy season, occurrence of too much rainfall, and the long dry spells that fall within the cropping season, as major constraints. Participatory analysis of climate in the past twenty years using historical calendars reported no major changes in rainfall amount and temperatures. Climate impacts however, included: influx of pests and diseases associated with too much rainfall; decline in water availability; famine; loss of livestock; and migration, especially for men. A major risk for agriculture production is dependency on rainfall, as only 17% of the cropped area is irrigated.

Food insecurity is prevalent across the districts. On average, households in Bagamoyo, Mbarali and Kilosa districts experience three months of the year where the family does not have enough food to provide for the family, and farmers in Kilolo district experiences this for two months of the year. This highlights the reliance on off-farm income. Adaptive approaches utilized by farmers in the study area include: engaging in off-farm employment; small business and kiosks; sale of livestock; growing irrigated crops along valley bottoms; and remittances. Farmers in all districts reported receiving remittances, while Bagamoyo had the highest percentage, followed by Mbarali, Kilolo and then Kilosa.

Conflict between farmers and pastoralists is a great challenge throughout the study site and more pronounced in in Bagamoyo and Kilosa. Pastoralists indicated that areas set aside as cattle corridors have been cultivated, which is a source of conflict when animals stray into fields. In addition, grazing land and water resources are inadequate. Water supply is also affected by climate variability which has motivated migration to valley bottoms or to other districts.

Overall, respondents across the study site rated the soil quality as good. However, high erosion prevalence was reported after heavy rainfall events, especially in Mbarali. Lower soil quality was reported in Mbarali as compared to the other districts. We noted gender differences in perception on soil quality, with higher scoring by women than men in Kilolo and Kilosa. To improve soil quality, thirty-nine percent of the farmers interviewed incorporate inorganic fertilizers, 29% crop residues, 9% organic manure, 8% deep ploughing to turn the soil, and 15% fallowing/minimum tillage. The use of inorganic fertilizers and pesticides is higher in Kilolo as compared to the other four districts.

Marketing was identified as another major challenge facing agriculture production in each of the four districts. Major issues include: lack of market information; inadequate market infrastructure; non-standardized weights and measures for the sale of the product; exploitation by farm-level brokers; and high transportation costs.

Agriculture mechanization is low, with the majority of farm operations, including land preparation, weeding, harvesting, post-harvest activities and livestock management, performed manually. Mechanized tools, mainly tractors and ox-ploughs, are used in less than 5% of the households surveyed. Evidence indicates that disparities exist between men's and women's access to and control over key assets. Women in the study site generally have fewer assets and rights than do men, and have lower ownership and control of both land and agriculture tools.

The institutional mapping revealed that most of the networks are highly de-centralized. The controls over resource and information flows are spread across several actors, implying that there are no central actors in the networks. Therefore, several partners will need to be targeted for effective outreach strategies. There is need to strengthen

collaboration and communication between actors in order to harness synergies, as several organizations have similar objectives. Non-governmental actors were more prominent and ranked as providing important services to the communities including health, credit, education, and agriculture.

Community demonstration plots were lauded for improving access to information on agronomic practices and improving the capacity of farmers to adapt to new technologies. The success of demonstration plots can be achieved by promoting group participation and community ownership of activities and ensuring close interaction between the implementers and the community. Barriers to adoption of new technologies included biophysical factors such as the soil texture, lack of technical knowledge, lack of financial capital, social preference, poor road network and lack of markets. Agricultural extension agents are the most important source of information for both genders. However, this service is not available to pastoralists. Farmers' social networks reinforce extension messages and increase the uptake of technologies. Active participation of youth in agriculture is challenged by unavailability of mechanized tools, high input costs especially fertilizer and improved seed, high cost of transportation, lack of storage facilities, lack of markets, poor road network and lack of social amenities in rural areas.

Children from a male-headed household were more likely to obtain higher education compared to children in a female-headed household. Furthermore, female-headed households also had a higher percentage of primary school dropouts and very few members attained post-secondary school level education.

Overall, this CSA-RA highlighted the challenges facing farmers in four districts across the SAGCOT and identified key next steps for identifying and implementing locally appropriate CSA practices across the region.

1. Introduction

This Climate Smart Agriculture Rapid Appraisal (CSA-RA) exercise in the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) is part the CIAT-CCAFS project titled, "Increasing Food Security and Farming System Resilience in East Africa through Wide-Scale Adoption of Climate-Smart Agricultural Practices". Information gathered in the CSA-RA will be used to inform activities within the CIAT-CCAFS project, as well as other initiatives. This report is a detailed and comprehensive summary of the information obtained during the CSA-RA, structured by activity.

1.1. Objectives of the CSA-RA in the SAGCOT

1. To obtain a preliminary understanding of the farming systems, household characteristics, infrastructure, land tenure, and other important agriculture-related features.
2. To identify farmers' perceptions of weather patterns (e.g., climate variability) and its perceived impact on agricultural production.
3. To obtain a preliminary understanding of major challenges and constraints faced by farmers (i.e., climate variability, land health, specific cropping and/or livestock issues, markets, etc.) across the four districts.
4. To identify CSA, agronomic, and land management practices currently utilized by farmers as well as assessing demonstration plots of these practices.
5. To identify opportunities for mainstreaming CSA and potential social, economic and/or institutional barriers to adoption.
6. To guide the final selection of sites for future land health surveys and demonstration trials of climate smart agriculture practices.

1.2. Site selection

The CSA-RA focused on the Southern Agricultural Growth Corridor of Tanzania (SAGCOT). SAGCOT covers approximately one-third of mainland Tanzania. It extends from the north to the south of the central rail, road and is the power 'backbone' that runs from Dar es Salaam to the northern areas of Zambia and Malawi (Figure 1). The SAGCOT was initiated at the World Economic Forum Africa summit in May 2010. Its Greenprint proposes a set of 'Agriculture Green Growth' (AGG) strategies that seek to increase yields, increase crop production per unit input, reduce waste and pollution, increase farm profitability, and conserve the natural resource base upon which agriculture depends (SAGCOT Centre Limited). Development of the corridor is outlined

following a cluster approach. The six clusters identified are: Sumbawanga, Ihemi; Kilombero; Mbarali; Rudewa and Rufiji (Figure 1).

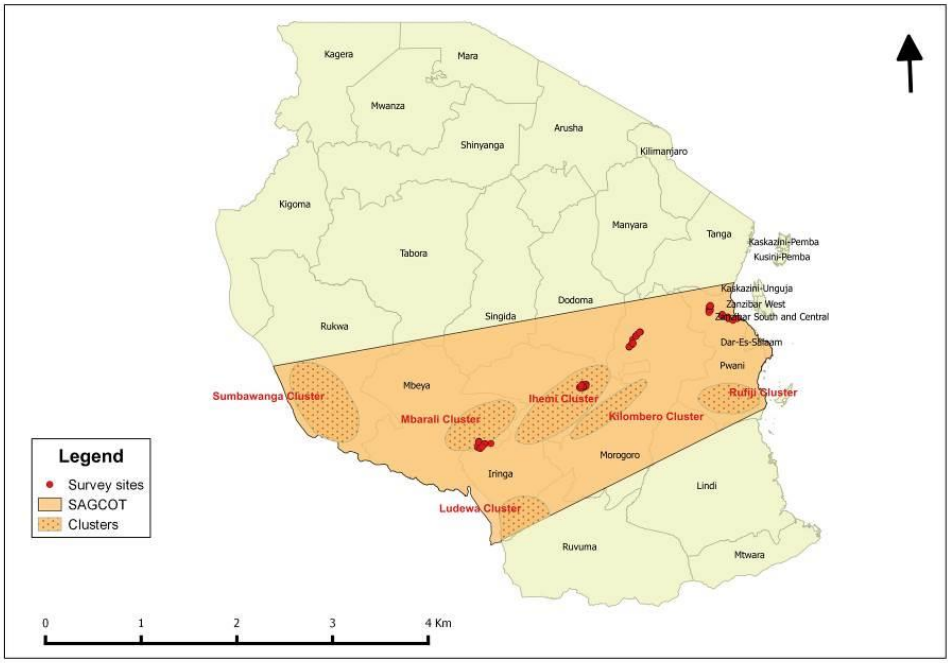

Figure 1: Map showing location of the SAGCOT, development clusters and CSA-RA survey sites are highlighted.

Four districts within SAGCOT were selected for the CSA-RA: Bagamoyo; Kilolo; Kilosa; and Mbarali to capture variability of climate and topography, which is expected to be reflected in variability in farming systems (Figure 2). Kilolo and Mbarali are in the Ihemi and Mbarali clusters, respectively, and are highlighted by the SAGCOT Centre as areas where opportunities for pursuing agriculture green growth are particularly ripe.

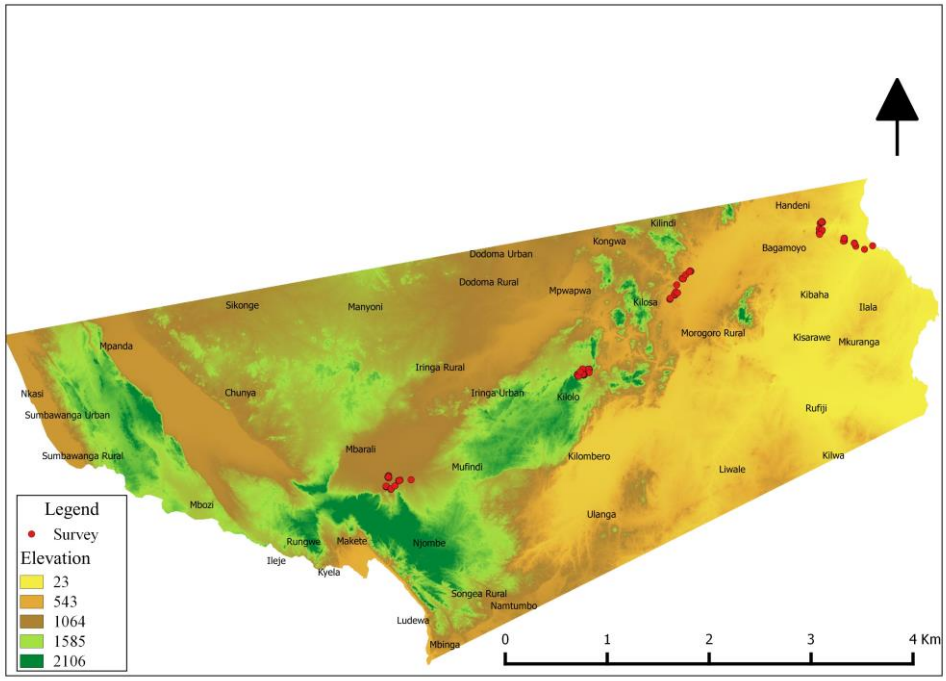

Figure 2: Elevation map (in meters) of the SAGCOT showing location of the surveyed sites.

The CSA-RA was implemented at a district level. Within the districts, wards were selected to capture: climate, topography and socio-economic variability. In each district a minimum of four villages were visited for the farmer interviews (see Appendix A). To select households within the villages, probability sampling was used. A list of all farming households was obtained for each village and a simple random sampling technique applied. In this respect, every household in the population had a known nonzero probability of being selected. GPS coordinates for all sampled households were collected.

2. Methodology

A multi-disciplinary team, which included team members from CIAT in collaboration with Sokoine University, conducted the CSA-RA in September to October 2014. Participatory tools and techniques were used in collecting primary data. Secondary information was also collected to inform the fieldwork and identify key informants. The following subsections include a short description of the tools employed in the CSA-RA. The CSA-RA tool is available for download and is freely available on the Harvard Dataverse web portal under the CGIAR Research Program, Climate Change, Agriculture and Food Security (CCAFS) Adaptation Project, as well as on the CCAFS

website.

2.1. Semi-structured interviews with key informants

Key informants were identified and included district level agricultural officers, livestock officers and extension agents. A questionnaire was developed to guide the discussion with key informants which included the following modules: farming systems; key institutions in the region; gender dynamics; activities of the institutions; basic household characteristics; important crops and livestock of the district; crop and livestock management practices (current, past and recommended); land tenure issues; perceived climate variability; challenges facing farmers in agricultural production, market access, input availability, credit access, pest and diseases, and seed supply.

2.2. Farmer workshops

A workshop was held with 30-40 local farmers in each district. These workshops were organized with the assistance of the district agricultural office and aimed to have good representation of men, women and youth. Several activities undertaken during the farmer workshops are discussed below.

2.2.1. Guided discussion

The guided discussion was used as an ice breaking exercise and to: 1) identify residence of participants; 2) identify the different crops and livestock in the region; 3) understand some of the gender agricultural norms; 4) understand the primary uses of the crops (e.g., home consumption vs. cash crop); and 5) identify the most important crops and common crop varieties.

2.2.2. Village resource maps

The village resource mapping was used to show information regarding distribution, occurrence and access to resources in the village including forests, community open land, human settlement, livestock, social infrastructure such as government offices, schools, churches, health centers, markets, water points, forests, etc. This exercise was also used to discuss changes in the community's resources over time (Figure 3).

Figure 3: Village resource mapping exercise at Kilosa district.

2.2.3. Climate calendar

This activity was used to understand typical weather patterns. Farmers were asked to indicate weather events in a typical year, wet year (heavy rainfall) and dry year (drought), to discuss overall impact of weather on agricultural production and to recall common and extreme weather events (strong winds, hail, floods, etc.) (Figure 4).

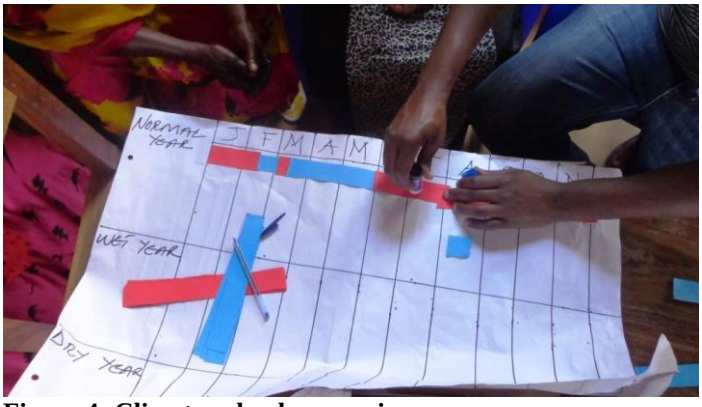

Figure 4: Climate calendar exercise.

2.2.4. Historical calendar

The historical calendar was used to indicate climate (rain, temperature), resources (soil, water, trees) and agro activities (crop production, cultivated area, livestock) levels over the past 20 years on a scale of 1-to-5 (where 1 is very low and 5 is very high).

2.2.5. Cropping calendar

A cropping calendar was used to identify the activities related to agricultural production for specific crops in a typical year. Specifically, who performs them, times for each farming activities, busiest months, and the labour demand for men, women and children.

2.2.6. Institutional/organization mapping using Venn diagrams

Venn diagrams were used to document the local institutions and groups utilized by farmers. After naming all the institutions, participants ranked each in terms of its relative importance (using small, medium, and large circles). The circles were placed relative to each other to symbolize linkages between different institutions as follows: Separate circle = no contact; Touching circles = information passes between institutions; Small overlap = some co-operation in decision making, planning and/or implementation; and Large overlap = a lot of co-operation in decision-making, planning and/or implementation (Figure 5).

Figure 5: Institutional mapping exercise at Bagamoyo District.

2.3. Village and farm visits

Four to eight villages were visited in each district during which transect walks and household interviews were conducted (Figure 6).

2.3.1. Farmer interviews

Farmer interviews were conducted with the principal decision-maker in the household (male or female) by use of a questionnaire. Information was collected on household assets, perception of soil health, land tenure, agricultural production, farm income, expenditures, input use, off-farm income, vulnerability to shocks, food security, agricultural practices currently utilized and crop production challenges. The respondents were also asked to assess demonstration plots in the community and give recommendations on how they would like them implemented.

Figure 6: Farm visit at Msata village, Bagamoyo District.

2.3.2. Transect walks

A transect walk through the village and individual farmer's fields was conducted to identify food and cash crops, landmarks, soil and vegetation patterns, socio-economic indicators, livestock types, and forestry practices. Specifically, the transect walk was used to familiarize the team with the biodiversity and the resource endowments with the aim of gaining a visual understanding of the challenges and opportunities for agriculture in that area. During the transect walk, existing demonstration plots were visited. Discussions with the implementers, as well as participating and non-participating farmers focused on the impact, management, and perceptions of the demonstrations. Photos were taken of key landmarks and GPS coordinates noted.

3. Results and Discussion

3.1. Participation in the CSA-RA

A hundred forty one farmers attended the workshops, and an additional 98 were interviewed during the farm visits (Appendix A). The percentage of male and female farmers was 57% and 43%, respectively. Expert interviews were held separately with 28 district and local-level officials who included agricultural, livestock and extension officers. The farmer interviews were carried out in a total of 17 wards and 24 villages in the four districts. Table 1 below presents the total number of wards and villages surveyed.

Table 1: Total number of wards and villages in the four districts

District	Total number of wards	Total number of villages
Mbarali	20	99
Bagamoyo	22	97
Kilosa	35	108
Kilolo	22	106

3.2. Household and farm characteristics

From interviews with key informants, women typically performed the role of nurturing the family as well as food provision through small-scale farming activities. Nevertheless, they also assisted the men in farming activities such as planting, weeding and harvesting. In regards to making decisions (both agricultural and non-agricultural), it was reported that most decisions were made by the men in all the districts. Women, on the other hand, made decisions regarding the private space (i.e. nurturing, cooking and generally taking care of the home). However, even in these decisions women consulted with the men and decisions made were out of co-dependence. Some of the decisions that were made jointly included: renting of land, selling of produce (even though women did not necessarily handle the cash in the household) or marrying/off a son and daughter. The main religion in Kilosa was Christianity with a few Muslims, whereas in Bagamoyo, Kilosa and Mbarali it was a near equal split between Christianity and Islam.

From the farmer interviews, we established that the average family size was six in Bagamoyo, Kilosa and Kilolo, and five in Mbarali. Sixty four percent of the households were male-headed. Monogamy is practiced in about 80% of the households. The main livelihood source is agriculture for 95% of the respondents, with 62% practicing both subsistence and commercial crop farming. Secondary sources of income include off-farm labour, charcoal burning, small shops, food kiosks and masonry. Households in Kilosa, Mbarali and Bagamoyo also practice fishing and brick making. In Kilolo, brewing of local beer is practiced. The average farm size of the households surveyed was 2.5 hectares ha in Bagamoyo, 1.9 ha in Kilosa, 2.4 ha in Kilolo and 2.2 ha in Mbarali (Table 2).

Table 2: Household and farm characteristics by district

District	Bagamoyo	Kilosa	Kilolo	Mbarali
Average age of respondent	49 years	48 years	44 years	40 years
Average household size	6	6	6	5
Education of respondent	Primary (P7)	Primary (P7)	Secondary (Form 4)	Primary (P7)
Highest grade obtained in the household	College (1 year)	College (3 years)	Bachelor's degree	Bachelor's degree
Second main occupation	Charcoal burning	Small business	Small business	Small business
Average number of years farming	21	21	20	16
Mean farm size (Hectares)	2.48	1.93	2.40	2.21

The majority of the respondents surveyed in Bagamoyo, Kilosa and Mbarali obtained primary education (P7 level), while in Kilolo the majority obtained secondary (O-level) education (Figure 7). Children from a male-headed household were more likely to obtain higher education compared to children in a female-headed household (Table 3). Furthermore, female-headed households also had a higher percentage of primary school dropouts. . Very few members of female-headed households attained post-secondary school level education (Figure 8).

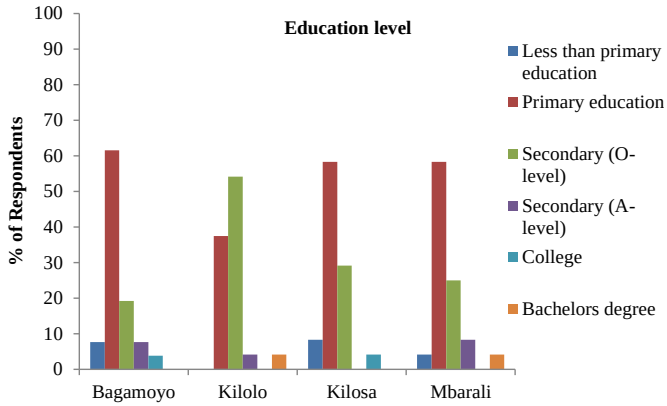

Figure 7: Education levels obtained in the household across the districts

Table 3: Household and farm characteristics of female- and male-headed households

Human or physical asset	Male-headed household	Female-headed household	p-value
Average age of head	48 years	51 years	0.45
Highest grade obtained	Bachelor's degree	Bachelor's degree	
Household size	6	5	0.06
Number of years farming	22	22	0.93
Total farm size, Hectares	2.69	1.88	0.08
Average number of plots	2	2	
Average land size rented (Ha)	0.31	0.15	0.18

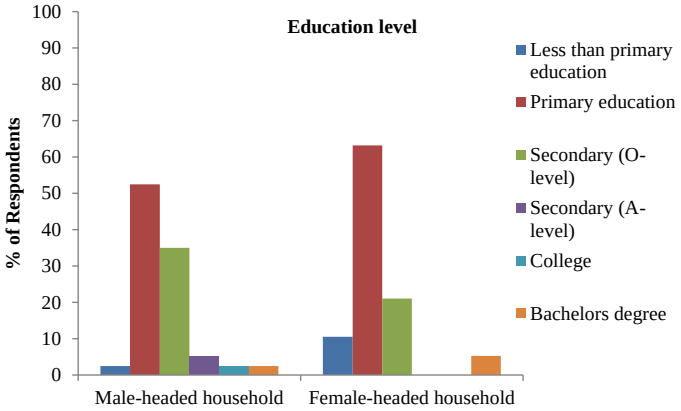

Figure 8: Education levels in male- (n= 63) and female-headed (n= 35) households

3.3. Farming systems

The SAGCOT includes a range of altitudes and climates as well as diverse soil types and vegetation (APPENDIX D: MAPS OF THE STUDY SITE). The CSA-RA established that rainfed agriculture is the most common practice on small-scale farms for subsistence crops. Small-scale irrigation systems, cover 39.8 hectares, about (17%) of the total reported farmed area. Irrigation is highly dependent on availability of water from the rivers and wells. Main irrigated crops are maize in Bagamoyo, rice in Mbarali and Kilosa, tomatoes and onions in Kilolo. Table 4 summarises the principal farming systems in the study site. Maize production dominates, although the southern corridor is also an important rice producing area. Appendix A presents the five most important crops in each district surveyed. Land preparation across the survey site is usually manual using hoes accompanied by direct seeding. The main land management practices include: mulching, intercropping, agroforestry, rain harvesting, irrigation, contour planning, fertilizer use and compost. In Bagamoyo farmers mainly practice intercropping such as maize with sesame, and maize with cowpea.

