

Report on Focus Group discussions in Meru, Machakos and Usin Gishu Counties Addressing the Impact of Climate Change on Agricultural Systems in Kenya

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Contents

Contents	2
Contents	2
Focus Group Discussions on the impacts of climate change on Agriculture in three selected locations in Kenya.....	5
Introduction	5
Background information on general agriculture in the three sites	6
Meru Site	6
Mwala site.....	7
Uasin Gishu, Ainabkoi Site.....	7
Impacts of climate change on farming systems.....	8
Objectives of the workshops	8
Agro Ecological Zones of Kenya.....	9
Methodology.....	11
Results per workshop site	12
Meru	12
General Comments by participants of Meru workshop.....	13
Discussion Questions.....	13
Preliminary	14
Crop Productivity Changes	14
Livestock	15
Water Availability.....	17
Climate Changes	17
Projects or Programs	19
Mwala – Machakos.....	21
General Comments by participants of Mwala workshop.....	21
Mwala group discussions	22
Crop Production Changes	22

Livestock	23
Water Availability.....	24
Climate	25
Projects or Programs	27
Usin Gishu	28
General Comments	28
Crop Productivity Changes	29
Livestock	30
Water Availability.....	31
Climate	32
Projects or Programmes	33
Summary of Discussions	40
How Climate Change is affecting areas differently.....	40
Availability of water	40
Amount and timing of Rainfall	40
Crop disease and pests	40
Vegetation cover	41
Farming or cropping systems	41
Pastures for livestock	41
Gender and wealth	42
Observations common across all sites.....	44
Effects of climate change on gender and nutrition	44
Differences due to variabilities in Agro-ecological zones and farming systems	45
Table 5. What is different because of AEZ	46
Knowledge Gaps – Need for further investigations	47
Suggestion for further investigations	47
Appendices	48

Lists of participants.....	48
Questions used in the discussions	51
Some photographs of the discussion groups	55

Focus Group Discussions on the impacts of climate change on Agriculture in three selected locations in Kenya

Introduction

This is a report on the results of three focus group discussions held in three separate locations in Kenya, on farmers' perceptions on climate change and the impacts climate change has on agriculture.

The three locations were selected to represent three different agro ecological zones where maize is grown and the three sites have variable environmental characteristics and land management practices. The three areas characterize high altitude small scale agriculture along the slopes of Mt. Kenya represented by Katheri site in Meru County at 1920 m above sea level with an average annual rainfall of above 2000 mm. The Ainabkoi site in Usin Gishu County represents a higher elevation site at 2400m asl where maize is cultivated in a more commercial production system in larger land production units. The third site is Mwala location in Machakos County which is drier than the other two sites and land sizes are bigger than those of Meru site but smaller than those of Usin Gishu site. Mwala site is located at an elevation of about about 1,335m asl. Cultivation in Mwala is in small scale production both for domestic consumption and for cash crop.

This report presents the farmer's perceptions and experiences on climate change in the three locations. Climate change is perceived by farmers as the state of having insufficient rainfall, uneven distribution of rainfall, and sometimes the situation of having no rainfall at all. Among the farmers there is very little understanding of the difference between climate variability and climate change. The dry conditions experienced almost every year these days used to occur only during the times of drought which were rare in the past as they occurred after long periods of time. Initially there was a 20 year period (1964-1984); which changed to a 12 year period (1984 -1996); to a 2 year period (2004 – 2006) and now they occur almost yearly in 2007, 2008, 2009. The drought of 1999 and 2000 for example was widespread and lead to famine and starvation that affected 4.4 million people across the country. The changes have made farmers to make many adjustments to their traditional farming practices right from land preparation to selection of seeds, to the way they remove the weeds, to the way they harvest and manage the harvest.

Crop productivity has dropped drastically mainly due to lack of sufficient rainfall. The low returns or off take from farming has made it difficult to afford labor to work on farms. The high cost of living in Kenya has worsened the situation due to higher daily wages for farm labor.

Michigan State University in collaboration with Ecodym Africa conducted workshops in three counties of Kenya to understand how farmers are responding to these changes that are triggered by shortages in rainfall. The workshops were held in Machakos, Usin Gishu and

Meru counties. The principle idea was to select places where maize is cultivated in different regions by different communities at different altitudes from a high altitude to low altitude maize varieties. The selection of sites also targeted highland small scale highland production and large scale highland production. In the cold highlands, maize is planted once a year due to the cold weather while in the lowlands maize is planted twice a year corresponding to a bi-modal rainfall pattern. The workshops were held in their specific locations where farmers can attend (Mwala in Machakos, Ainabokoi in Usin Gishu and Katheri in Meru). The Meru site is at an altitude of 1920m asl and although with a bi-modal rainfall pattern, maize is planted once a year because of the cold weather. Mwala is at an elevation of 1,335m asl while Ainabkoi is at the altitude of about 2400m asl.