Table 4: Farming systems in the study site

Location	Farming system	Characteristics	Main challenges
Mbarali	Rice/Maize	-Other important crops are beans, sorghum and vegetables -Practicing system of sustainable rice intensification (SRI) -Villagization system still practiced has reduced crop-livestock conflict -Farmers rate soil quality as good	-Water shortage and competition for water resources for irrigation -Large capital required for rice production that is difficult to access by most farmers -Poor markets -Improved varieties promoted through SRI are difficult to market as they are not yet accepted locally.
Kilolo	Maize/ Horticulture	-Most important horticultural crops are tomatoes, onion and capsicum which are cultivated for sale -Other important crops are sunflower and beans	-Lack of market information -Exploitation by farm-level brokers -Poor market prices
Kilosa	Maize/ Rice	-Other important crops are sesame and cowpea -Farmers rate soil quality good -Has a total of 32 rice schemes, 12 are part of the national irrigation scheme	-Pastoralist conflicts -Poor quality road network -High cost of inputs -Lack of access to credit
Bagamoyo	Pineapple/ Maize	-Other important crops are cassava, sorghum and sesame -Limited intensive grazing is practiced -Tree crops dominated by coconut and cashew -Large-scale sugar cane outgrower scheme planned	-Pastoralist migration especially at Ruvu and Wami river basins creating conflicts with farmers. -Agricultural operations are mostly manually performed. -Poor markets and storage -Lack of knowledge on modern production techniques -Lack of access to credit

3.4. Land access and farm size

On average, households have two hectares of land allocated across separate plots (between one and five) (Table 2). The average distance of the farms from the homestead was ~2.7 km in Bagamoyo, 2.3 km in Mbarali, 2.4 km in Kilosa and 1.6 km in Kilolo. In Bagamoyo, farmers reported that fields over 3 km from the homestead are men's fields and mainly used to grow maize. Majority of plots in all the four districts are located on flat land.

Land acquisition is predominantly through inheritance (45%), followed by purchase (32%) and allocation by the local government (16%) across the districts (Figure 9).Only seven percent of the farmed area was obtained by renting. The number of farmers who obtained land through renting was higher in Kilolo, followed by Mbarali and Kilosa (Figure 10). In Bagamoyo, less than 5% of the farmers reported renting land. The high cost of renting land was reported as a challenge in Kilolo and Mbarali. Male-headed households have larger farm sizes (both owned and rented) as compared to the female-headed (Table 3).

Discussions with farmers in the four districts revealed that inheritance of land among both men and women is considered a birthright. Women in general have less access to and control over land than men. Specifically, farmers in Kilosa indicated there are equal rights to land access through inheritance but not through marriage. Women in Kilolo reported that they did not have equal rights to land access, and also less power in decision making on land access. Presently, men are the main landowners and land titling is a recent development, for example, in Kilolo district. The experts reported that access and use of land is through purchase and inheritance and from further probing it was worthwhile to note that land inheritance was linked to kinship ties embedded in a wider patriarchal structure. The experts observed that while women do own land, as is the case in Mbarali, this is skewed to the men with the ratio standing at 26% to 74%. Widows can inherit land. However, the process of inheritance is more complex, especially if the widow has no children. In Bagamoyo, the experts reported that a widow can inherit land if she has children, however, if she has no children then her male in laws inherit such land. Notably, having children is not a guarantee to land ownership, if the children are male then such land is passed on to the widow's male children. The implication is that women are structurally excluded from positions of power and authority and in this specific context, ownership and access from land. The experts acknowledged that women faced the following challenges when it comes to access and ownership of land, lack of financial empowerment, socio-cultural barriers, and shortage of land. Further discussions with the women revealed that they mainly access land through matrimony, and they had no decision-making rights.

Farmers reported challenges related to unequal distribution of land especially by the local government and the existence of large tracks of land that is not in use. More than this, ownership of land is shaped by the power dynamics within specific districts. For example, in Kilosa, rich men own land whereas their poorer counterparts rent. This pattern is also demonstrable in Bagamoyo where financial power determines ownership of land. In Kilolo, it was indicated that most of the land is owned by the government and farmers rent yearly which is a setback to agriculture production. However, there are some few farmers who own large tracks of land part of which they rent out to other farmers. Further discussions with experts revealed that the land acquisition system in Mbarali is mainly customary (the experts observe that this is the reason there is high inequality in land distribution of land). Kilolo and Kilosa were also primarily customary whereas Bagamoyo was a mix of both customary and leasehold. Farmers in Kilolo

reported unwillingness make investments on rented land such as application of organic manure.

The discussions highlight the complex nexus of land, ownership, access and privilege. Besides access and ownership being shaped by kinship ties and patriarchy, they were also shaped by privilege and financial endowment.

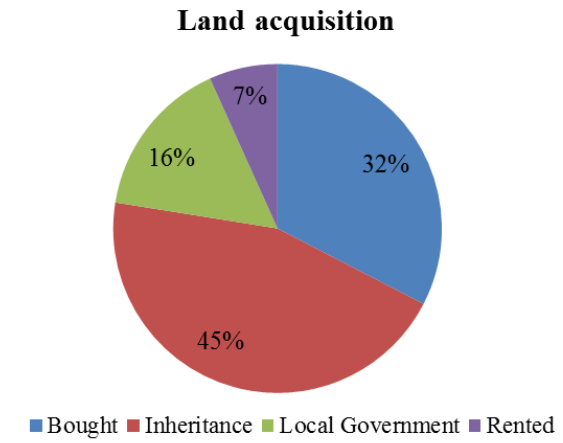

Figure 9: Land acquisition summarized across the four districts

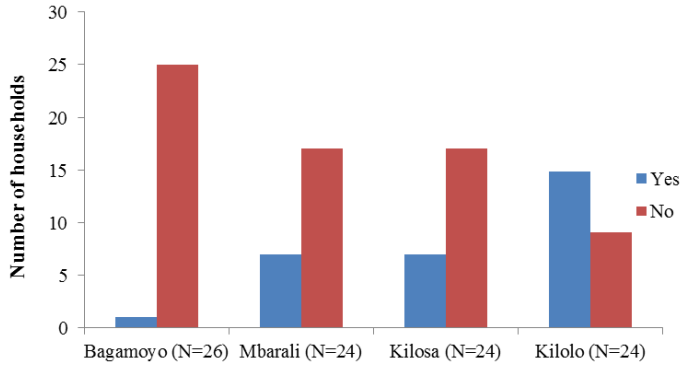

Figure 10: Number of households renting land by district

3.5. Soil health

Overall respondents across the study site rated the soil quality as good (Figure 11). Only 10% of the respondents in Kilolo and 5% in Bagamoyo reported soils of poor quality. To improve soil quality, 39% of the farmers incorporate inorganic fertilizers, 29% crop residues, 9% organic manure, 8% deep ploughing to turn the soil, and 15% fallowing/minimum tillage (Figure 12). Incorporation of crop residues is the main practice in Bagamoyo and Kilosa. In Kilolo, farmers burn residue because of high infestation by ants. Farmers in Bagamoyo indicated that stray animals damage the crop residues. Soil erosion was reported in all districts and especially in El Nino years. Thirty-percent of the households reported regular erosion on their land. For example in Kilolo, farmers reported soil erosion due to heavy rains and especially in 1997-1998. Less than 10% of the farmers challenged by soil erosion have undertaken control measures such as planting cover crops, grasses or trees.

Although the soils in the area were characterized as fertile, soil compaction was reported in some areas e.g., in Mbarali, farmers reported soil compaction resulting in reduced water infiltration. Incorporation of crop residue is low as it is used for fodder. The low use of soil management practices such as incorporation of organic manure and residues, low adoption of fallowing and crop rotation will likely to lead to soil fertility declines.

There is also widespread use of fuel wood in the entire region and logging in the southern parts. This, together with the fact that charcoal production is an important source of livelihood during periods of vulnerability, has led to degradation of soil cover in the targeted areas. This has potential implications for soil fertility at larger scale, soil erosion, as well as retention of soil moisture.

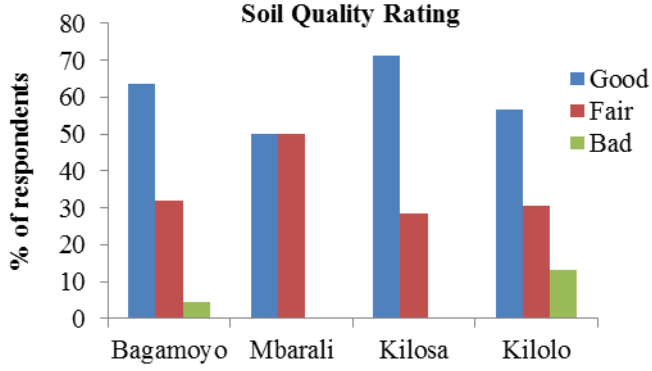

Figure 11: Rating of soil quality by respondents in the study site

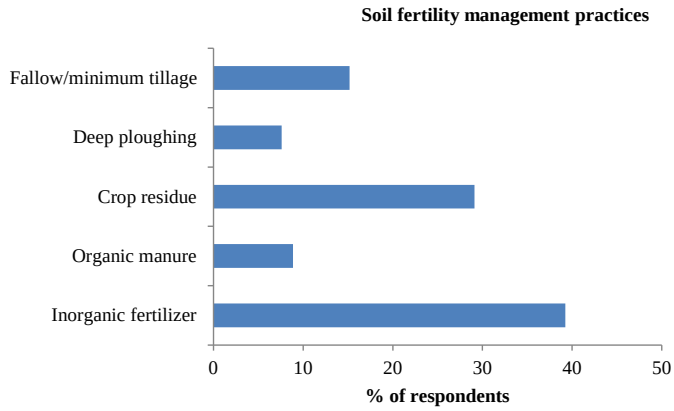

Figure 12: Soil fertility management strategies in the study site

3.6. Agricultural production

Although reported yields by farmers do not represent absolute yields, Table 5 demonstrates the differences in crop yields achieved across the districts. It considers five major crops across the study site. Kilolo has the highest yields for maize and sunflower, with Mbarali achieving the highest yields for rice and Kilosa having the highest yields for sesame.

Maize ranks as the most important food crop across the four districts (see Appendix B).Maize production and sales quantities are higher in Bagamoyo and Kilolo compared to Mbarali and Kilosa. The difference in annual production is also high. However, the proportion sold by the household is highest in Mbarali, which is about 97% of total production, in Bagamoyo and Kilosa it is 67% and Kilolo 51%. For example, Bagamoyo has an average production of about 23 bags compared to an average of about 15 bags for all the rest of the districts. Mbarali and Kilosa on average produce about 10 and 12 bags of maize respectively, which is significantly lower than the average for the other two districts which is 19 bags for each.

Mbarali and Kilosa are major rice producing districts. The average production among the farmers interviewed was 53 bags in Mbarali and 15 bags in Kilosa with 20% of the rice produced in Mbarali and 26% of the rice produced in Kilosa is sold.

Sunflower is also grown in Kilosa and Kilolo. Farmers in Kilolo reported higher production (12 bags) compared to 4 bags in Kilosa. Sesame is common in Bagamoyo and Kilosa. Kilosa, however, has a higher production (240 kg) compared to 177 kg in Bagamoyo. Results indicate that about 14% and 16% of the sesame produced in Bagamoyo and Kilosa is sold. There are oil extraction services offered within the townships in Bagamoyo and Kilosa. Most of the oil is used for home consumption and the rest sold from the farm.

Compared to the other three districts, tomato production and sales are highest in Kilolo. Tomatoes are usually measured in a local unit called "*tenga*" which is equivalent of 60 kg. Results from the farmers interviewed showed that, production is about 111 tenga. Tomato is produced for commercial sale. Table 6 presents the average household income from sale of each of the selected crops (see APPENDIX C: COMMON UNITS OF MEASURE USED BY FARMERS).

Table 5: Annual crop production, by district and crop

		Maize (bag)		Rice (bag)		Sunflower (bag)		Sesame (bag)		Tomato (Tenga)	
		Produced	Sold	Produced	Sold	Produced	Sold	Produced	Sold	Produced	Sold
Bagamoyo	Mean	22.98 (23.90)	15.50 (11.96)	-	-	-	-	177.08 (155.37)	151.67 (132.73)	-	-
	Median	18.00	14.50	-	-	-	-	100.00	100.00		
Mbarali	Mean	9.63 (9.17)	9.40 (11.99)	53.33 (89.25)	41.44 (83.87)	-	-	-	-	-	-
	Median	6.00	3.00	26.00	14.00	-	-	-	-	-	-
Kilosa	Mean	11.63 (12.17)	7.73 (11.11)	15.08 (10.79)	11.11 (8.40)	4.00 (1.00)	3.67 (0.58)	240.00 (183.07)	200.00 (104.08)	-	-
	Median	10.00	3.00	10.00	8	4.00	4.00	200.00	200.00	-	-
Kilolo	Mean	23.10 (23.60)	11.80 (15.33)	-	-	12.50 (6.36)	8.72 (5.63)	-	-	111.28 (108.47)	110.48 (107.71)
	Median	17.00	6.50	-	-	12.5	7.00	-	-	75.50	75.50

Note: Figures in parentheses are standard deviations

See appendix C for units of measure and conversion

Table 6: Annual crop income, by district and crop in Tanzanian shilling

		Maize	Paddy	Sunflower	Sesame	Tomato
Bagamoyo	Mean	640000 (590000)	-	-	310000 (300000)	-
	Median	600000	-	-	200000	-
Mbarali	Mean	400000 (480000)	2200000 (4200000)	-	-	-
	Median	100000	870000	-	-	-
Kilosa	Mean	270000 (390000)	590000 (550000)	130000 (20207)	640000 (1100000)	-
	Median	140000	350000	140000	260000	-
Kilolo	Mean	490000 (750000)	-	310000 (190000)	-	2400000 (3200000)
	Median	260000)	-	250000	-	850000

Note: Figures in parentheses are standard deviations

1 USD is equivalent to 1700 TSh

Farmers were also asked about labour demands and allocation for crop management activities ranging from land preparation to harvesting and transportation from the farm to home. For each crop, the farmer was asked to describe the different activities involved. Subsequently, the farmer reported how many people from his/her family engage in the activity and whether or not labour is hired for the activity. The total number of people for an activity was calculated as number of people involved multiplied by the number of times the activity is performed and how long it takes to complete the activity each time. Table 8 provides results of family labour use while Table 9 shows allocation of hired labour by activity and district. As shown, generally all the main activities are demanding in terms of labour.

Among the activities, however, weeding and harvesting were the most demanding in terms of labour allocation across all the districts. Farmers who hired labour were also asked to report how much on average they pay to hire labour for the respective activity. The total cost of hired labour was obtained by summing up the cost for the different activities for each farmer. Table 7 presents the average cost of hiring labour by district. Results indicate that the average cost of hired labour is highest in Mbarali (TSh 192,257) and lowest in Kilolo (TSh 32,775). The high cost in Mbarali is as a result of high demand for labour in rice production. Below is a summary of the average labour costs for rice, maize and beans in Mbarali.

Table 7: Average labour in cost for important crops in Mbarali district (TSh)

Activity	**Rice**	**Maize**	**Beans**
Land preparation	50000/acre	20000/acre	15000/acre
Ploughing	50000/acre	50000/acre	50000/acre
Harrowing	50000/acre	Not practiced	20000/acre
Planting	50000/acre	30,000/acre	40,000/acre
Weeding	50000/acre	50,000/acre	40,000/acre
Harvesting	50000/acre	40000/acre	25000/acre
Drying	40000/acre		
Transportation		Power tiller = 30000 Tractor = 40000 1000/bag	Power tiller = 30000 Tractor = 40000 1000/bag
Threshing	3000/ bag	200/debe	15000/day
Winnowing	1000/bag	Not practiced	500/bag
Bagging	500/bag	500/bag	500/bag

Bag = 8 debe; 1 debe = 20 kg

On average the cost of labour for each rice management activity such as weeding, planting, harvesting and transportation is TSh 50000 per acre. The average cost of threshing is TSh 3000 per bag of paddy and winnowing TSh 1000 per bag.

Generally, the use of external inputs including fertilizer, herbicides, and pesticides varies across the districts. The four commonly mentioned fertilizer types include DAP, CAN, Urea, and KEN. DAP was the most commonly used fertilizer across the three districts. As shown in below in Figure 13, the use of DAP fertilizer and pesticides for crops is higher in Kilolo compared to Mbarali and Kilosa. Notably Kilolo is well-known for tomato production. Mbarali, however, has a higher use of herbicides compared to Kilosa and Kilolo. The main crop in Mbarali is rice. Results show that on average, farmers spend about TSh 57,000, TSh 42,000 and TSh 56,000 in Mbarali, Kilosa, and Kilolo respectively on external inputs.

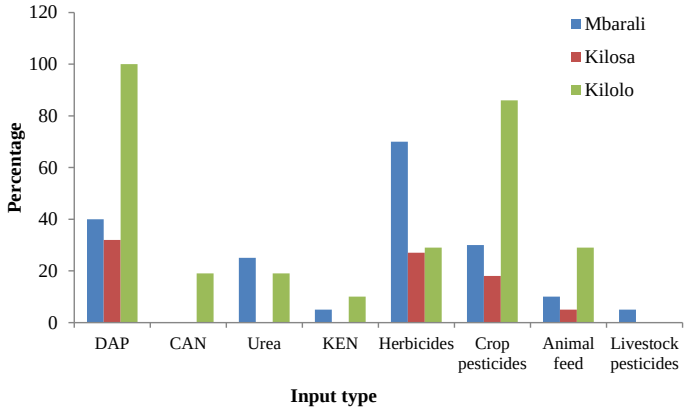

Figure 13: Input use by district

Table 8: Family labour, number of persons per season

	Mbarali			**Kilosa**			**Kilolo**		
Activity	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Maize									
Land preparation	15	9.47	18	42	70.79	24	40	39.31	28
Planting	16	6.24	18	45	74.44	22	23	11.02	28
Weeding	24	25.55	16	59	83.13	24	29	21.84	28.00
Spraying	-	-	-	-	-	-	54	9.19	53
Harvesting	24	26.63	18	59	83.13	24	31	18.14	28
Transportation	49	38.14	28	-	-	-	-	-	-
Rice									
Land preparation	22	23.10	14	18	26.93	9	-	-	-
Planting	27	30.38	12	27	29.78	18	-	-	-
Weeding	31	31.46	22	34	33.63	18	-	-	-
Spraying	5	1.41	5	-	-	-	-	-	-
Harvesting	31	33.45	17	31	30.59	19	-	-	-
Transportation	29	6.36	29	-	-	-	-	-	-
Sesame									
Land preparation	-	-	-	49	46.48	57			
Planting				52	42.54	57			
Weeding				80	27.32	72	-	-	-
Harvesting				84	37.48	84	-	-	-
Tomatoes									
Land preparation							29	27.40	26
Planting							39	31.05	28
Weeding							31	28.25	27
Spraying							36	31.43	35
Harvesting							40	27.79	35

Note: Labour is measured in number of persons

Table 9: Hired labour, number of persons per season

	Mbarali			Kilosa			Kilolo		
Activity	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Maize									
Land preparation	32	35	26	20	20.21	13	28	23.22	30
Planting	-	-	-	21	19.08	16	-	-	-
Weeding	32	35.61	17	34	19.50	32	26	21.76	17
Harvesting	76	9.19	76	22	12.18	23	46	3.54	46
Transportation	54	40.31	54	-	-	-	-	-	-
Rice									
Land preparation	30	39.51	16	12	14.36	10	-	-	-
Planting	46	47.83	18	55	35.36	55	-	-	-
Weeding	54	49.32	29	58	31.11	58	-	-	-
Harvesting	52	52.12	23	49	27.30	36	-	-	-
Transportation	62	58.29	43	12	14.36	10	-	-	-
Sesame									
Total hired labour				10	7.55	9	-	-	-
Tomatoes									
Total hired labour	-	-	-	26	33.10	12	-	-	-

3.7. Agricultural inputs

Farmers in Kilosa, Mbarali and Kilolo reported that inputs such as seed, fertilizer, pesticides and herbicides were readily available. In Bagamoyo, they indicated that inputs were not easily available, and seed quality was poor. As a result, farmers preferred using local seed varieties. In Kilosa they indicated that seed and fertilizer were unavailable on time, were of low quality (seed and pesticides) and they incurred high price of inputs. For example a 1 kg of maize seed is 2000 TSh (app USD 1.20). In all the four districts it was reported that inputs cost were high and not easily affordable. For example, Kilolo was a case in point where NPK cost TSh75000 (app USD 45), CAN cost TSh44000 (app USD27) UREA TSh50000 (app USD 30) and DAP cost TSh68000 (app USD 41). In addition, some inputs in the market were of low quality especially pesticides. Farmers also cited lack of knowledge in the proper use of inputs e.g. on the proper seed density, of the most appropriate crop varieties, fertilizer type and pesticide type. In cases where the farmers accessed inputs, these were not delivered on time e.g. fertilizer.