At both Meru and Mwala sites farmers are small scale growers for different reasons. In Meru the main reason for small scale production is the small sizes of land owned by individual families. There are no spaces left for open livestock grazing. In Mwala, the main cause for small scale farming could be attributed to poor productivity of the land and lack of sufficient resources and labour to cultivate more land. Much land is left uncultivated or as un managed grazing lands some of which appear to be follow.

Machakos is inhabited by the Kamba community, Usin Gishu by the Kalenjin community and Meru by the Ameru community. All the three communities use maize as their staple food, but the Kalenjins are much more dependent on maize meal (ugali) than the Kambas or Merus. Among the three communities the Kambas are next to Kalenjins in terms of day to day use of maize meal (ugali) as food. The Amerus have just recently embraced ugali as food because their traditional food comprised of boiled beans mixed with maize grains (Githeri) and beans cooked with bananas and some green vegetables munched together (Mukimo). The gradual shift to Ugali by many communities in Kenya both urban and rural is perhaps due to the low cost of Ugali. It is easy to cook and requires just maize meal as the main ingredient. After ugali is made it can be eaten with a range of accompaniments including milk, vegetables, tea, beef stew or even eaten alone during times of scarcities.

Maize is perceived as the food for Kenyans without which the country is considered to have no food. Even the government measures food security by the amount of maize harvested per season and the amount in the stores.

Background information on general agriculture in the three sites

Meru Site

The site selected in Meru (Katheri) is a high altitude area on the slopes of Mt. Kenya a relatively cold place where maize is planted only once a year. The main cash crops are Irish potatoes and coffee while the upper part of the area plant tea and coffee. Katheri is a dairy farming area and milk production is a major source of income for people.

Katheri has been occupied for a long time and land parcels have been sub-divided many times for several generations. Land units per household have become too small for many crops to be produced profitably. It is for example not profitable to cultivate maize which takes a whole year to mature and the returns not so profitable. The current trend is to grow vegetable like cabbages, carrots, and kales (Sukuma Witki) that mature much faster and have good prices in the market. Cultivation of vegetables is possible through irrigation. Unlike Mwala there are some large rivers flowing across Katheri originating from Mt. Kenya Forest that provide water for irrigation. All homes have access to irrigation water on their land hence growing of vegetable can be done all the year round. However, coffee and tea are grown by those who have larger pieces of land.

Due to the small pieces of land many people have migrated to settlement schemes outside the area (Katheri) where they can get bigger land. Many of those that have not migrated, they have leased land in the settlement schemes where they grow food crops.

Mwala site

Mwala is the direst of the three sites visited. They have two rain seasons as October to December and April to May. Most of the crops are planted twice per year corresponding to the two seasons but a few crops like peas and bananas are annual and perennial respectively. Crops like pigeon peas and cotton are planted during the October rains and remain in the gardens through the April –May rains to be harvested in the months of June July and August. Other crops like bananas and cassava remain on the garden for several years harvested year round.

Among all the three sites, farmers in Mwala are the least mechanized as they rarely use tractors for ploughing. Only a few farmers are able to purchase fertilizers as most of them rely on animal manure for increasing soil fertility, but because animal manure may not be enough for applying on all the farms, some of the land is planted without manure unless for the households with many cows and goats /cheep.

Farmers in Mwala have large sizes of land available as some of the land could be seen on fallow probably left to gain fertility. The area receives little rainfall and has no water for irrigation.

They use maize seeds bought from Kenya Seed Company or other seed suppliers who supply them in their local markets.

Availability of labour for planting and weeding is not sufficient as most people have their own gardens to tend to. When available the cost for hiring people to work is costly as it is paid per day. Labour is a limiting factor to the size of land one can cultivate.

Uasin Gishu, Ainabkoi Site

Uasin Gishu is one of the counties that have favourable climatic conditions for growth of a wide variety of crops. The county has an altitudinal range of between 1800 to 2400 meters above sea level. Ainabkoi the sub county where data was collected is around 2100 above sea

level. Due to the high altitude the sub-county has moderate temperatures of between 18^o Celcius during the cold months and 27^o during the hot months. The coldest month is July and the hottest month is usually January. However, due to the current climate change this pattern does not occur as it used to be in the past.

The sub-county receives rainfall of between 1000 and 1200mm per year which falls in two seasons enabling the farmers to grow many crops twice a year. The soils are red volcanic loam soils that are rich in plant /crop nutrients. Due to relatively high ground cover, in almost all parts of the sub-county, soil erosion and landslides are not experienced in the sub county.

Agriculture is one of the major economic activities carried out in Uasin Gishu County. Most of the agricultural activities are carried out on large scale and this in turn helps to boost the economy and food security of the county. The region is best known for the high production of maize that is used to feed a large proportion of the population in the country.