Table 10: Average cost of renting land, labour and inputs (TSh)

Variable	Mbarali		Kilosa		Kilolo	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Cost of renting land	160000	72801	78571	38591	78036	45932

Labour cost	192257	128354	94056	75081	32775	23178
Input cost (fertilizer, herbicides, and pesticides)	57037	50034	42172	32595	56488	39045

3.8. Pests and diseases

Pest and disease outbreaks, especially thrips and army worms were reported as limiting agricultural production. In Bagamoyo, infestation of thrips is a big problem for maize and sesame. Farmers lack knowledge on the proper use of pesticides and financial resources to access to control the diseases. However, it was observed that there was high pesticide use in Kilolo for tomato plants. In this district, farmers indicated a high incidence of tomato pests and diseases, with blight attacks being prevalent.

3.9. Seed supply

We observed that farmers had access to improved seeds in the four districts. However, important challenges were the high seed prices, presence of adulterated seed (especially maize and horticultural crops), and too few agro-dealers (e.g., they were stationed far from many households). Bagamoyo farmers cited poor seed quality, which resulted to the use of local seed varieties. Kilosa indicated that seed were not available on time, and the seeds were of low quality and high price (1 kg of maize seed is app USD 1.20).

3.10. Crop calendars and agronomic practices based on information from the farmers workshop

Gender disaggregated cropping calendars were developed during the workshops for crops perceived as the most important by each group (Figure 14 to Figure 21).

A. Bagamoyo district

The women's group in Bagamoyo selected maize, sesame, cowpea and cassava as their most important crops (Figure 14).

1. Maize is grown both in the long and short rains season. However during the short rains farmers reduce the area under cultivation. Farmers reported that the short rains are not reliable and manage to harvest produce only for home consumption.
2. Land preparation for maize is carried out by men because it requires considerable effort and time, to avail time for women to engage in domestic activities. Planting and weeding, harvesting and threshing are less demanding and are carried out by the whole family.
3. Wild animals e.g. wild pigs, monkeys and guinea fowl are a great challenge in

Bagamoyo. Men relocate to live in temporary shelter in the fields after grain filling to guard the crops from animals.

4. Land preparation for sesame, cassava and cowpea is labour intensive and carried out by men.
5. Sowing sesame seed is also done by the couple because it requires greater attention and skills. Threshing also requires keenness to avoid mixing the seed with sand and is carried out by adults.

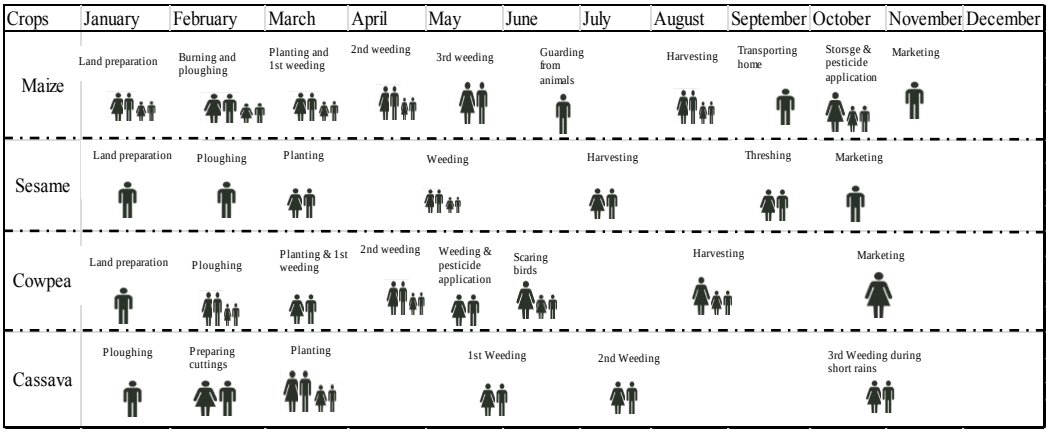

Figure 14: Crop management activities by month for maize, sesame, cowpea, and cassava as detailed by the women's group in Bagamoyo district.

The men's group in Bagamoyo selected maize, pineapple and cassava as their most important crops (Figure 15).

1. Pineapple management is carried out by men because most activities e.g. land preparation, weeding and fertilizer application is physically demanding and they also have a sharp point on the tip of the leaf and spines along the margins of the leaves that cause injuries.
2. Pineapple requires high capital investment limiting women's participation in its production.
3. Cassava land preparation and weeding is less labour intensive and is carried out by the whole family. However, weeding is a delicate process and therefore children are not involved.

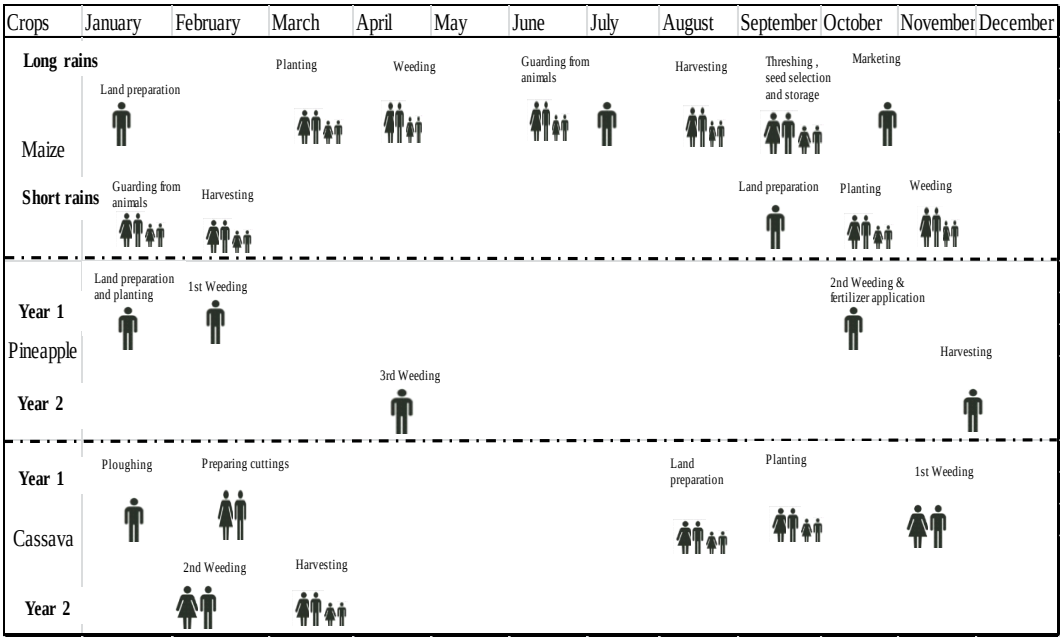

Figure 15: Crop management activities by month for maize, pineapple, and cassava as detailed by the men's group in Bagamoyo district.

Bagamoyo has two cropping seasons but the second season is considered as minor for crop production. Farmers reduce the area cultivated in this season and also grow fewer crops, notably maize, sorghum and cassava. Previously sugarcane was also an important crop but has been abandoned due to the difficulty in accessing planting material.

B. Mbarali district

The women's group in Mbarali district selected rice, maize, and groundnuts as their most important crops (Figure 16).

1. Weeding in rice fields is considered easy and less time consuming, therefore carried out by women and children. Fertilizer application requires attention to detail and is carried out by men. Rice is attacked by birds especially the Quelea quelea and boys are involved in scaring them.
2. Maize occupies a small area as most of the land is reserved for rice. For this reason, rice management activities are predominantly by women and it is only grown in one season.
3. Maize and groundnut are grown for subsistence use. Groundnuts are cultivated on a small area and therefore easily managed by women and children. They are mostly grown in fields close to the homestead.

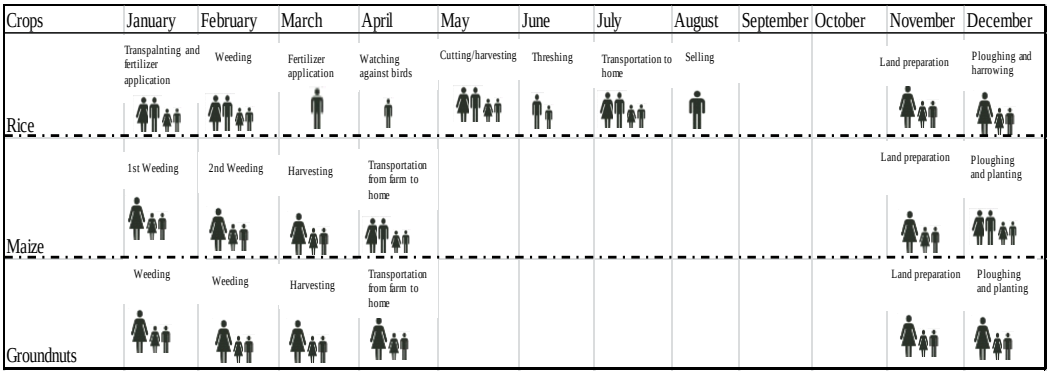

Figure 16: Crop management activities by month for rice, maize, and groundnut as detailed by the women's group in Mbarali district.

The men's group in Mbarali district selected rice, maize, pumpkin, groundnuts, and sunflower as their most important crops (Figure 17).

1. Rice is the most important crop. It is cultivated in Usangu basin under irrigation with water from river Ruaha, the water is distributed through channels. Land preparation is tasking and mostly men are involved. Planting is considered easy because the seed is mainly broadcast involving the whole family. Farmers practicing SRI however use row spacing.
2. Men are involved in transportation of rice from the farm mainly because this requires bicycles and heavy lifting of the bags.
3. Sunflower growing period is short, usually from February to May and most activities involve the whole family.

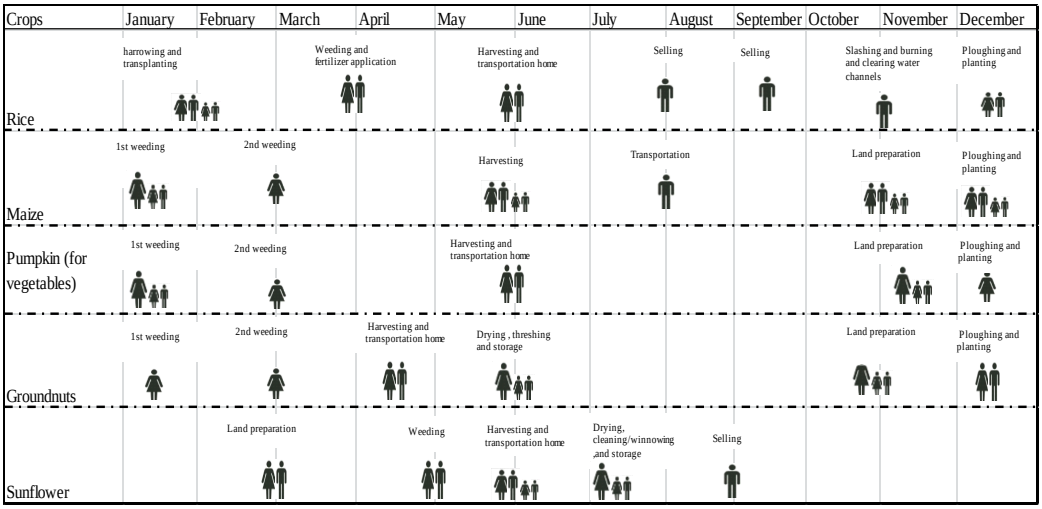

Figure 17: Crop management activities by month for rice, pumpkin, groundnut, and sunflower as detailed by the men's group in Mbarali district.

Mbarali has one cropping season which runs from December to July. Men prefer to engage in production with high commercial value and therefore are mainly concerned in rice production leaving management of other crops to women.

C. Kilosa district

The women's group in Kilosa district selected maize, pigeon pea, sesame and tomato as their most important crops (Figure 18).

1. Maize crop management activities are carried out by the whole family because this is a staple crop and all of the family members are involved in ensuring its success. However the third weeding is carried out by women and children because it is simple to undertake as weed infestation is low.
2. Pigeon pea activities are also carried out by the whole family because it is intercropped with maize in the same field.
3. Marketing is carried out by men because they are perceived as better negotiators and better at finding markets.
4. The whole family participates in sesame management as a way of division of labour.
5. Thinning is carried out for maize and sesame to ensure optimum plant density.
6. Tomato management activities are carried out by women and children because this period is considered the off-season and men are often engaged in off-farm labour.

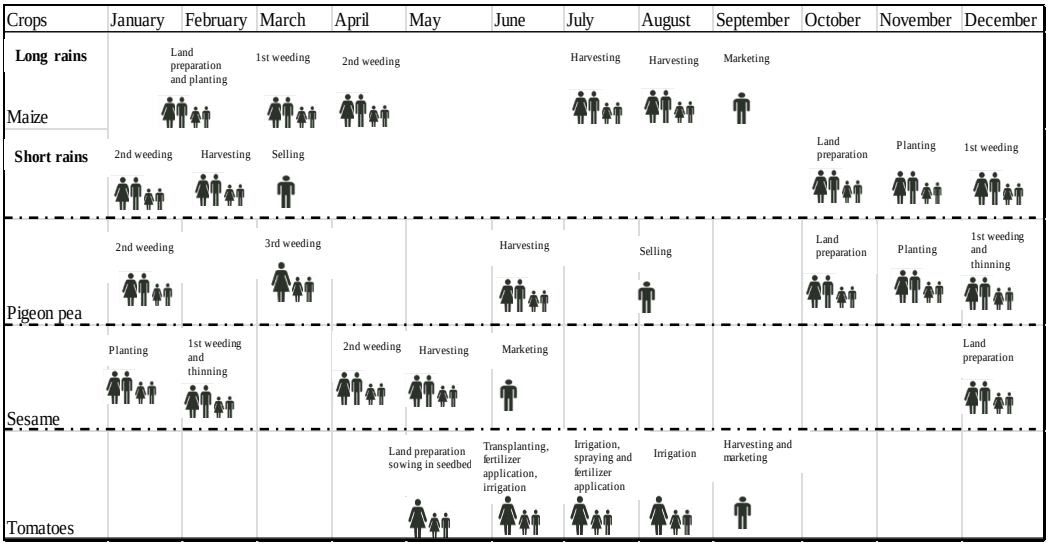

Figure 18: Crop management activities by month for maize, pigeon pea, sesame, and tomato as detailed by the women's group in Kilosa district.

The men's group in Kilosa district selected maize, sesame and rice as their most

important crops (Figure 19).

1. Maize land preparation is performed by men and women as this is a manual and labour-intensive task. Planting and weeding are less difficult and children are also involved. The whole family also participates in planting because this should be accomplished within a short period of time. The group also reported that they involve children in order to transfer skills to them.
2. Planting sesame and rice requires close attention to detail and therefore children are not involved.
3. It is the norm to involve men in marketing as women are considered not to be good negotiators and not able to look for markets as this may require some travel and take a lot of time to identify buyers.

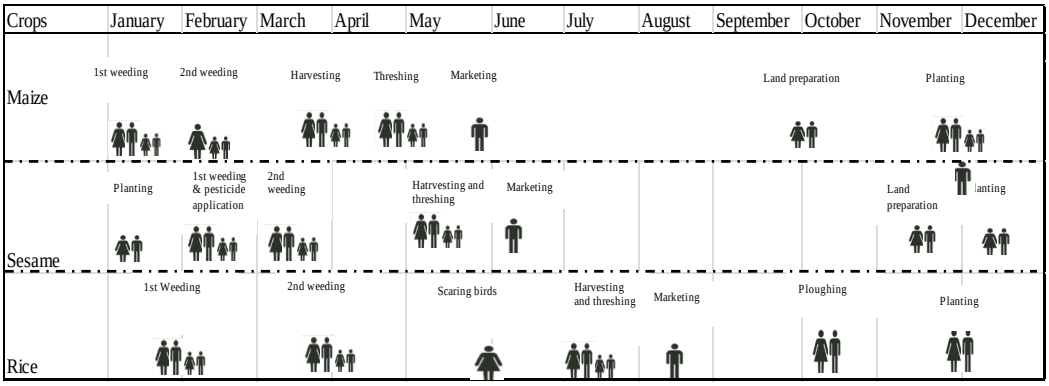

Figure 19: Crop management activities by month for maize, sesame, and rice as detailed by the men's group in Kilosa district.

Kilosa district has two cropping seasons. Previously cotton was a major crop but has been abandoned because it takes long period to maturity and requires a lot of labour.

D. Kilolo district

The women's group in Kilolo district selected maize, tomatoes, beans, sunflower and capsicum as their most important crops (**Figure 20**).

1. Maize land preparation and planting is carried out by the whole family as a way of sharing the work since there are many operations involved. Most maize varieties are improved and include Kifaru, Pannar and DK. Weeding fertilizer application, and harvesting are carried out by women and children, men during this period are tending to the tomato garden which is given preference since tomato is a cash crop.
2. Land preparation for tomato and garlic cultivation is labour demanding and is carried out by men. The whole family is involved during transplanting, weeding and fertilizer application.
3. Looking for buyers for the crops and negotiating the price is done by men.

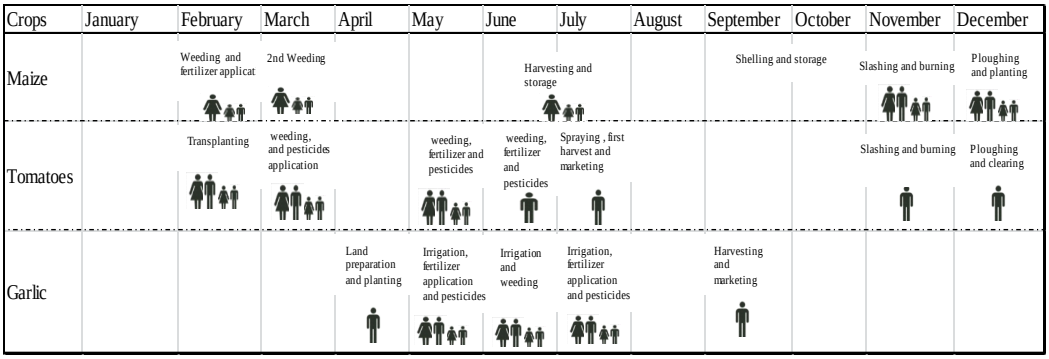

Figure 20: Crop management activities by month for maize, tomatoes, and garlic as detailed by the women's group in Kilolo district.

The men's group in Kilolo district selected maize, tomato, sunflower, beans and capsicum as their most important crops (Figure 21).

1. Maize is the most important crop and mainly grown for subsistence use. Crop management activities are mainly carried out by the man and the woman. Children also help with activities coinciding with the school holidays such as threshing.
2. Tomato is mainly grown for commercial purpose. Both men and women are involved in most of the management activities. Land preparation and marketing is undertaken by men.
3. Beans are mainly grown in the upland areas of the district for family consumption. The management is by men and women, as well as marketing.
4. Sunflower is produced for commercial purposes. The crop requires low levels of management and both men and women are involved.
5. Capsicum is a commercial crop managed by both men and women.

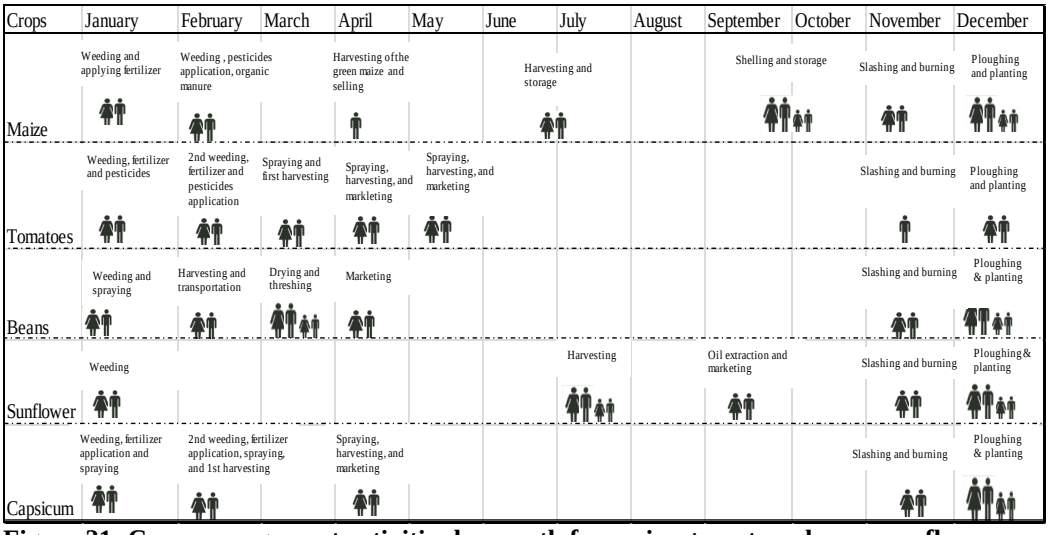

Figure 21: Crop management activities by month for maize, tomatoes, beans, sunflower and capsicum as detailed by the men's group in Kilolo district.

In Kilolo we noted near-equal engagement of men and women in the cropping activities. The farmers reported that this was as a result of social change in the society and they now involve the women more. In addition life has become more challenging demanding concerted efforts from the couple in supporting the family.

E. Expert Interviews – Changes in Cropping and Livestock Practices

When asked about the changes of crop management practices over the past ten years, the experts from Kilosa observed that these included: use of pesticides and use of use of chemical fertilizers (Table 11). In Bagamoyo, the experts observed that pesticides previously used were no longer in use. Whereas in Kilolo and Mbarali, the past ten years has seen increased use of fertilizers, pesticides, irrigation methods, and improved farming methods. With regard to livestock management practices, the experts in Bagamoyo observed that there has been increased uptake of crossbreeding, those in Kilosa observed increased use of vaccination (as a result of capacity building by extension officers) while those in Kilolo observed increased artificial insemination. The experts in Mbarali observed that dipping, spraying, vaccination, dehorning, and castration were all practices that had changed over the past years. It is notable that across all districts, the changes in both crop and livestock management were as a result of seeking increased productivity. To this end, some of the crop management practices that the experts would like to see implemented included: better storage and more efficient processing and packaging, use of improved farming systems and seamless market linkages (efficient end to end integration of the supply chain)

Table 11: Summary of Crop Management Practices

	Bagamoyo	Kilosa	Mbarali	Kilolo
Common Crop Management Practices	Mulching High quality seeds Use of farm manure	Weeding Chemical fertilizers Pesticides	Use of fertilizers Irrigation Use of pesticides and herbicides Use of improved varieties	Spraying Fertilizer application Thinning (maize, tomatoes) Pruning (Bananas) Use of manure

3.11. Awareness of various agriculture technologies

Households in the four districts were asked about awareness and adoption of various agricultural practices, including CSA (Figure 22). All the farmers interviewed reported having knowledge about use of inorganic fertilizers, intercropping and irrigation, with 77%, 69% and 19% of the farmers having adopted the practices respectively. The low adoption of irrigation was attributed to inaccessibility to water sources and lack of irrigation infrastructure. Mulching and use of organic manure were practiced by 42% and 12% of the farmers respectively. Farmers are least aware of green manure (42%)

and composting (46%), which were both practiced by only 8% of the households. Terracing has the lowest adoption rates of 4% and this may be attributed to the topography with most of the land being flat. There was a weak positive relationship between the number of households aware and currently using a practice (R= 0.51).

In Kilolo, crop rotation, use of inorganic manure, irrigation and intercropping recorded the highest awareness among the households, and this stood at 96%. Incorporation of inorganic fertilizers was the highest crop management practice used by 92% of the households, followed by irrigation and crop rotation by 79% and intercropping by 72%. The lowest awareness was indicated for zero grazing at 58%. Green manure had the lowest adoption rates at 4%. Application of organic manure is relatively low as well (29%) and this was attributed to renting land. Adoption of a practice and awareness of the practice, show a positive relationship (R=0.77).

In Kilosa, farmers reported greatest awareness of intercropping, use of inorganic fertilizer and terracing at 96%, followed by use of farmyard manure at 88%. However the highest adoption rates were indicated for intercropping at 63% and mulching at 42%. The lowest awareness was recorded for use of green manure at 25%, with zero adoption among the households. Only 8% of e households practice agroforestry. Awareness of practice and adoption were positively correlated (R=0.66).

In Mbarali, 100% of the households were aware of irrigation and the practice has the highest adoption rates of 72%. Ninety-two percent are aware of crop rotation which has an adoption rate of 17%. The low adoption of crop rotation is expected since rice is the main crop grown on irrigated fields and the households cultivate in one season in a year. Awareness of intercropping, terracing and use of organic manure was indicated by 88% of the farmers. Agroforestry recorded the lowest adoption rate at 4%. There is a weak positive relationship between the number of households aware and currently using a practice (R= 0.52).

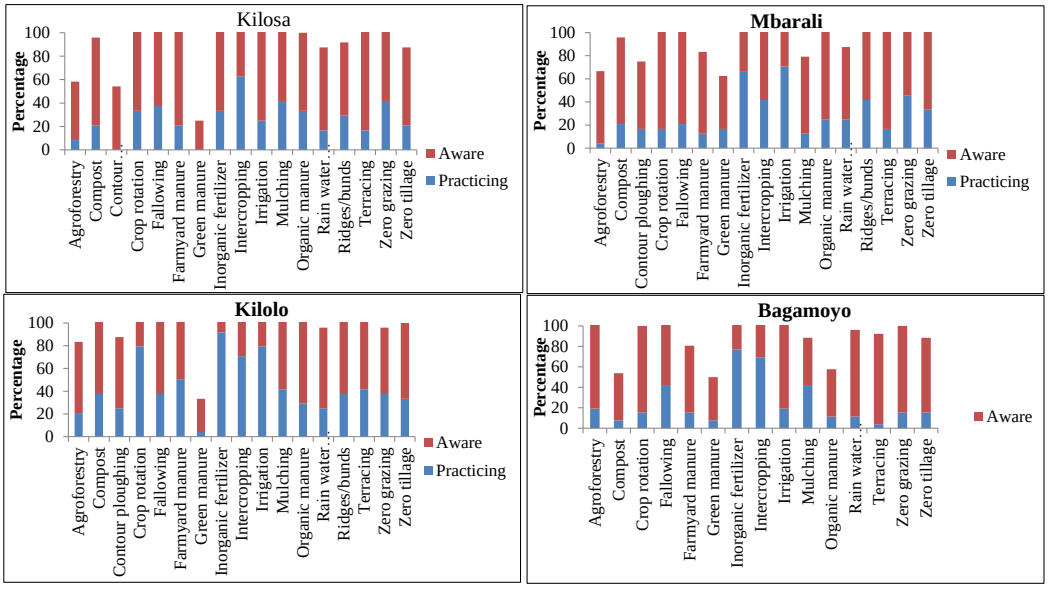

Figure 22: Awareness and adoption of agriculture practices in the study area

Experts interviewed reported that farmers would find the following land management practices beneficial: crop rotation, intercropping, animal manure, improved seed variety and irrigation.

Table 12: Summary of the Main Challenges Farmers Experience

Category	Challenge
Climate Change Variability	Food insecurity as a result of: floods in Bagamoyo, Kilolo and Kilosa. Droughts in Mbarali
Market Access	Poor market structure in terms of: infrastructure, information sharing, processing and value addition.
Input Availability	Expensive and not readily available
Credit	Inaccessible due to: lack of collateral, high risks associated with farming, and high interest rates
Land Access	Land scarcity: conflict between crop and livestock farmers e.g. Mbarali, expensive as is the case in Bagamoyo
Pest and Disease	The risk is high for example: tomatoes adversely affected in Kilolo, some pesticides are adulterated as was the case in Kilosa, and they are expensive as reported by experts in Bagamoyo.
Seed Supply	The prices of seeds are high, seeds are also adulterated as is common in Mbarali and Kilosa
Agricultural Inputs	High prices of inputs
Land preparation	Labor intensive, for example Mbarali which has parts with clay soil requires high labor input to prepare land. In cases where labor is hired, the costs incurred eat into proceeds made from the farm, for example Kilolo.
Post-harvest	Poor storage, adulterated pesticides
Transport	Poor transport due to poor infrastructure especially during the rainy season. High costs of transportation for example Kilosa district.
Marketing	Lack of structure in the market for example: information flows, and standardization of measurements as well as quality.
Other	There is limited knowledge in better farming methods, lack of access to extension officer (e.g. in Mbarali, Kilosa)- where the working environment for the extension officers is not conducive.

Farmers reported that the above challenges greatly contributed to the dynamics of poverty. These challenges were similar across the four districts. They cited that net returns for almost all enterprises are negative.

3.12. Household assets, income and expenditure

3.12.1. Household Assets

In the study site, majority of farm operations including land preparation, weeding, harvest, post-harvest and livestock management were being manually performed. Farm mechanization was scanty consisting of mainly tractor with a plough and power tiller. Farmers mainly own hoes and machetes for manual operations in crop management activities such as land preparation, weeding and harvesting. The mechanized tools observed in the study site were mainly tractors and ox-ploughs, in total these were less than 10 among the ninety eight households surveyed (Figure 23). Farmers sampled in Kilosa did not report owning either of these tools. It was noted that farm transportation was mainly by use of bicycles followed by motorcycles. Donkeys were the main mode of transportation in Mbarali and Kilolo. As well, few farmers owned ox-carts and it was noted that this was mainly prevalent in Mbarali.

From interviews with the youth in Kilosa, it came out strongly that they were averse to farm work because they perceived it as labor intensive. Beyond this, farming was generally perceived as an activity of those who were uneducated, and this attitude has sustained the minimal involvement of youth in agriculture. This means that any intervention targeting the youth must incorporate their attitude and perception to agricultural mechanization if any headway towards including youth in agriculture is to be made.

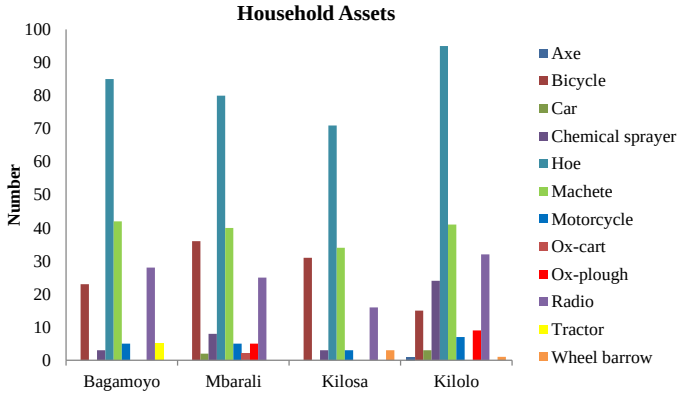

Figure 23: Asset ownership by district

There were differences in asset ownership among men and women (Figure 24) with most agricultural tools belonging to the man. The difference in asset base not only reflects the cultural rules and norms that shape ownership and control over assets, but also the way these are gendered The broader implication is that women may lack access to assets necessary for participation in agricultural production and are likely to face constraints in climate adaptation.

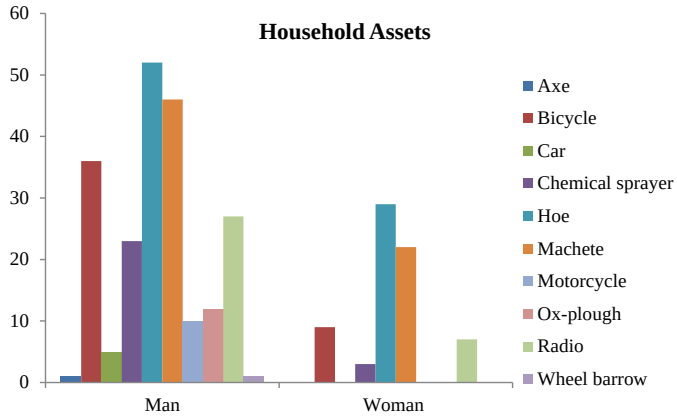

Figure 24: Asset ownership by gender

Figure 25 shows the distribution of the asset index by district. The index was constructed from radio, bicycle, motorcycle, ox-plough, ox-cart, machete, axe, hoe, wheel barrow, car and sprayer. Principal component analysis was used to generate the weights used in creating the index. Results show that across the districts the distribution of assets is more concentrated in the lower tail indicating a lower degree of asset ownership. A graph of per capita asset index (Figure 26) which takes into account the size of the household shows a similar trend. Kilolo, however, seems to have a larger concentration of the distribution of per capita asset at the upper tail.

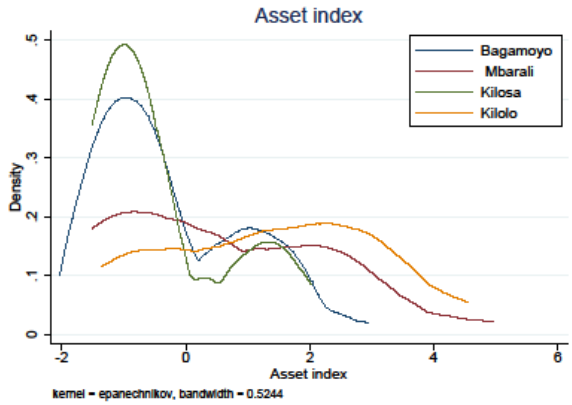

Figure 25: Distribution of asset index across the four districts

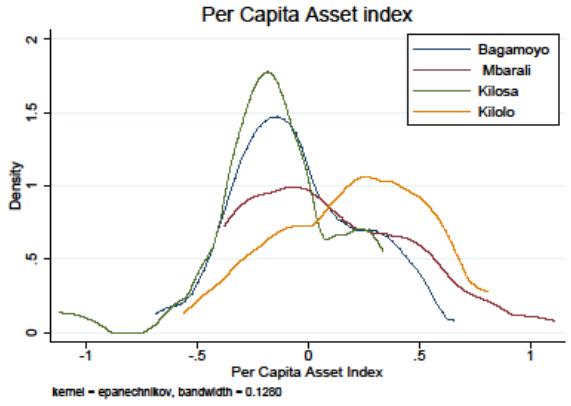

Figure 26: Per capita assets index across the four districts

3.12.2. Household income

The below figures show the percentage of people that earn income within a particular range. Figure 27 captures external income by category across the four districts, while Figure 28 indicates the percentage of households that reported receiving remittances in the last twelve months. Both figures highlight that many households reported not receiving remittances. Generally, less than forty percent of the households across the four districts receive remittances. The highest number of households receiving remittances is in Bagamoyo, followed by Mbarali, Kilolo and Kilosa. Among those that receive remittance, the main source was from a son or a daughter (58%). A few farmers also reported that they had received money from other relatives, churches, and NGOs. Among farmers that engage in non-agricultural activities, the mean income was reported to be TSh 363,863; TSh. 236,707; TSh. 1,822,222; and TSh. 1,542,128 for Bagamoyo,

Mbarali, Kilosa, and Kilolo districts, respectively (Figure 29). The figures, however, only includes farmers that earn non-agricultural income and excludes that that reported zero income.

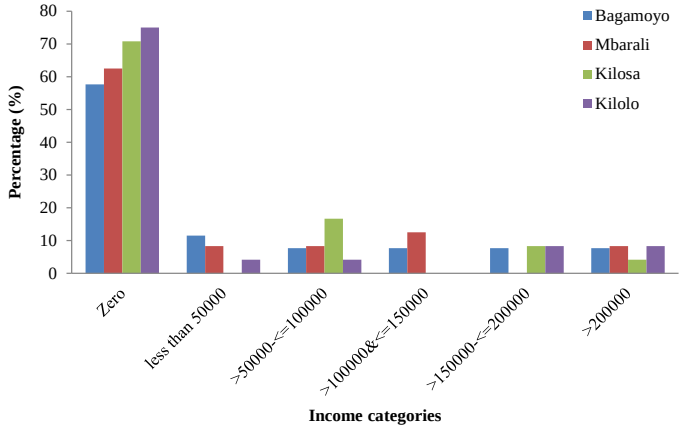

Figure 27: External income by district

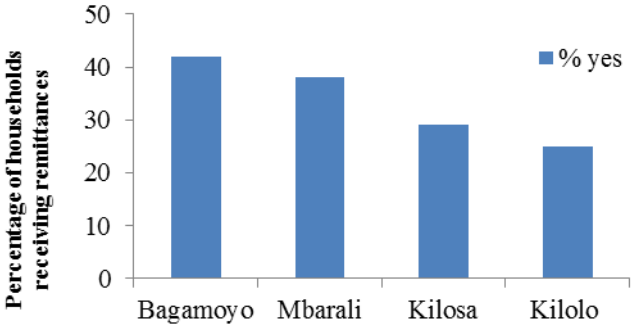

Figure 28: Percentage of households that receive remittances

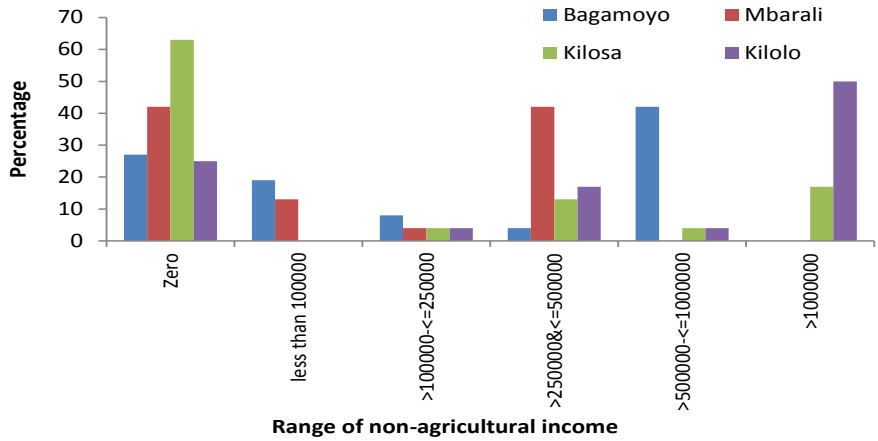

Figure 29: Non-agricultural income, percentage of people in income ranges by district

Figure 30 shows that across the four districts the distribution of total external income (remittances) in the past twelve months is mostly concentrated between 50,000 – 200,000 Tsh. The annual per capital external income is on average 50,000 Tsh (Figure 31).

The low asset index and external income across the districts indicate low financial capacity to invest.

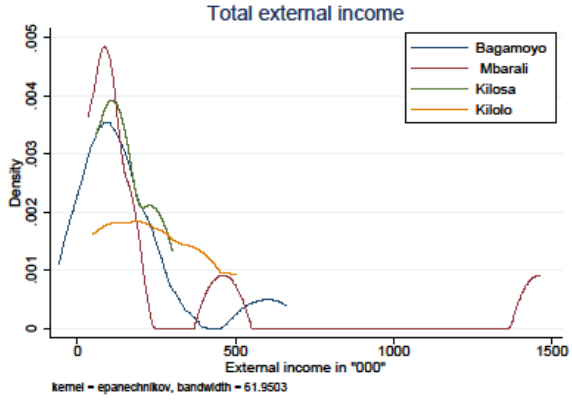

Figure 30: Total remittances received by the households in the past twelve months across the four districts

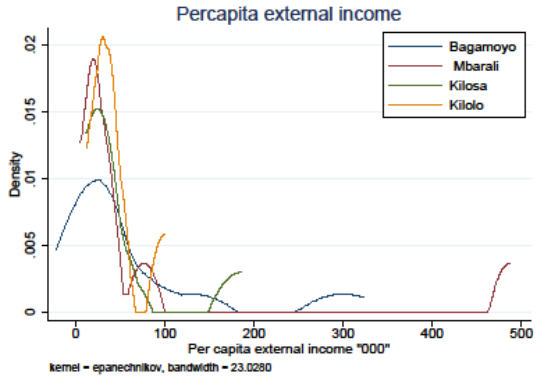

Figure 31: Per capita external income across the four districts

3.12.3. Household expenditure

As shown in Figure 32, the largest expenditure shares go to paying school fees followed by other general services (such as purchasing water) and clothing.

Reliance on non-agricultural income (secondary sources such as brick making and charcoal burning) is highest in Bagamoyo and Kilolo and lowest in Mbarali Income from sale of crop produce is highest in Mbarali, followed by Kilosa, Kilolo and Bagamoyo. This could be attributed to the fact that Mbarali relies on rice as a cash crop and is among the leading rice producing districts. More so, the market price for rice is higher as compared to for instance pineapple which is the main cash crop in Bagamoyo.

The contribution of external income (remittances, donations and gifts) to the total household income is highest in Bagamoyo and lowest in Kilolo (Figure 33).

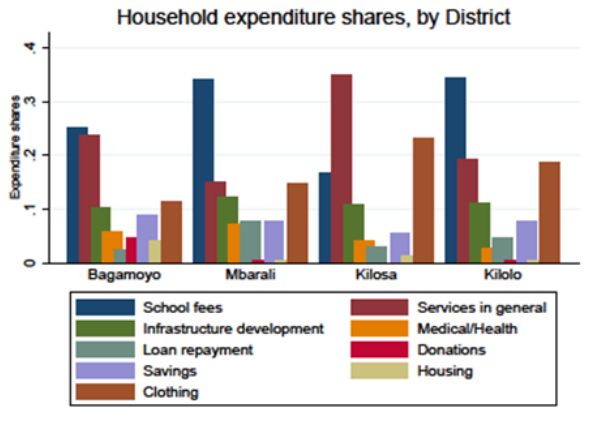

Figure 32: Expenditure of households in the four districts

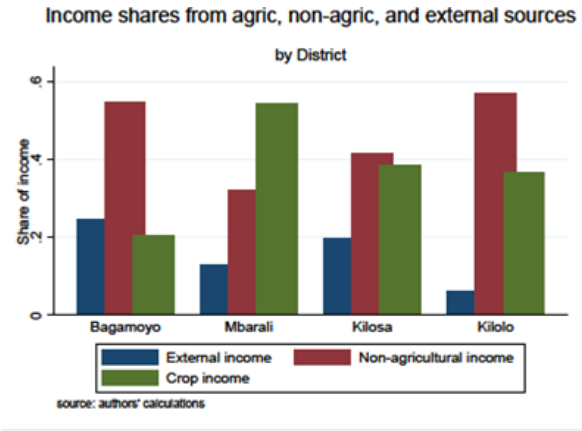

Figure 33: Income categories as a share of total household income in the four districts

3.13. Gender dynamics

Interviews with experts revealed misconceptions on what gender means. The responses varied from interpreting gender as equality to meaning an elimination of male domination ('Kuondoa Mfumo dume'). Others understood gender as 'jinsia' (sex). From these discussions, it appeared that gender was understood as a distinction between sexes and not necessarily as a social construction of female and male identity. To this end, gender is not understood as the relations between men and women rather, it is associated with concepts like equality or as sex male/female. The understanding of gender as sex is problematic because of the likelihood of assuming fixedness about male or female roles therefore making it much more challenging to address women exclusion in agricultural education, or climate change initiatives.

From the interviews with the experts, it was revealed that gender dynamics are considered important and part of government policies, but not well implemented at the local level. For the most part, it was international non-governmental organizations that were concerned with development of women. According to experts, issues of gender equality, especially in agriculture, were relatively new and much more needs to be done to apply these ideas. With regard to the level of funding by the central government for gender sensitive programs, the experts reported that there were positive developments towards this as gender and development had specific budgetary allocation.

Other developments regarding access to funds and finances included: Tanzania Women Bank, which specializes in providing financial services to women. The bank was established in 2007 and seeks to empower women economically and socially. Its main target market is low-income earners, who are women), micro finance and other international nongovernmental organizations. However, even though the experts mentioned these institutions, further interviews with the women revealed that they

lacked access to credit facilities.
When asked their perception of women participation in agricultural projects, the experts reported that women did not participate in development projects mainly due to their roles in the household. Moreover, they reported that socio-cultural norms made it a challenge for women to be empowered since women still preferred to take a back seat assuming that men were the rightful drivers of development agenda. With regard to women's empowerment, they reported that in their view, the empowerment of women was important because women were nurturers of the family unit. Yet, they maintained, women were not entirely powerless as they were increasingly making small gains in agriculture and were contributors to the household budget. However, there was a caveat to this position since this was not the general situation. They observed that in some households, women had no agency and had limited choices to make independent decisions since they were less financially empowered as compared to men. Further probing revealed that, women were not entirely without agency as there was 'room to manoeuvre' within their private space. To this end, the experts reported that often women survived through collective organizing as they formed groups to grow and sell agricultural products from the portions of land allocated to them by the men. While the collective organizing of women is useful to their empowerment, interventions should also seek to increase the choices available for women.

With regards to decision-making, the experts reported that this is mainly co-dependent even though most of the times the man had the final say. For instance, in plot allocation. With regard to the educational levels of women, more men were educated compared to women and women in the cities were more educated compared to women in the rural areas. Discussions revealed that most of the women at the village level had not completed year seven of primary school. The disparity between women in the cities and in the rural areas was largely attributable to socio-cultural practices. They reported that cultural practices such as the Unyago, which serves as the introduction into the symbolic marital language, act as barriers to development of young women. The parents of young women preferred their daughters not pursuing education beyond secondary level because this level marked the age that is perceived to be apt for marriage when most parents expected to receive dowry. These socio cultural norms regulate women to ensure conformity to the broader patriarchal structure that contributes to their exclusion. To this end a gender inclusive intervention should incorporate the socio-cultural context that women, youth and men operate in.

3.14. Climate

According to the farmer workshops undertaken during the CSA-RA there is an increase in seasonal rainfall variability, characterized by dry periods and too much rainfall, regardless of district. The unpredictability in rainfall with respect to the start, cessation of the rains, number of rainy days and long dry spells, causes problems for agriculture in the region. This has an impact on farming practices, since an early start of the rains leads to lack of preparedness on behalf of farmers. In addition, there has been an

increase in the number of severe rainfall events and climate extreme, including floods in some areas, which lead to human deaths, loss of livestock, crop losses, human migration, disease outbreak and infrastructure destruction.

In Bagamoyo farmers reported relying on food aid and eating roots of trees to cope during periods of low crop productivity. Women also reported being affected by the migration of the spouse and household members in general through a loss in income and labour. Farmers reported that maize, rice and pineapple were especially affected by too much rainfall and noted that weed infestation was also high. Farmers living in lowlands are less affected because they have access to water-rich valley bottoms for irrigating crops. Late cessation of the short rains also disrupts cropping activities in the subsequent long rains, because of delayed harvest.

In Kilolo farmers reported changing crop varieties, use of pesticides and engaging in small business as coping strategies to climate variability. Farmers mentioned that timely seasonal forecasts would be essential to help them plan and reduce the impacts of weather variability.

In Kilosa farmers indicated that too much rainfall washes away the crops, fertilizer and leads to soil erosion. It also increases incidences of crop disease and pests, and destroys seed beds. Farmers resort to contour farming as a coping mechanism. Drought leads to crop failure and drying of water points.

3.14.1. Climate calendars prepared in farmer workshops

A. Bagamoyo district

The climate calendars were used to understand typical and abnormal weather patterns in the study area, how they impacted livelihoods and farmers' coping strategies (Figure 34 to Figure 35).

According to the farmers, Bagamoyo has two main cropping seasons; long rains from March-June (referred to as 'masika') and short rains from October-December (referred to as 'vuli'). January to March was described as a period of high water scarcity both for domestic use and livestock.

During this rainy season, the following were common weather events that occurred:

a. Strong winds, floods, high temperatures, army worms which destroy maize, in the month of March-May. Floods usually occur on plots located near river banks, but this had low impacts on food sufficiency since most of farmers grow rice which is less vulnerable.

b. At the end of July to early August light rains are observed and they usually destroy crops that have matured in the fields.

1) Normal Year

During the short rain season, September-October, farmers do not engage much in crop production since rains are not reliable. Usually they grow maize, sorghum and cassava, which require less rainfall compared to other crops. Sorghum is mainly grown for its cultural benefit as it is used in preparing traditional beer for celebrations such as the initiation ritual for girls practiced at 18 years referred to as 'unyago'.

2) Wet year

According to farmers, in 1997 rains started from early February to June. Intense rainfall also occurred from early September to the end of December. Men were most affected since they rely on agriculture to feed their families and had to migrate to look for casual employment. In the following season the soils being highly compacted and difficult to till.

3) Dry year

2012 had an extremely long dry season, it started in early January to February, then light rains in March followed by a long dry period from April to September, light rains again in October and dry weather from November-December. During this year most of the crops were affected resulting in famine. Men offered labour in the neighbouring Mkata village and also relied on food aid from the government. People ate roots of a tree called 'mdudu'.

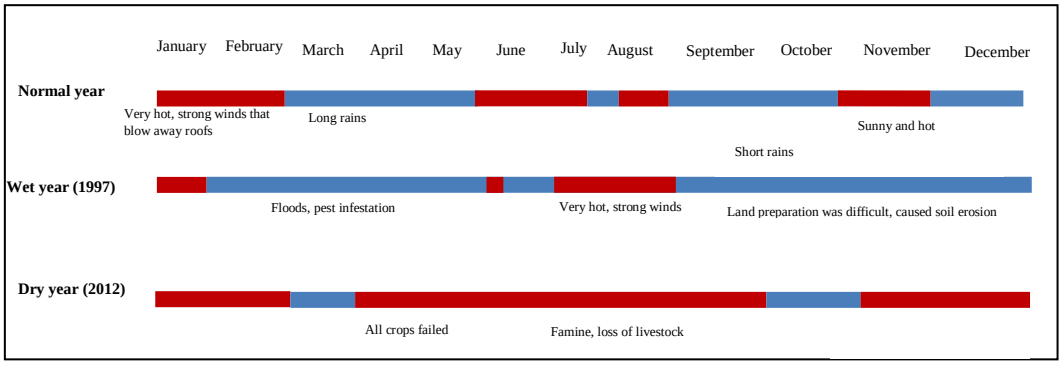

Figure 34: Climate calendar for a normal, wet (1997) and dry year (2012) as prepared by the men's group in Bagamoyo district. Red bars denote dry season and blue bars wet season.

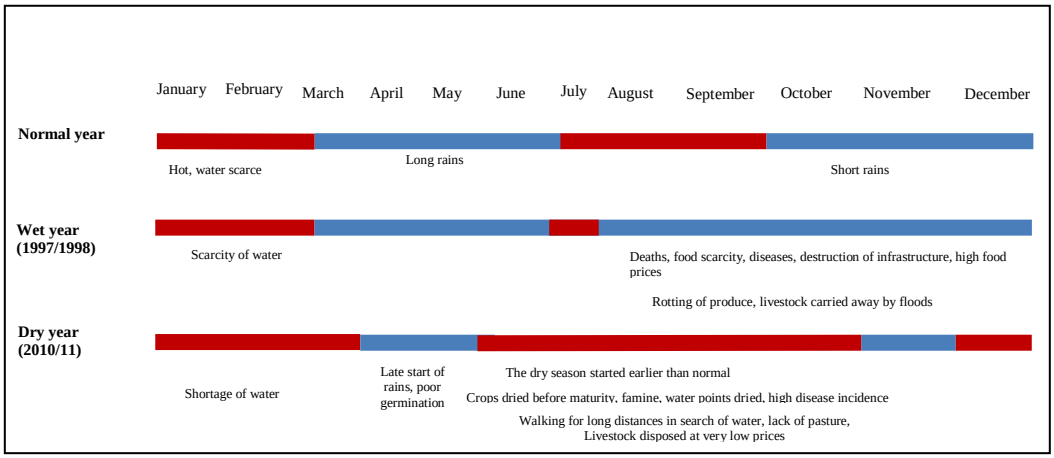

Figure 35: Climate calendar for a normal, wet (1997/98) and dry year (2010/11) as prepared by the women's group in Bagamoyo district. Red bars denote dry season and blue bars wet season.

The pastoral group reported that too much rainfall led to incidence of livestock diseases such as east coast fever, ringworms and sores between the hooves. On the other hand, drought leads to wasting and death of animals.

There are differences between men and female perceptions of the dry year. Men selected 2012 and women 2011. This can be related to the lack of income in 2012 as a result of harvest from the 2011 cropping season. Men are usually associated with marketing activities in Bagamoyo.

B. Kilolo district

1) Normal year

The rains start in December-April each year (Figure 36 to Figure 37). These are accompanied by strong winds and thunderstorm, scorching sun, which results in crops destruction especially for tomato. Also, in instances where there is heavy railnfall the result is soil erosion especially at the river banks. Few farmers reported practicing contour farming to control erosion.

The dry season starts from the month of May-November. During this period the only source of water for irrigation is wells since most of the rivers lack adequate water.

2) Wet year

1998 was reported to be a high rainfall year (Figure 36 to Figure 37). The rains started in November 1997 and lasted until April 1998. There was flooding which caused soil erosion, destruction of the infrastructure, destruction of crops especially rice paddys along rivers banks and eruption of water borne diseases. It affected the next growing season since most people lacked capital, supply of seeds was limited as most farmers depend on own saved seed. Men were most affected and had to migrate to earn income to pay loans they had taken at the start of the season for rice production. Pastoralist were

also affected and had to dispose their animals (average price of a cow was TSH 7,000 which could only buy a 2kg tin of maize).

3) Dry year

The dry year was indicated as 2006 by the women's group and 2012 by the men's group (Figure 36 to Figure 37). In 2012 it only rained in January and mid-March. The dry season was characterized by high temperatures, strong winds, high food prices (up to TSH 100,000 for a bag of maize) and famine.

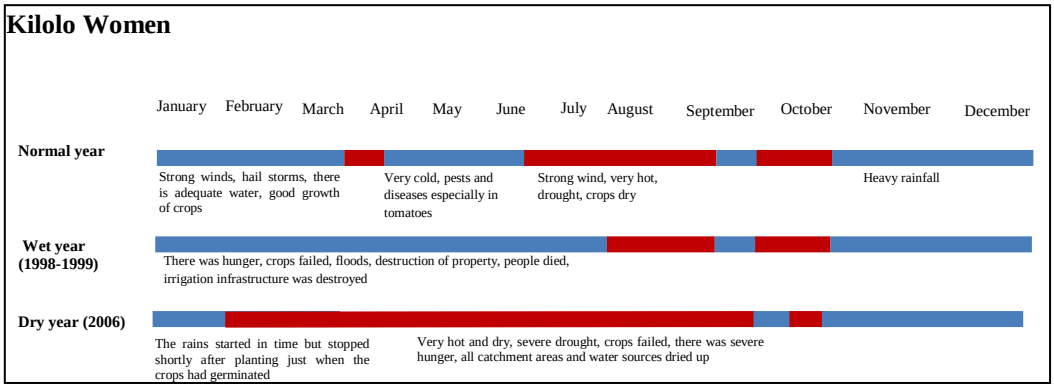

Figure 36: Climate calendar for a normal, wet (1998/99) and dry year (2006) as prepared by the women's group in Kilolo district. Red bars denote dry season and blue bars wet season.

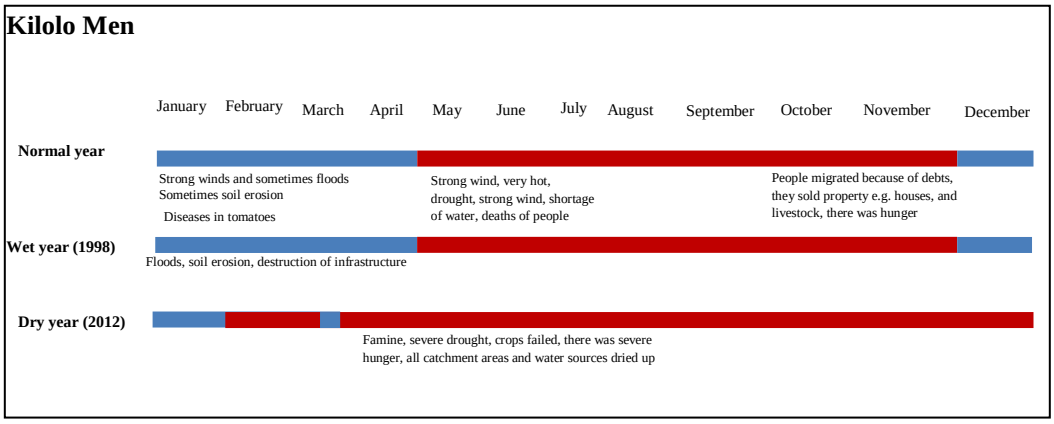

Figure 37: Climate calendar for a normal, wet (1998) and dry year (2012) as prepared by the women's group in Bagamoyo district. Red bars denote dry season and blue bars wet season.

There are differences in perceptions on the dry year. Men choose 2006 and women choose 2012.

C. Kilosa district

1) Normal year

Normally in Kilosa rains start in November to January (short rainy season). The long rainy season begins from March-June (Figure 38 to Figure 39). The rain is often accompanied by outbreaks of malaria, especially in March and April. In April-May some floods occur along the river banks. The dry season starts from July-October each year. There are army worms February which destroy maize.

2) Wet year

The most recent year with extreme rainfall was 1997-1998 (Figure 38 to Figure 39). Rainfall started in October 1997 to May 1998. These rains were accompanied by floods which resulted in destruction of infrastructure, destruction crops, and deaths. Coconut and cassava were able to survive.

Most of the people received support from their relatives outside Kilosa. The only crop they depended on was cassava which was insufficient to feed the whole community. The government provided food aid.

3) Dry year

1999 was reported as an extremely dry year by the men's group while the women indicated the year 2001(Figure 38 to Figure 39). In 1999, the dry season started from July to mid-March. In 2001 the dry season ran from January to mid-October. In both years the next growing season was also affected since most farmers lacked produce to sell to obtain capital to establish their farms.

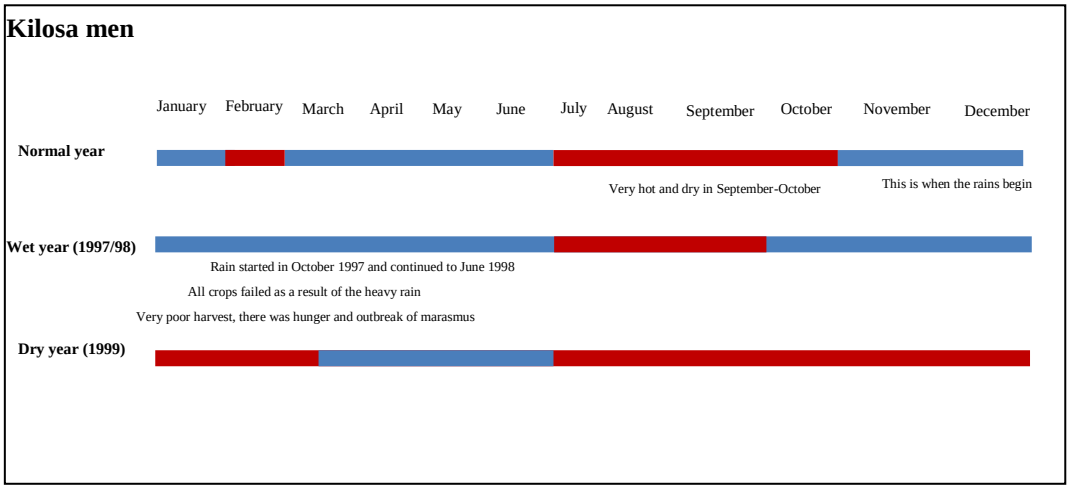

Figure 38: Climate calendar for a normal, wet (1997/98) and dry year (1999) as prepared by the men's group in Kilosa district. Red bars denote dry season and blue bars wet season.

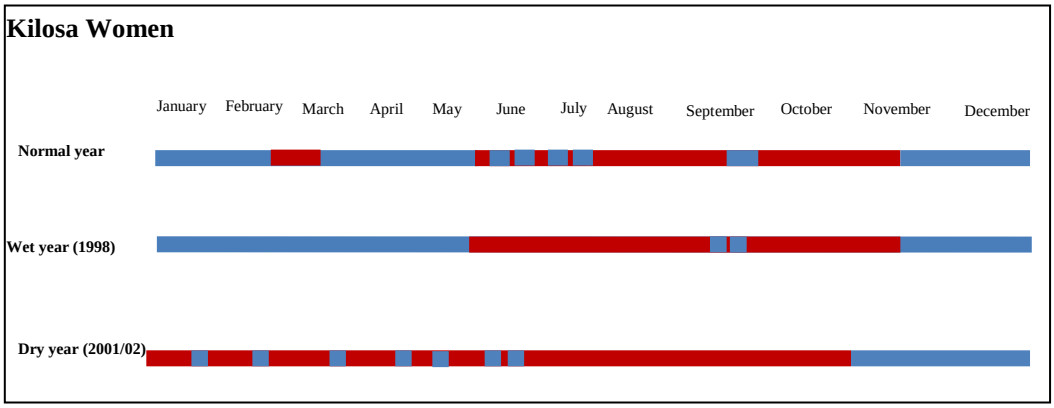

Figure 39: Climate calendar for a normal, wet (1998) and dry year (2001/2) as prepared by the women's group in Kilosa district. Red bars denote dry season and blue bars wet season.

There is a difference on perceptions on the dry year, men choose 1999 and women choose the 2001-2002 cropping season.

D. Mbarali district

1) Normal year

In the normal year, the long rains begin at the end of November to April (Figure 40 to Figure 41). The long rainy season is accompanied by floods especially during February-March, as a result of river Mbarali bursting its banks. Secondly, the soils are mainly clay with low infiltration. The soils become highly compacted and difficult to dig.

In the normal year, the dry season occurs from May to November (Figure 40 to Figure 41). In Mbarali there is no crop production during the short rain season (vuli). The dry season is usually accompanied by high temperatures especially in September-October, high humidity. Most of the pastoralists bring their livestock into the valley bottom which results in destruction of the catchment area.

2) Wet year

Farmers reported that 1998 was a heavy rainfall year, which started in November 1997 and lasted until May 1998, these rains were referred to as El Nino (Figure 40 to Figure 41). They resulted in floods. Large-scale farmers, farming along river banks, were most affected. Farmers in the uplands were less affected. However, there was soil erosion on the sloping areas. The next growing season was affected most since most farmers lacked capital to prepare their plots.

3) Dry year

According to the men's group, a long dry season occurred in 1991 (Figure 40), it began in January, then there was rainfall for two months (February-March) and the dry season

continued from April-December. Temperatures were high, strong winds, and most of the crops were dried up especially rice. They planted fast maturing maize variety (CG) from Malawi, which takes 60 days to mature.
Men were most affected since most of the cash crops dried up, this is because they are grown along the river banks under irrigation and the water supply was low due to the long dry season.

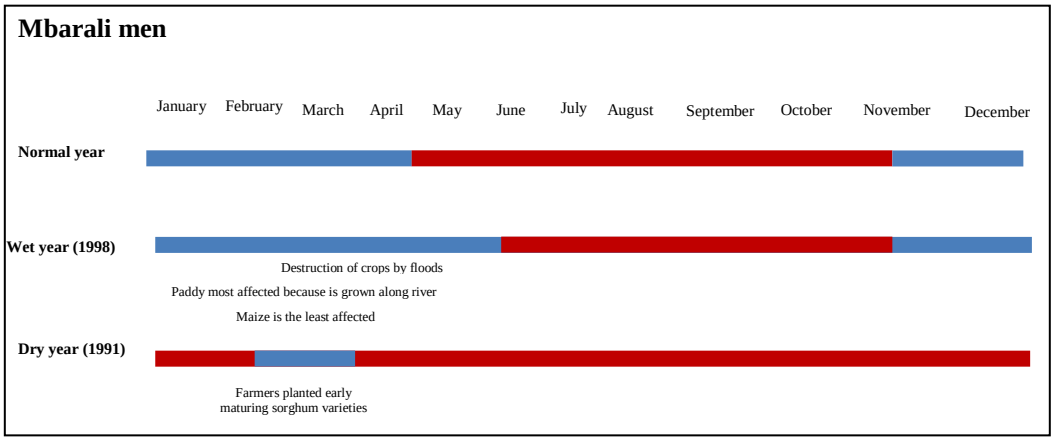

Figure 40: Climate calendar for a normal, wet (1998) and dry year (1991) as prepared by the men's group in Mbarali district. Red bars denote dry season and blue bars wet season.

The women's group indicated that the long dry season occurred from 2011 to 2012 (Figure 41). In 2011, rainfall was only experienced in January, with short showers also occurring in early-March. All the other months were dry. To cope the households engaged in off-farm employment.

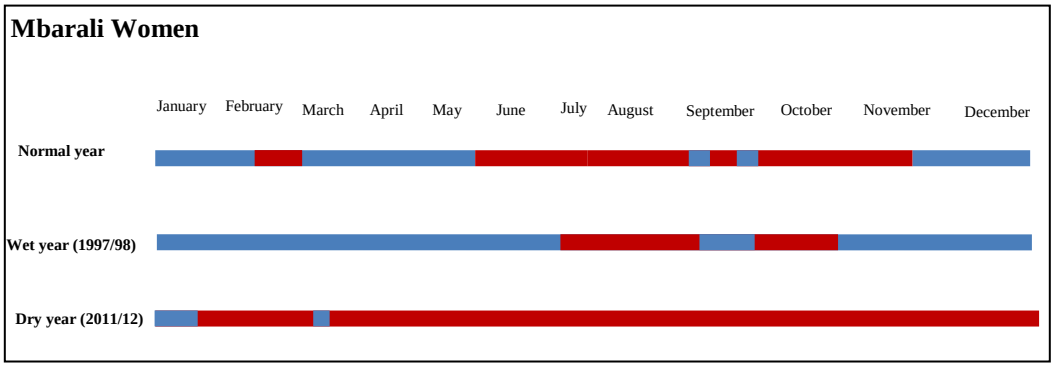

Figure 41: Climate calendar for a normal, wet (1997/98) and dry year (2011/12) as prepared by the women's group in Mbarali district. Red bars denote dry season and blue bars wet season.

3.14.2. Historical calendars

Farmers were asked about their perceptions of temperature and rainfall changes and about overall changes in the climate over the previous 20 years (Table 13-Table 20). This information was recorded separately for male and female groups in the four districts. Please indicate what the numbers in the tables mean, is 5 high?

A. Bagamoyo district

In Bagamoyo farmers reported high soil quality and good rainfall, however crop production was indicated as low. High Temperatures were negatively correlated to low rainfall. Water availability and area under cultivation were reported to increase over the 20 year period. Livestock production was also reported as increasing by men, while women stated it was declining. The gender difference may be attributed to either the increasing crop- animal conflicts which are mainly handled by men, or the fact that in the district livestock is managed by men. Tree cover was reported to have declined rapidly (Table 13 and Table 14).

Table 13: Bagamoyo men's group perceptions of changes in resources in the previous 20 years. 1 indicates very low and 5 indicates very high.

	Climate		Resources			Agro-activities		
	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	5	3	5	5	2	3	5	5
Last year	4	4	4	5	2	3	4	5
2 years ago	3	4	3	5	3	3	4	3
10 years ago	2	3	5	2	4	5	2	2
20 years ago	5	3	5	5	5	5	2	2

Scored from 1 (very low) to 5 (very high)

Table 14: Bagamoyo women's group perceptions of changes in resources in the previous 20 years. 1 indicates very low and 5 indicates very high.

	Climate		Resources			Agro-activities		
	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	4	2	5	5	1	2	5	2
Last year	3	5	5	3	2	2	3	2
2 years	4	4	4	2	3	2	3	2

ago								
10 years ago	4	2	2	2	5	2	2	5
20 years ago	3	5	1	1	5	2	2	5

Scored from 1 (very low) to 5 (very high)

B. Mbarali district

From the farmers' workshop in Mbarali, it was indicated that over the past twenty years, the rainfall has been good. However, perceptions of temperatures were more negative, over the same period.Soil quality and livestock production were seen to decline, while. crop production, area cultivated and water resources increased. Perceptions on water resources can be explained by the reported increase in rainfall. The men's group indicated an increase in trees in contrast to a decline reported by the women's group. This gender difference in perception can be explained by women's focus on tree resources for their importance in providing firewood (Table 15 andTable 16).

Table 15: Mbarali men's group perceptions of changes in resources in the previous 20 years. Where 1 indicates very low and 5 indicates very high.

	Climate		Resources			Agro-activities		
	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	5	3	2	5	5	5	5	3
Last year	4	3	2	5	5	5	5	3
2 years ago	3	4	2	3	4	5	5	4
10 years ago	3	4	4	2	3	2	3	5
20 years ago	2	5	5	2	2	2	2	5

Scored from 1 (very low) to 5 (very high)

Table 16: Mbarali women's group perceptions of changes in resources in the previous 20 years

	Climate		Resources			Agro-activities		
	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	4	4	2	5	3	5	5	2

Last year	3	5	2	3	3	3	5	3
2 years ago	2	5	1	2	5	3	5	5
10 years ago	5	3	2	3	5	5	5	5
20 years ago	4	3	5	5	5	5	3	5

Scored from 1 (very low) to 5 (very high)

C. Kilolo district

Farmers reported that rainfall was increasing and there were no changes in the low temperatures. Women reported that soil quality was fair whereas men indicated that it had declined rapidly. Both men and women rated tree cover and water resources as declining. The low tree cover can be linked to the logging that has been going on in the area. Crop production, cultivated area and livestock production has been increasing. The increase in cultivated area was closely linked to increasing rainfall. The cultivated area is increasing as more land under trees is cleared and put under crops. This confirms that farmers are not replacing cut trees leading to the rapid decline in the previous twenty years (Table 17 and Table 18).

Table 17: Kilolo men's group perceptions of changes in resources in the previous 20 years. Where 1 indicates very low and 5 indicates very high.

	Climate		Resources			Agro-activities		
	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	5	3	1	3	1	5	5	5
Last year	4	5	2	2	2	3	5	5
2 years ago	2	5	3	2	3	2	4	4
10 years ago	5	5	4	5	4	4	3	3
20 years ago	5	3	5	5	5	4	2	1

Scored from 1 (very low) to 5 (very high)

Table 18: Kilolo women's group perceptions of changes in resources in the previous 20 years. Where 1 indicates very low and 5 indicates very high.

	Climate	Resources	Agro-activities

	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	5	2	3	1	3	5	5	5
Last year	3	3	3	2	3	3	3	2
2 years ago	2	3	3	3	1	2	2	2
10 years ago	5	3	3	4	3	2	2	1
20 years ago	5	1	4	4	5	5	3	5

Scored from 1 (very low) to 5 (very high)

D. Kilosa district

The men's and women's group both indicated a decline in rainfall, temperature, soil quality, water, trees and crop production. Women reported higher soil quality as compared to men. The men's group indicated increase in livestock production, whereas the women reported a decline. This can be related to reports that livestock activities in the district are mainly associated with men. Both sexes indicated that the cultivated area had been increasing. This increase in area cultivate was associated to the declining productivity since farmers said they now have to cultivate larger areas to ensure the household's food sufficiency (Table 19 and Table 20).

Table 19: Kilosa men's group perceptions of changes in resources in the previous 20 years. Where 1 indicates very low and 5 indicates very high.

	Climate		Resources			Agro-activities		
	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	4	2	2	3	2	1	5	5
Last year	2	5	2	3	2	1	5	5
2 years ago	4	3	3	4	2	2	5	5
10 years ago	5	2	4	5	5	5	3	3
20 years ago	5	1	5	5	5	5	3	2

Scored from 1 (very low) to 5 (very high)

Table 20: Kilosa women's group perceptions of changes in resources in the previous 20

years. Where 1 indicates very low and 5 indicates very high.

	Climate		Resources			Agro-activities		
	Rain	Temperature	Soil	Water	Trees	Crop production	Cultivated area	Livestock
This year	4	3	3	3	1	3	5	2
Last year	4	4	2	3	1	3	4	2
2 years ago	3	2	3	3	2	2	3	3
10 years ago	2	3	5	2	4	3	3	3
20 years ago	5	2	5	1	5	5	2	3

Scored from 1 (very low) to 5 (very high)

3.15. Vulnerability

On average, there are three hungry months for households in Bagamoyo, Mbarali and Kilosa and two hungry months for farmers in Kilolo (Figure 42). Please describe what a hungry month is a period when the household is not able to obtain food from their own farm production. Kilolo has higher food sufficiency as compared to the other three districts. Specifically, the hungry months in Kilolo were, February and March because of sale of food stocks to acquire inputs as this period is the start of the cropping season. Additionally, it is also the same period that farmers require cash to pay school fees.

In Kilosa households reported that they experience food shortages from December to February. Whereas in Bagamoyo the period of food vulnerability usually occurs between March and June. During food shortages, households cope by engaging in charcoal burning, borrowing food to repay at harvest, and engaging in off-farm labour. The fact that families borrow food to repay at harvest periods is indicative of their reliance on social systems like reciprocity for support. This is important to note since it informs any future approaches or interventions. In Mbarali, hungry months are January to early April. There are three main causes of food shortage: firstly, is the sale of reserves to purchase farm inputs as well as to hire labour for land preparation. Secondly, the price of food in the market is high. Thirdly, farmers have spent their savings during the Christmas festivities and are left with little disposable income to purchase adequate food. In this district, it is not uncommon to borrow cash for inputs and for labour to prepare rice fields. The money is repaid in terms of grain, another demonstration of the society's strong reliance on social systems of exchange. Every 30,000 TSh borrowed is equivalent to 1 bag of rice, whereas the average market price for a bag of rice is 60,000 TSh Shillings. For this reason, farmers end up with a net loss and are left with few

options but to borrow again in the next season. They then become part of a vicious credit cycle.

Financial hardships in Kilosa were greater between September and December as majority of the households were dependent on agriculture and there was no produce to sell during this period. Apart from low produce, they had little savings as a result of the low market prices.

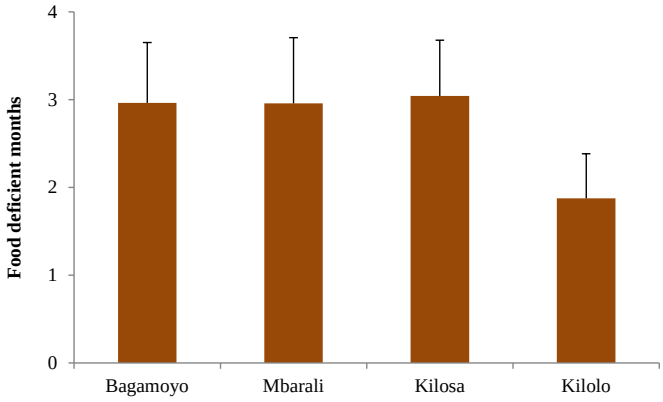

Figure 42: Average number of food deficit months per year.

Coping strategies include: borrowing food to repay in kind during the harvest period, off-farm labour, planting early maturing varieties e.g. cassava, migrating from uplands to lowlands to cultivate along the river banks, practicing small-scale irrigation, enrolment into farmer groups to access credit, and purchase of seed subsidies for food.

3.16. Markets

Majority of the farmers reported challenges with the market as the greatest problem in agriculture production. In Bagamoyo the main challenges were reported as lack of markets close to the villages, high agricultural tax and high transportation cost. The average distance to the respective markets among the households surveyed was 5.8 km. Sesame was indicated as having better market as compared to other crops as it is less affected by price fluctuations. In Mbarali, Kilosa and Kilolo, the average distance to the nearest market was12.5, 9.2 and 4.8 kilometres respectively. The main marketing challenge in Kilolo was reported as price fluctuation, buyers had no negotiation power, lacked market information, lacked cooperation between large and small-scale farmers, incurred high transportation costs and prices were dictated by brokers. Specifically, farmers in Kilosa cited price dictation by brokers, price fluctuation, lack of market infrastructure, unstandardized weights and measures, and high transportation costs. Whereas farmers in Mbarali indicated lack of established grain markets since they sold from farm gate to brokers. More than this, weights and measures were not standardized and they incurred high transportation costs. Discussions with men revealed that markets in some cases were uncertain since they were not well organized. For example, in Kilolo they reported that they lacked buyers for their rice and maize produce because of information asymmetry. Currently, they strongly rely on the local market and they argue

that they would be in a position to make better returns if they expanded their customer base beyond the locals. The price fluctuations made earnings unpredictable and the lack of standardized measurements exposed farmers to possible loses. In the four districts surveyed, marketing of all agricultural crops is mainly dependent on buyers at the farm gate. Additionally, market infrastructure is poorly developed and the few markets in existence are inaccessible to most of the farmers and are controlled by brokers. In Kilolo for example, farmers reported that the brokers do not allow them to transact directly with the buyers. Farmers felt that a collective marketing approach would enable them negotiate better prices. In Mbarali farmers reported that this would encourage them to package rice depending on the variety and grade, as they would be sure of fair prices thereby improve their returns.

3.17. Access to credit

The main source of credit is the village community banks (VICOBA) in Bagamoyo and Kilosa while in Mbarali and Kilolo these are Savings and Credit Cooperatives (SACCOS).

The main challenges related to credit in the four districts were indicated as:

i. Lack of information on credit facilities available
ii. Credit is not offered at the right time
iii. High interest rates
iv. Difficult requirements
v. Most facilities did not offer equal opportunities to men and women to access the facility. Most facilities targeted women in groups.
vi. Requirement of collateral

Credit is mostly is also obtained through farmers groups in the districts and from private lenders who are repaid with the harvested produce in Mbarali and Kilosa. The challenge with this mode of financial access was the short lending period and the requirement of a guarantor. Whereas most facilities targeted women, interviews with women revealed that, credit accessibility was a challenge since the interest rates were extremely high and the procedures to secure funding were long and cumbersome. For example the women in Bagamoyo reported that the interest rates for the local microfinance organizations were 56%. While credit was expensive across women, youth and men; the challenges faced by women and youth versus men were different since men had easier access to and ownership of land than the former two groups. In Kilolo the youth reported bias in the awarding of loans and they had fewer chances in obtaining credit. In addition, farmers in all the four districts reported that credit organizations did not target farmers, rather were offering business loans.

3.18. Institution mapping and network analysis using Venn diagrams

Institutional mapping using Venn diagrams provides a visual tool for assessing information and resource flows within communities. The below graphics highlight not only which institutions provide what services and information, but also, how well these

institutions are linked. Farmers were asked to indicate the core activities of the institutions and rank the importance of each actor. These exercises were performed as sex-disaggregated to understand whether these networks differ by sex.

A. Bagamoyo district

The men's group in Bagamoyo ranked Room to Read and Ifakara Health Institute (IHI) as the most important organizations (Figure 43). Below is a summary of the institutions as detailed by the men's group (Table 21).

Table 21: Institution's role as highlighted by men's group in Bagamoyo farmers' workshop

	Institution name	**Role**	**Importance to the community**
1.	WCR	• Providing gender awareness and education among the youth. It works closely with APA to facilitate educational seminars and training in the area	• Promotes gender awareness
2.	APA	• APA provides HIV/AIDs education to the women and youth groups; it also provides education on women and children rights	• Facilitates knowledge of gender rights
3.	CVM	• Provide loan to youth especially girls	• It helps girls get capital • It reduces poverty among girls
4.	Room to Read	• Contribute in construction of schools by providing 20% of the total cost	• Assist in provision of education to the community
5.	IHI	• Offers free medical treatment for children below 5 years	• Increased accessibility to treatment and provide malaria treatment
6.	DOT Africa	• Provides loans to the women to enable them engage in commercial pineapple farming. It has also introduced some processing for pineapples	• Eased access to capital for women and improved their economic status
7.	MUVI	• Support value chain development for	• Established farmer groups to access credit

		pineapple	
8.	Eco Energy	• Will develop a modern sugar cane plantation and factory producing sugar	• Yet to be established
9.	CVM	• Provides education on HIV/AIDs to the women groups, teaching girls on their rights and gender issues, capacity building for women	• Reduce spread of HIV and promote awareness of women rights

Bagamoyo Men

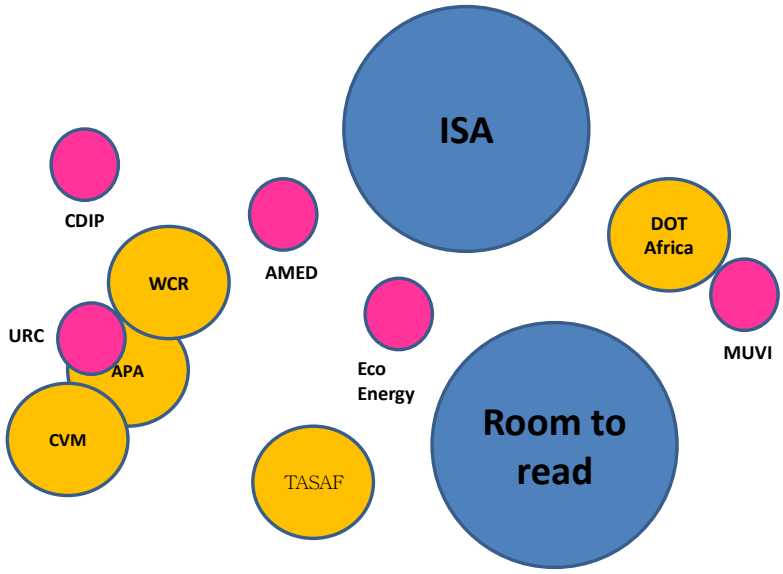

Figure 43: Institution mapping and linkages as detailed by men's group in Bagamoyo district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

The women's group in the Bagamoyo workshop ranked UNICEF, VICOBA and FINCA as the most important institutions in the community (Figure 46). Below is a summary of the role of the organization from discussions with the women group (Table 22).

Table 22: Institution's role as highlighted by women's group in Bagamoyo farmers' workshop

	Institution	Role	Importance to the community

	name		
1.	UNICEF	• It provide health services such as medicine to the sick	• Improve health quality
2.	CAMFED	• It provide education to girls from poor families	• Reduce illiteracy especially among women
3.	FINCA	• Provide credit facilities (both men and women)	• It helps farmers access capital • Poverty reduction
4.	ROOM TO READ	• Contribute in construction of schools by providing 20% of the total cost	• Assist in provision of education to the community
5.	TASAF	• Providing assistance (money) to poor family especially elderly and young people • Build classrooms	• Poverty eradication • Increasing number of classrooms to school
6.	VICOBA	• Access to credit especially for women	• Provide loans to women
7.	BAWADEN	• Provide entrepreneur training especially for women in livestock keeping.	• Encourage women to engage in small business (chicken keeping)
8.	CHALAMILA	• Access to credit especially for women	• Loan to women

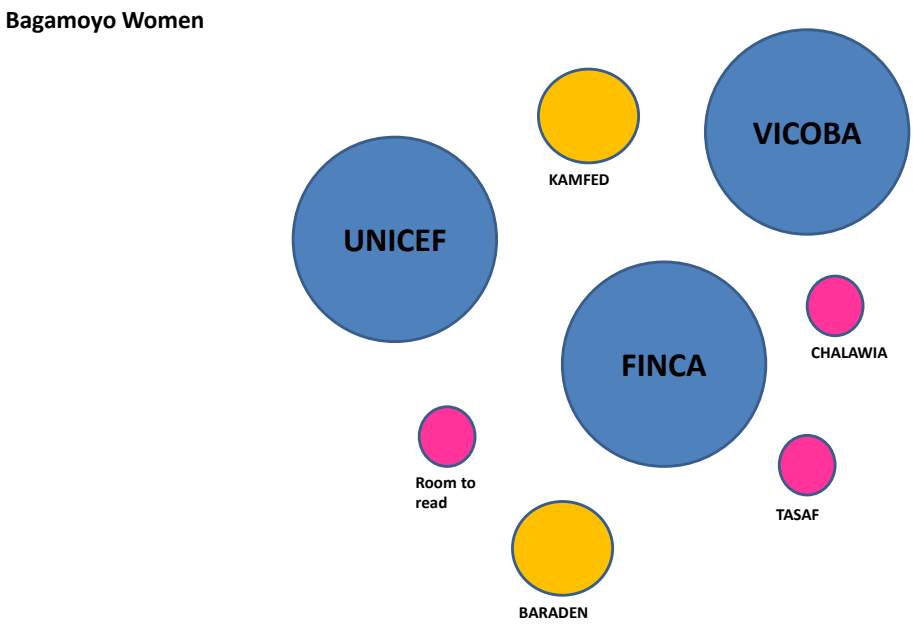

Figure 44: Institution mapping and linkages as detailed by women's group in Bagamoyo district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

B. Kilolo district

The Kilolo men's group ranked UNICEF, TASAF, Mission, Lutheran church and SUA as the most important institutions in the community (Figure 45). Table 23 is a summary of the organizations' role as detailed in the farmer workshop.

Table 23: Institution's role as highlighted in Kilolo farmers' workshop

	Institution name	Role	Importance to the community
1.	CHITA	• Provides improved inputs loans to farmers • Drying of fresh vegetables • It looks for market for farmers product	• Promotes high production • Helps farmers in preservation • Help farmers get markets
2.	SILK	• Access to credit especially to both men and women	• Loan to the community
3.	TASAF	• Provide credit to community (both men and women) • Assists in sourcing for markets	• Poverty reduction

4.	IMO	• Provides first aid services • Assists vulnerable farmers in accessing inputs such as pesticides, irrigation facilities and pumps	• Promotes agriculture and health •
5.	MUVI	• Provides inputs such as seed and pesticides • Has built markets	• Supports agriculture
6.	SACCOS	• Providing credit	• Access to capital
7.	IOP	• Provides credit especially for women	• Loan to women
8.	MISSION	• Provides health facilities • Supports the disabled • Supports education for orphans	• Supports the most vulnerable members in the society
9.	MAMA BAHATI	• Provide loans to women	• It help girls access capital • Reduce poverty among girls
10.	IOP	• Provides free education for orphans and children from poor families • Built a secondary school for the disabled	• Supports education
11.	DANIDA	• Introduced a goat programme 'kopa mbuzi lipa mbuzi' • Installed piped water • Provided tree seedlings	• Support agriculture and water supply
12.	Technoserve	• Demo training on improved methods of tomato growing and improved varieties • Training on drip irrigation • Established collection centres for tomato, potato and sunflower	• Supports agriculture
13.	Lutheran mission	• Build hospitals, schools and an orphan centres	• Support education, health and the vulnerable members in the society
14.	SIDO	• Provide training on farming • Provides inputs • Provide credit in farmer groups and building materials	• Improves agriculture
15.	HIMA	• Provides training on conservation of the environment	• Improves the environment

		• Provide tree seedlings	
16.	SPION	• Installed electricity in the villages	• Improves access to electricity
17.	SUA	• Training on improved crop and livestock management	• Improves agriculture production
18.	Mucoba Bank	• Provide credit in farmer groups and inputs	• Improves access to credit
19.	UNICEF	• Provides health services especially to women and children and vaccines	• Supports better health

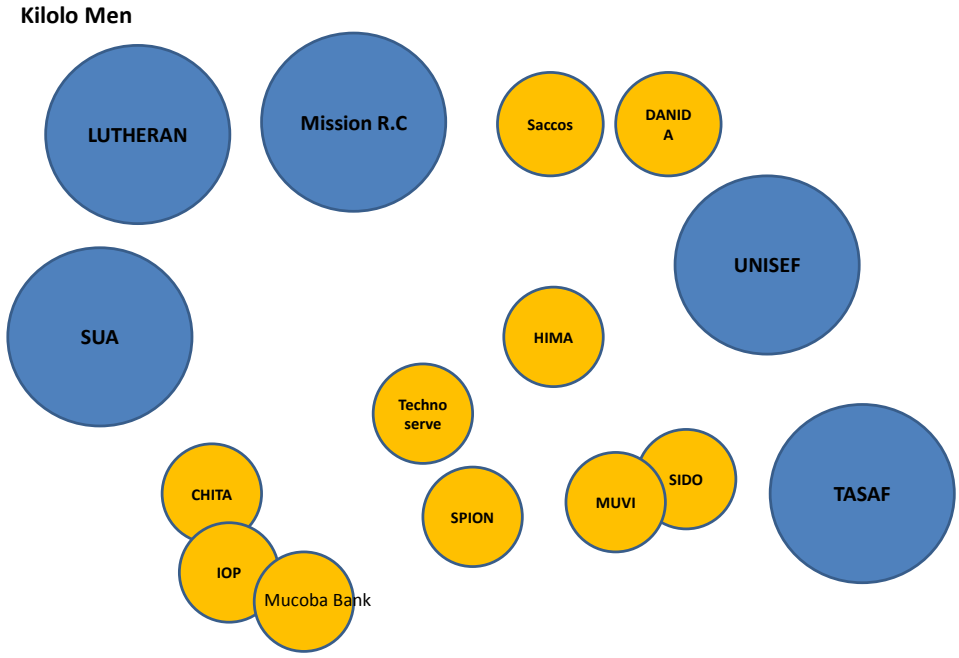

Figure 45: Institution mapping and linkages as detailed by men's group in Kilolo district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

The Kilolo women's group selected CHITA, SILK, TASAF, IMO, MUVI and MISSION as their most important organizations (Figure 46).

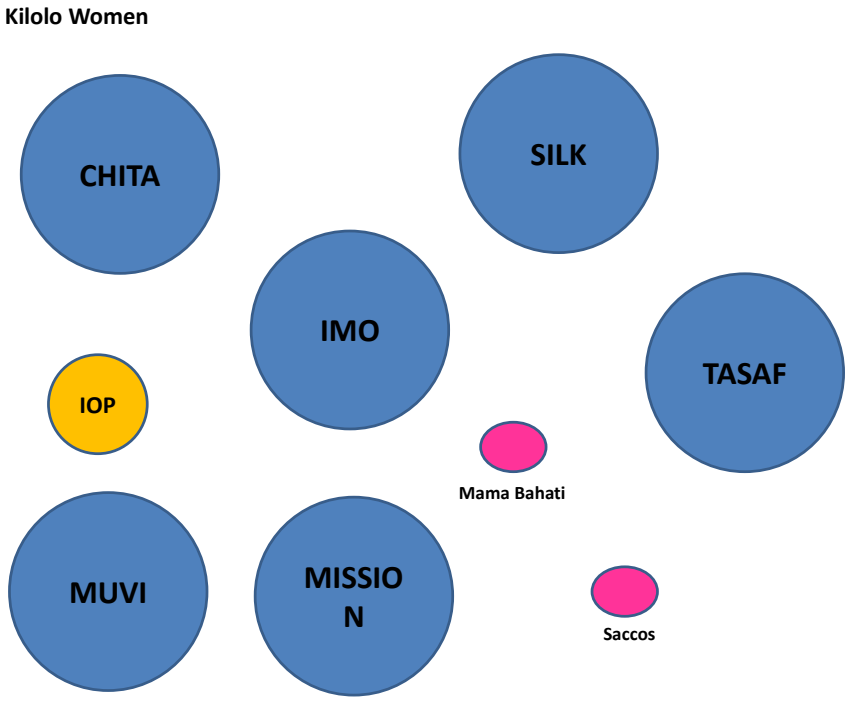

Figure 46: Institution mapping and linkages as detailed by women's group in Kilolo district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

In Kilolo, institutions networks are decentralized. The most important institutions selected by the men and women groups were also different with only TASAF and MISSION being common between the two genders.

C. Kilosa district

Below are the organizations ranked by level of importance (as high, medium and low) iby both women's and men's groups in the Kilosa farmers workshop (Table 24 and Table 25).

The men's group in Kilosa ranked VICOBA, Anglican diocese and HEIFER International as the most important organizations (Figure 47).

Table 24: Institution's role as highlighted by men's group in Kilosa farmers' workshop

	Institution name	Role	Importance to the community
1.	IPRCC	• Provide training on modern agriculture practices. • Provide loans, improved seeds and fertilizers.	• Improve agriculture practices

2.	EFCC	• Provide training on cowpea and maize production	• Farmers increase production by obtaining training on improved seeds
3.	HEIFER	• Provide training on constructing animal shelter (chicken and cattle) • Introducing cow project (Pewa Ng'ombe lipa Ng'ombe)	• Poverty reduction • Access to improved cattle breeds and improved cattle management
4.	TANSEC	• Provide training on improved seed (maize, sesame, and sunflower)	• Agriculture training
5.	Anglican Diocese	• Provide training on modern agriculture practices • Provide knowledge on medicinal plants such as neem • Provide training on composting	• Assist in improving agriculture and human welfare
6.	TASAF	• Providing assistance (money) to poor family especially to elderly and • Provided elderly men with processing machine to earn income	• Poverty reduction
7.	VICOBA	• Access to credit especially for farmer groups	• Ease access of capital
8.	CCT	• Provide training on VICOBA	• Encourage women to engage in small business
9.	CIS	• Train women on safe motherhood	• Improve health quality for women and children
10.	CHF	• Provide health insurance services	• Improve health standards for both women and men

Kilosa Men

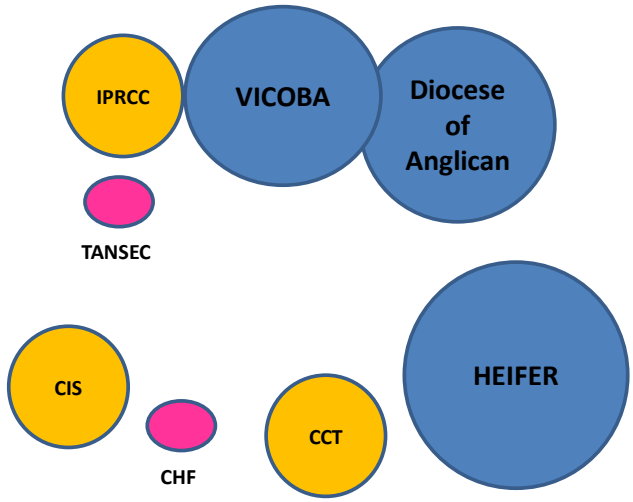

Figure 47: Institution mapping and linkages as detailed by men's group in Kilosa district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

The role of the institutions as highlighted by the women's group in Kilosa is presented in table (Table 25).

Table 25: Institution's role as highlighted by women's group in Kilosa farmers' workshop

	Institution name	Role	Importance to the community
1.	VICOBA	• Provides credit and savings facilities	• Provide loans to both men and women
2.	SACCOS	• Provides credit	• Helps in accessing capital
3.	FINCA	• Provide credit to both men and women)	• Helps community access capital • Poverty reduction
4.	BRAC	• Create farmers' groups and provide loans	• It helps farmers access capital
5.	FAIDA MALI	• Provide training on planting legumes crops (pigeon peas, cow peas, beans) for the purpose of improving soil quality	• It helps the community to improve soil quality and reduce the cost of fertilizer by planting legumes

6.	IPRCC	• Providing credit with no interest rate	• Poverty reduction • Increase farmers capital
7.	CAMFED	• It facilitates education for poor families and orphans	• Reduce illiteracy
8.	ASA	• Provide training to farmers by supplying seed through demo plots in order for farmers to learn use of improved varieties for maize and sunflower	• Helps the community engage in modern agriculture practices
9.	ILONGA	• Forms farmer groups • Provides training on good farming practices	• It helps the farmers know their rights • Educates on good agriculture practices
10.	SUA	• Provides training on improved seed and tree planting • Provides training on processing of fresh produce	• Improve crop production
11.	TASAF	• Build schools • Provides milling machines to the disabled	• Facilitates increase in social facilities • It helps the disabled access income by providing services using the milling machine
12	PRIDE	• Access to credit	• Helps the community get loans

Kilosa Women

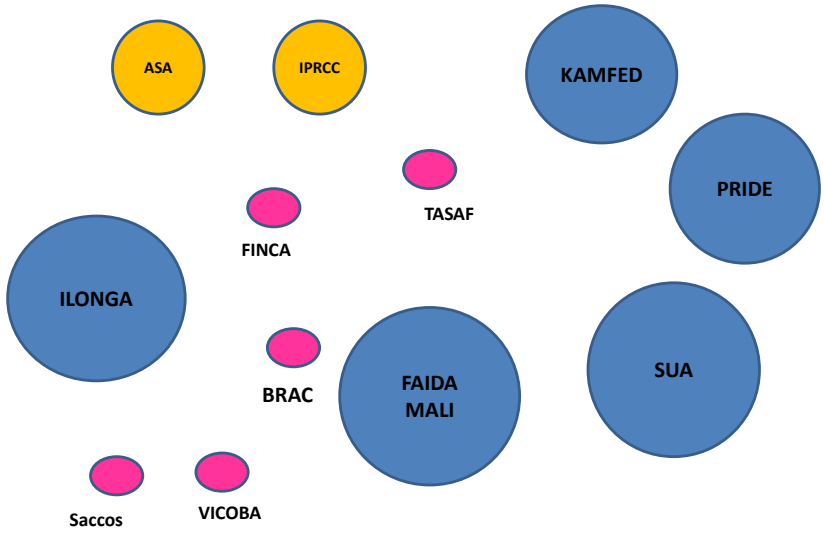

Figure 48: Institution mapping and linkages as detailed by women's group in Kilosa district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

The men's and women's groups selected different organizations as their most important. The women's group indicated no linkages in the institutions (Figure 48). The men's group however indicated there some linkages between IPRCC, Vicoba and the Anglican diocese. According to the discussion there was no institution targeting the specific needs of youth and elderly people. BRAC targets women only.

D. Mbarali district

The men's group in Mbarali selected ZIU and RUDI as the most important organizations (Figure 49). Below are details of the activities of institutions in the community (Table 26).

Table 26: Institution's role as highlighted by men's group in Mbarali farmers' workshop

	Institution name	Role	Importance to the community
1.	SACCOS	• Provide loans to their members	• It helps community members access capital
2.	ZIU	• Provides training on irrigation farming	• It helps the community to engage in irrigation farming

3.	RUDI	• Provides rice processing machines to farmers • Provides training on farming and entrepreneurship • Links farmer groups with banks and VICOBA	• It helps farmers adopt modern agriculture practices. • It helps community access capital
4.	TAAP	• Repair warehouses and provide training on preservation	• Improves storage of produce
5.	ARI-UYOLE	• Provide training on use of improved inputs such as fertilizers • Training on rice farming • Form rice farmer groups	• Helps the community to engage in modern agricultural practices
6.	SAMAWAMBU	• Provides training on gender issues	• Helps women and young children know their rights
7.	MIIKO	• Provides training to farmers on how to find markets by using phones	• Assists in access to markets
8.	SHIRIKISHO	• It provides improved inputs • Links farmers' associations from different districts in Mbeya region	• It encourage high production Increases cooperation between farmers
9.	MAMMREMA	• Provides advice and solves conflict	• It helps maintain peace to the community
10.	FINCA	• Provide credit to enterpreneurs	It helps in access to capital • Poverty reduction
11.	RBWO	• Provide training on water conservation • Repairs water streams	• It help the community to preserve water
12.	AGRA	• Provides training on fertilizer and improved farming technologies • Provides farmers with inputs	• Improves agriculture production

Mbarali Men

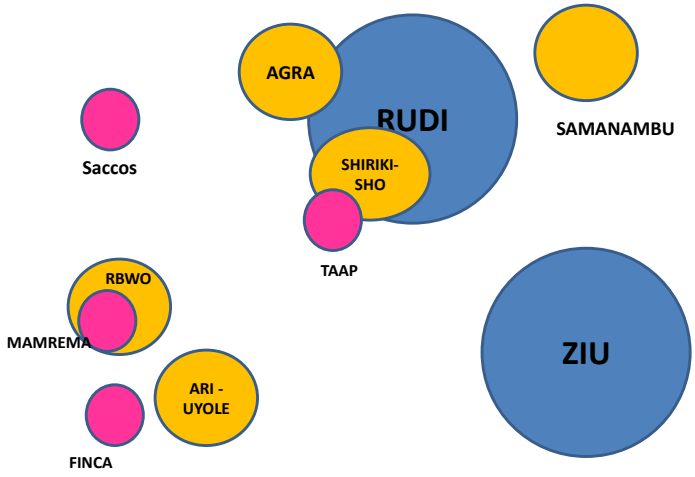

Figure 49: Institution mapping and linkages as detailed by men's group in Mbarali district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

In Mbarali the women's group selected CHF, UNICEF and RUDI as the most important organizations (Figure 50). Below are details of the activities of institutions in the community as detailed by the group of women farmers (Table 27).

Table 27: Institution's role as highlighted by women's group in Mbarali farmers' workshop

	Institution name	Role	Importance to the community
1.	UNICEF	• Provides health services such as medicine to women and young children	• Improve health quality by providing free medicine
2.	CHF	• Provide health services to the whole community	• Improve health quality
3.	RUDI	• Provide inputs such as seeds and loans to farmers	• Helps farmers engage in modern agricultural practices. • Improves access to credit
4.	TAAP	• Repair warehouses and provide training preservation	• Improves preservation and storage
6.	TASAF	• Building schools and staff houses	• Improves quality of education
7.	ARI-UYOLE	• Provide training on use of improved inputs such as	• Helps the community to engage in modern agricultural

		fertilizers	practices
8.	EEAP	• Provide training on crops value chain and create small farmers groups	• Improve returns from farmers produce
9.	KONOIKE	• Develop irrigation infrastructure	• It helps the community engage in irrigation

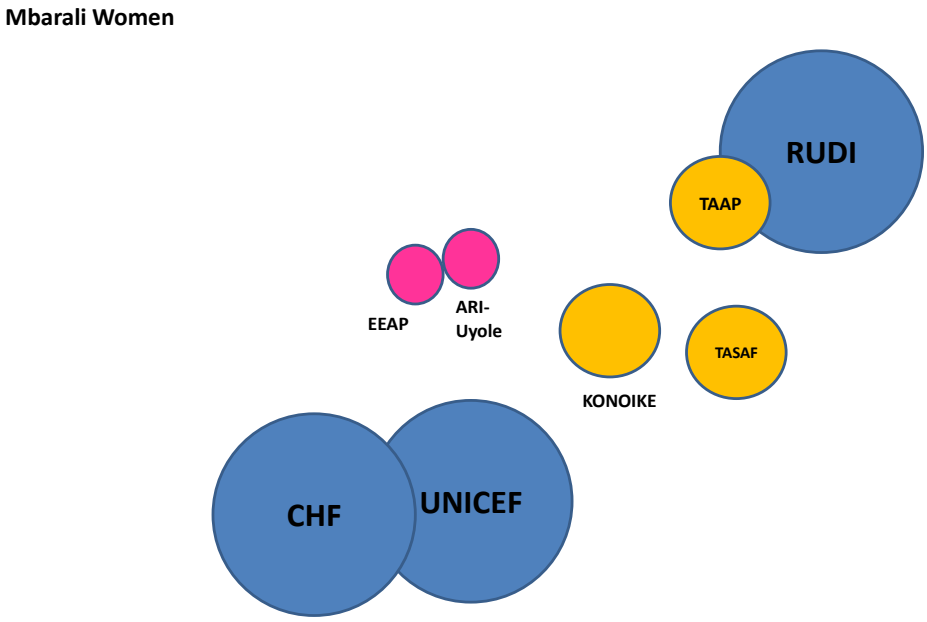

Figure 50: Institution mapping and linkages as detailed by women's group in Mbarali district. Blue circles denote those ranked as of high importance, yellow circles of medium importance, and pink circles of low importance.

In Mbarali, the groups denoted linkages between some of the institutions. The women's institutions map reveals that RUDI is working closely with three other organizations. The men's map indicates RUDI as an important organization working closely with TAAP. In addition UNICEF and CHF are both important and work closely.

3.19. Key insights and implications from the network analysis across the study site

While comparing results across districts has its limitations- primarily because the analysis is based on participatory interviews – it does show that the networks are mainly decentralized wherein non-governmental institutions play a prominent role. Five of the eight networks are decentralized. Decentralization indicates that control over network flows are concentrated in several actors, implying there are no core actors, decision

makers and gatekeepers of information. Hence many partners are required in any climate smart agriculture outreach strategy. Rather than reaching out to a single small group of actors, the strategy should be multi-pronged. In addition, working to improve the connectivity among the actors could feasibly shift the shape of the entire network to promote better flows of information, and create better synergies. Private-sector actors were also prominent in the discussions, and were perceived as providing helpful services to support the community. Research, church-based and credit organizations are involved in the networks in the four districts. It is noteworthy that there was no organization indicated as supporting livestock keeping. This was also a key issue raised in separate discussions with pastoralists.

In making use of these networks to inform outreach efforts to the communities, it will be essential to take into account both the network structure and the characteristics of the various actors. Not only can the particular institutions specified be targeted for partnerships or for dissemination of technologies, but those that are closely linked indicate that information will likely spread quickly through their clusters.

3.20. Agriculture information and extension

Agriculture extension officers were reported as the most important source of information in all the four districts surveyed. However they mainly offer information on crop production. Pastoralists expressed a need for extension services. Even though there were extension officers hired by the government, their numbers was not adequate to provide the level of service required. Farmer-to-farmer extension was the second most important source of information. This form of farmers' social networks reinforces extension messages and increases the uptake of technologies. They are also more cost-effective compared to direct extension visits to farmers in their fields; however, they are also vulnerable due to the impact of social norms or the gender composition of the targeted groups. In Kilolo farmers revealed that the lack of means of transport among the extension agents hampered effective visits to the farms.

Interviews with experts revealed that key sources of information were from: extension officers, radio, research institutions, fellow farmers, farmer organizations, exhibitions, and other stakeholders such as RUDI (Rural Urban Development Initiatives is a private sector initiative that seeks to empower micro-small enterprises and farming communities through improved market linkages and distribution channels for their products) and MVIWATA (Mtandao wa Vikundi vya Wakulima), a national network for farmers groups which brings together small holder farmers from all regions of Tanzania in order to have a common voice to defend economic, social, cultural and political interests of smallholder farmers) in Mbarali.

3.21. Assessment of demonstration plots across the SAGCOT

Demonstration plots are an experiential approach that offers an opportunity for 'learning by doing' with the aim of improving relevance and adoption of a given technology. We visited existing demonstration plots in the communities and interviewed the

implementers, participating and non-participating farmers to assess their implementation, success and challenges. Figure 51highlights the percentage of famers aware of demonstration plots in their district. Over ninety percent of respondents in Kilolo are aware of demonstration plots in the community, with the majority participating in the activities. Kilosa had the lowest awareness at about 50% (Figure). The main source of information for farmers to participate in demo plots is through workshops organized by the implementers (33%), as well as from other farmers (31%). Sixty two percent of the farmers currently not involved in any demonstration plot activities expressed interest in participating. Figure 52 show that farmers receive information on demonstration plots in the community mainly through seminars and from other farmers. Although extension officers were reported as the main source of agriculture information, this is not the case on providing information on demo plots. Separately, the extension agents reported that they were poorly integrated and not involved in the demo exercises. In several instances they learnt about activities taking place in their administrative units through the farmers.

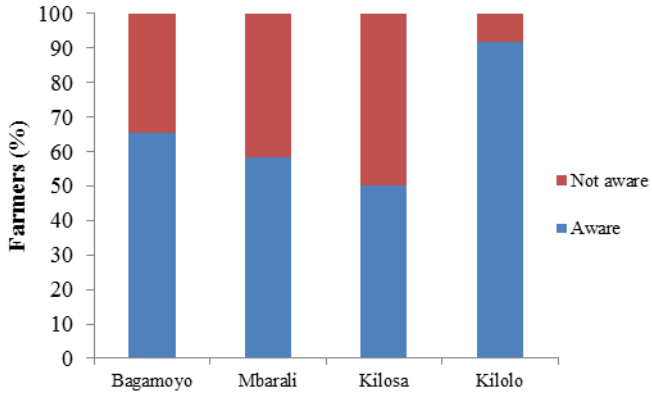

Figure 51: Percentage of farmers aware of demo plots

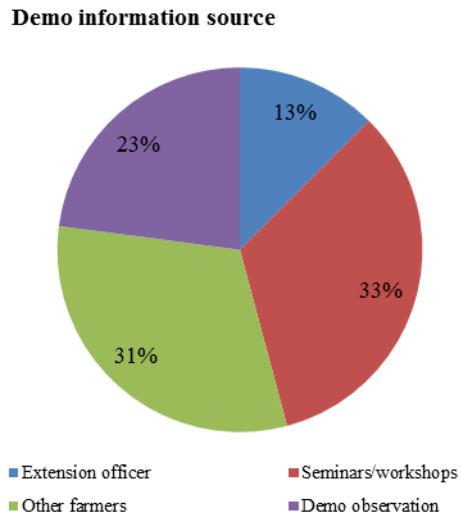

Figure 52: Source of information on demo plots

There are two main types of demonstration plots across the SAGCOT; farmer and implementer led and implementer alone (Table 28). The implementer alone type of demo was reported mainly in Bagamoyo where farmers had stopped visiting the demos set up by the extension officers and they proceeded with the activities in the next seasons alone. The reason cited for this was apathy from the community members.

Table 28: Demonstration plot typologies across the survey site

	Farmer & Implementer	**Implementer alone**
Selection of technologies	Mainly implementer (top-down), few times participatory	Implementer (top-down)
Participation	- Farmers provide land and labour for management activities - Farmers select demo location - Participatory - Labour pooling enhances participation in activities - All community members involved (both men& women) - Some farmers are not invited/aware - No cost in participating	- Implementer provides land - Community mainly observers of activities - -Location is selected by implementer - Farmers are mainly observers and do not participate - No cost in participating
Implementation	- Implementer provides inputs	- Implementer provides training

	- Implementer provides training - No management committee - No rules are set - Implementation decisions are top-down - No channel for problem solving	and all inputs and decides how demo is implemented
Decision making	- Implementer	- Implementer
Evaluation	- Compare yields with own farms	- None
Decision making	- Mainly implementer, farmers also involved few times	- Only implementer
Communication	- Farmers not fully involved in give feedback on implementation and evaluation of activities - Implementer –owned'	- Decision and activities at the discretion of implementer - 'Implementer –owned'
Facilitation	- By implementer	- By implementer
Impact/success	- Has improved farmers knowledge - Increased yields - Change in farming practices - Farmers teach others - Crop status in demo inspires passers-by and neighbours	- Farmers are mainly observers and do not gain any benefits - Capital constraints

Demonstration plots have been used in the study area to create awareness on agriculture technologies including: proper storage techniques, timely weeding, organic manure, mulching, monoculture, herbicide application, usage of improved seed, fertilizer application, improved crop management, row spacing, land preparation, agriculture tools such as power tillers, grafting technology, tree planting, composting and incorporation of crop residues. For implementation of CSA, it is necessary that the demonstration plots are both implementer-and farmer led and encourage the community's ownership of the demo activities.

3.21.1. Challenges in demo plot implementation highlighted across the study site

Several challenges were identified by famers regarding the success of the demonstrations plots. These challenges will be important to address and overcome in

any demonstration plot that aims to promote CSA technologies.

1) Poor leadership
2) The produce from the plots were not shared with members
3) Unequal opportunities to community members
4) Inputs were not provided on time
5) Too technical and instructions were difficult to follow
6) Farmers were not remunerated
7) High climate variability
8) Poor soil conditions
9) Difficult to market the produce
10) High prevalence of pests and diseases
11) Farmers were not involved in decision making
12) Plots were too small
13) Demostration plot cropping cycles were too short
14) Demonstration plot location was not easily accessible
15) Demonstrations often had very large groups
16) Some interested farmers were not involved
17) Farmers were reluctant to attend
18) Extension officers were not fully/ well involved

3.21.2. Suggestion for demo plots implementation

1) Have close interaction between implementers and farmers
2) Promote community ownership of the demonstrations
3) Encourage group participation in identifying practices to demonstrate and in its management
4) Ensure collective decision making on group matters
5) Promote collective action in resource mobilization and labour sharing
6) Use communal land rather than hired or private land
7) Consider the whole value chain and ensure that all components are facilitated for example introduction of new varieties should also ensure access to markets.
8) Integrate the local extension services in the demo implementation and communication
9) Ensure demo sites are easily accessible including visibility of random vistors
10) Demonstrations plots should allow for smaller group interaction
11) Communicate benefits of adopting the technology such the three pillars of CSA: food security, climate adapation and mitigation, resilience, as well as economic, and other benefits of the technology
12) Develop structures with the farmers for giving any feedback on success or failure of demo
13) Invite local leaders to participate in demo activities
14) Motivate knowledge sharing such as farmer-to-farmer extension
15) Share income from group activities
16) Ensure good communication and use as varied methods of creating awareness

on demo

17) Schedule meetings in good time, provide some form of motivation and limit time spent on demo

3.22. Policy implications

1) Market mechanisms were the main driving force in the dynamics of poverty with implications for food security. Farmers were not able to make enough money to access inputs required to plant in the next season. This was attributed to high cost of credit, lack of market information and the effect of farm-level brokers who offer poor prices.
2) Adoption of technologies was closely related to its economic value; hence farmers prioritize practices that improve their economic status.
3) Biophysical properties of the farm clearly matter in the adoption of improved or climate-smart technologies. Practices that ignore or interact poorly with the local biophysical or social conditions may not achieve adoption. For example, adoption of minimum tillage promoted through a demo plot in Mbarali district was unsuccessful because farmers normally planted after the start of the rains. Farmers found it difficult to use the hand-held planter for seeding as compared to the current practice of using a hoe since the soils are heavily compacted.
4) The social dynamics should also be considered. For instance some improved varieties promoted through SRI have not been locally accepted making it difficult to attract markets.
5) Closing the gap in attainment of higher education is important to address. Our finding on the positive correlation between the gender of the household head and the attainment of high education levels, suggests that male-headed households may have higher physical and human wealth to support education. Female-headed households are at a disadvantage due to lower levels of education than male-headed. Helping community/local groups access and use external resources may strengthen the ability of local organizations to foster knowledge and adoption of CSA practices. Local institutions operating in the area can act as a starting point for mobilizing farmers for learning due to the existing structures, social networks and ties.
6) Long-term commitment is required for capacity building and should be responsive to the community needs and demands. Women in general have less access to and control over economic and productive resources such as agricultural produce, credit and land, than men.

7) Gender dynamics should also be considered, and this includes women's participation in decision-making processes at all levels. Beyond their participation, access to and ownership of resources is important if interventions seek to effectively include women in the multiple levels of agricultural production. To this end, gender mainstreaming should be such that it targets the multiple levels and complex processes encompassing agricultural production. For example, marketing of agricultural produce is considered a man's activity, since women are perceived to be poor negotiators. This indicates the need to empower women with negotiating skills and also to provide market information. As well, women have fewer opportunities to access capital and this limits their involvement in cultivating crops such as pineapples which require high capital investment. This indicates the need to address the multiple levels of inequality both at the family and community level.
8) Farmers reported purchasing seed subsidies to cope with climate vulnerability. Government and relevant stakeholders should improve response in providing assistance to vulnerable groups during food deficit months. The high dependence on a single livelihood source and few crops needs to be addressed.

3.23. Youth

Discussions during the workshops were also held with farmers below 30 years to understand their challenges in agriculture production.

In Bagamoyo, the youth have challenges in availability of tools and this limits the amount of land cultivated. More than this, they also find it difficult to access hired labour and affected by: high input costs especially fertilizer and improved seed, high cost of transportation, lack of storage for perishable crops such as pineapples, pest and disease outbreaks, lack of markets and the long expensive processes to own land. To obtain land titles meetings were required with the village committee, then other meetings at the ward level and district level. This process was indicated as an expensive procedure. Lack of title deeds limit access to credit as this is the main form of collateral required by lending institutions. The Bagamoyo youth group specifically recommended development of markets in villages, provision of loans at low interest rates, agricultural mechanization and provision of irrigation facilities. The youth are attracted to low labour demanding enterprises and that which can offer quick returns. Farming is also associated with those who do not do well in school and therefore, most youth do not want to be associated with it. Lack of good infrastructure in the villages such as good roads and electricity have led the youth to migrate to urban centres where they can access these services that are regarded as offering better quality of life.

In Kilolo, the land is mainly accessed through inheritance, it was noted that this was not sufficient; therefore, to obtain adequate land the youth need to purchase or rent. They also reported that adulterated seed and crop diseases were on the increase and they attributed this to climatic changes. Of the challenges they highlighted, they singled out

thrips since they caused the greatest damage in tomato. As well, seed was reported as expensive and farmers resulted to saving their own seed for tomato. This has also affected production of tomato in the area. Another challenge reported was climate variability which causes destruction of crops when rainfall is high. Brokers who act as middlemen between the farmer and buyer were challenge as well. Kilolo is a case in point where the new market for agricultural produce at Ilula Township was under the control of brokers.

To improve the respective markets, farmers recommended setting up of farmer input shops controlled by the government, putting in place standardized weights and measures, and providing of market information. It came out strongly among the youth in Kilosa that they were averse to farm work because of the perception that it is labour intensive, beyond this; they also perceived farming as an activity by those who were uneducated –an attitude that has sustained their minimal involvement in agriculture. This means that any intervention targeting the youth in Kilosa must incorporate the attitude and perceptions that the youth presently hold if any headway towards including youth in agriculture is to be made. In as far as access to land is concerned the youth revealed that they mainly access land through inheritance. It is notable whereas the male youth have better chances to access to land through kinship ties; the same cannot be said of female youth since like older women they mainly have access through relations with men.

3.24. Overcoming agricultural challenges in the surveyed site

From the workshops and farmer interviews we identified several opportunities to address existing challenges:

1. Provide market infrastructure
2. Provide irrigation infrastructure – requested in Bagamoyo
3. Provide affordable credit facilities
4. Provide knowledge on input use
5. Increase the number of agricultural extension staff
6. Ensure high quality inputs are offered in the market
7. Develop land use plans
8. Facilitate access of land titles
9. Increase the role of animal power in farming and transportation
10. Promote settled livestock keeping among the traditional pastoralist and support them by provision of permanent water sources, combatting diseases, provision of extension services and adequate designation and registered grazing lands.
11. Limiting livestock numbers to the carrying capacity (sensitize pastoralists)
12. Introduce land sharing e.g pastoralists allowed to graze and in turn provide manure
13. Regulate export of timber and logs to neighbouring countries
14. Built capacity in best agricultural practices that are climate smart
15. There is need to provide scientific information on soil health

16. Provide climate information including short-term forecasting

3.25. Opportunities for scaling up climate smart agriculture in the SAGCOT

Given the high climate variability reported by farmers across all districts, and the high dependence on farming products and farming income, there is a high potential for developing and implementing locally appropriate CSA technologies across SAGCOT. In fact a current study conducted by SUA also indicated that there are many CSA practices in the Tanzania that are giving good results and thus should be widely promoted and especially those that can be easily implemented.

1) Use of information and communication technology such as short message service
2) Workshops and seminars
3) Mobilize local institutions and farmer groups
4) Farmer-to-farmer extension
5) Expansion through successful, farmer-driven demo plots
6) Use of alternative media outlets such as radio, local newspapers, television was also recommended to reinforce demo plots.
7) Cinema shows on best practices and documented success stories from within the region and world over, if appropriately packaged will attract youths' attention.
8) Focus on long-term resilience of farming systems that can cope with climate uncertainty and variability
9) Focus on soil health improvement, especially in regions reported to have high erosion prevalence.
10) What else

3.26. Barriers in adoption of CSA practices across the site

1) Access to markets
2) Inappropriateness of the practices for the particular landscape
3) Social preference - for example some local varieties have attributes preferred over improved varieties
4) Lack of financial capital – for example women lack capital to purchase fruit trees such as oranges. The low asset index and external income across the districts indicate low financial capacity to invest.
5) Lack of technical knowledge/assistance – for example farmers in Mbarali lacked knowledge on budding to adopt fruit tree seedling production
6) Attitude – the youth reported that trees take long to mature and provide benefits, yet they are interested in investments that bring in income quickly. Adoption of

fertilizer in Mbarali and Bagamoyo was low because they view as the soil fertility as good

7) Lack of proper infrastructure such as roads, markets and storage
8) Attitude – for example women consider planting trees as a long term investment yet they may be unsure of being in the matrimonial home in the future
9) Tradition – for example activities in managing trees such as planting and pruning are associated with men and therefore men are more likely to adopt trees than women.
10) Land tenure – farmers in Kilolo were reluctant to practice soil improvement on rented plots.
11) Labour – for example in Mbarali row planting is considered to be more time consuming.
12) Accessibility of inputs – Farmers in Mbarali learned about the benefits of Minjingu phosphate rock through demo but it is not easily accessible for adoption.
13) Lack of market information
14) Lack of access to skills and knowledge required to implement the technology

3.27. Awareness of SAGCOT framework

Over 98% of the respondents surveyed both in the workshops and farmer interviews were not aware of the SAGCOT framework or what it represents. The initiative has been presented as a public-private partnership, and therefore it is important to create awareness to all stakeholders in order to ensure ownership, acceptance and that the investment guidelines are developed through a consultative process.

4. References

SAGCOT Centre Limited. "What Is Sagcot?" *Southern Agricultural Corridor of Tanzania:* Web. 22 Oct. 2014.http://www.sagcot.com/who-we-are/what-is-sagcot/

5. APPENDIX A: SURVEY SITES

Table 29: Wards and Villages surveyed for the farmer interviews

District	Wards	Villages	Number of farmer interviews
Bagamoyo	Msata, Mandera, Fukayosi	Msata, Kihangaiko, Kugini, Plot, Mandera, Kidomole, Vigwaza, Mwavi	26
Kilolo	Mlafu, Ilula, Lugalo, Magomeni	Ikokoto, Itingi, Imalutwa, Masukanzi	24
Mbarali	Mapogolo, Mabadaga	Msesule, Mbuyuni, Ukwavila, Utulo	24
Kilosa	Zombo, Rudewa, Masanze, Memba, Lugunga, Dundumwaa, Masanze, Estate, Chanzulu	Zombo lombo, Changarawe, Miyombo, Batini, Gongoni, Ilonga, Mapipili, Rudewa	24

6. APPENDIX B: MOST IMPORTANT CROPS CULTIVATED ACROSS THE DISTRICTS

Table 30: The five most important crops across the districts

Position	Kilosa	Kilolo	Mbarali	Bagamoyo
1	Maize (S)	Maize (S)	Rice (C)	Pineapple (C)
2	Rice (C)	Tomatoes (C)	Maize (S)	Maize (S)
3	Sesame (C)	Sunflower(C/S)	Beans (S)	Cassava (C/S)
4	Cowpea (C)	Beans (C)	Leafy vegetables (S)	Rice (S)
5	Beans(C)	Onion & capsicum (C)	Sorghum (S)	Coconut (C)

S = grown for subsistence use; C = grown as cash crop

7. APPENDIX C: COMMON UNITS OF MEASURE USED BY FARMERS

Table 31: Common units of measure across the four districts

Site	Crop	Reference	Unit	Equivalent
All districts			debe	20 kg
Bagamoyo	Maize	Grain	bag	6 debe
Mbarali	Maize	Grain	bag	8 debe
Kilosa	Maize	Grain	bag	6 debe
Kilolo	Maize	Grain	bag	7 debe
Kilosa; Kilolo	Sunflower	Grain	bag	7 debe
Kilolo: Kilosa: Bgamoyo	Beans	Grain	bag	7 debe
Mbarali	Beans	Grain	bag	8 debe
All districts	Cassava	Fresh tuber	number	1 piece
All districts	Banana	Fresh fingers	bunch	
All district	Cowpea	Grain	debe	20 kg
Mbarali	Rice	Paddy	bag	8 debe
Kilosa	Rice	Paddy	bag	7 debe; 6 debe
Kilosa	Sesame	Grain	bag	6 debe
Bagamoyo	Sesame	Grain	Kg	1 Kg
Bagamoyo	Sorghum	Grain	Bag	6 debe
Kilosa; Kilolo	Tomato	Fresh fruit	tenga	20kg

8. APPENDIX D: MAPS OF THE STUDY SITE

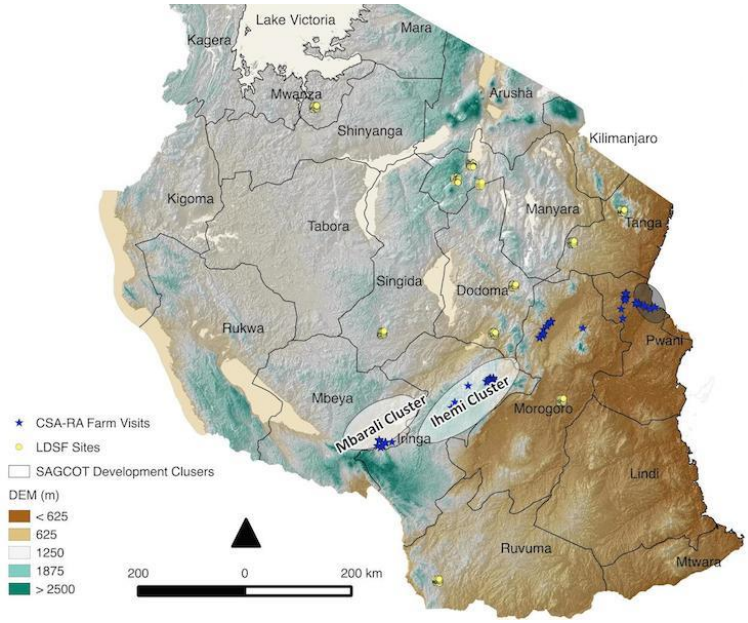

Figure 53: Map of the digital elevation model for Tanzania, with the SAGCOT clusters and the CSA-RA sampling points highlighted.

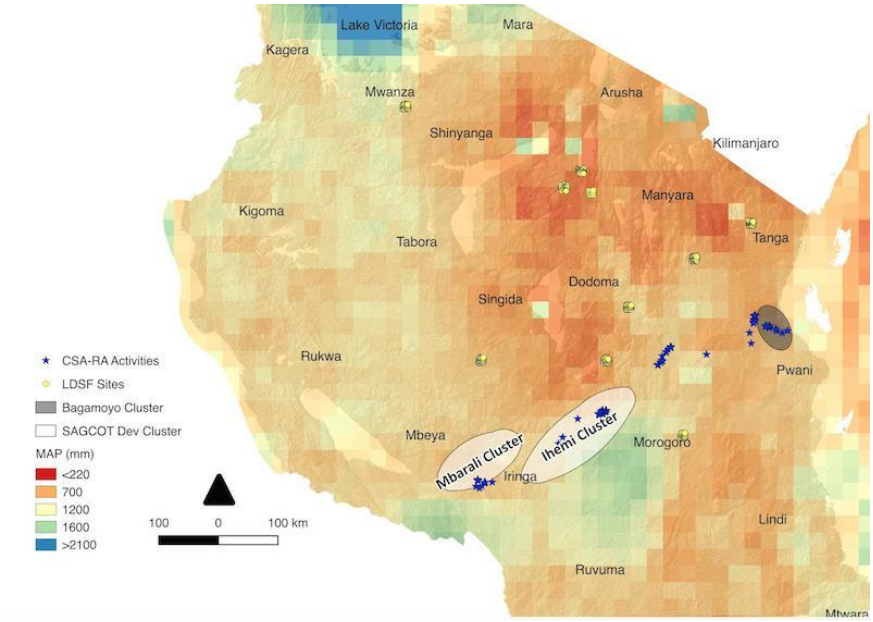

Figure 54: Map of mean annual precipitation of TZ, with the SAGCOT Clusters highlighted, using the TRMM data.