Maize is grown in plantations that are distributed all over the county especially in the lowlands. Farmers use tractors and other farm machineries to prepare and harvest the produce from their farms. Other crops that are grown include wheat, vegetables and certain fruits. Some of the produce is consumed locally while the surplus is sold in the various agricultural markets in the county

Impacts of climate change on farming systems

Climate change is disrupting farming systems everywhere in Kenya mainly through variations in the timing and the amount of rainfall. Rain may come sometimes too early before the farmers prepare their land or in many times rainfall starting too late long after the seeds planted have been eaten by pests or have become rotten in the soil. In many seasons it rains for short durations and the crop dries up due to lack of water. Farms have become unproductive due to a number of reasons but by far the most visible reason is the lack of sufficient amount of rainfall. Other reasons include poor soil fertility, outbreaks of diseases, pests and weeds becoming unmanageable especially at times when rainfall variability makes the weeds to germinate before the crops forcing the farmers to weed for the crop twice unlike the traditional one round of weed removal. All these are reasons for poor crop productivity which can be directly or indirectly linked to climate change. There are other causes like changes in land use that has increased the intensity of land use allowing no fallow periods at any time.

Objectives of the workshops

The workshops were held to understand how climate change is affecting different aspects of farming with a special interest on Maize which is planted across a wide range of agro-ecological zones and is the most widely consumed food crop in Kenya. Some of the specific objectives include:

1. How climate change is affecting agriculture in general

2. How climate change is affecting water availability around the year
3. How farmers perceive climate change and how they are adapting to the changes
4. How climate change is impacting on gender and social lifestyles at family level.

Agro Ecological Zones of Kenya

There are seven agro-ecological zones in Kenya divided based on their ecological characteristics that determine agricultural potential. These zones also follow climatic patterns as described by the amounts of rainfall and temperature regimes. A major factor that also characterizes the zones is elevation and the position in relation to the rain bearing winds. The highlands for example are the wettest parts of the country (zone I in the map below) as they receive more rainfall and the lowlands are the driest except in the coastal regions where moist air from the oceanic winds makes the surrounding environments wetter.

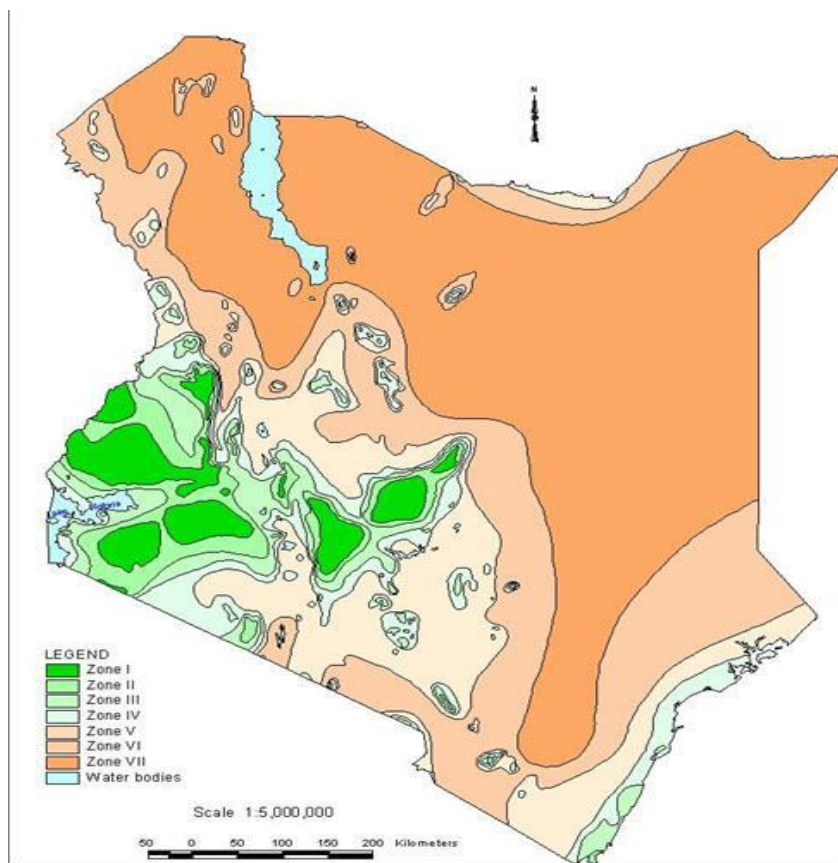


Fig. Agro Ecological zones of Kenya

Agro-Ecological Zones of the project sites

Katheri – Meru = Zone = II
 Ainabkoi - Uasin Gishu = Zone III
 Mwala - Machakos = Zone IV

Distribution of the zones and their ecological characteristics

Zone II. Meru - Katheri Site

This zone is generally restricted to the highlands of Kenya between 1980 and 2700 m and occurs as a forest or open grasslands. This zone is found in the surrounding of Mt Kenya (parts of Meru, Embu, Kirinyaga and Nyeri), isolated parts of the Rift Valley around Mau and Abadares mountains (e.g around Kericho and Nyahururu respectively) and the surrounding of Mt Elgon (e.g around Kitale and Webuye). The minimum rainfall is 1000mm.

The main grasses are *Pennisetum clandestinum* (Kikuyu grass), *Themeda triandra* (Red oats), *Andropogon Chrysostachyus*, *Andropogon pralonsia*, *Exotheca abyssinica*, *Digitaria scalaram*, *Eragrostis lascantha*, *Seteria sphacelata*, *Pennisetum catabasis* and *Sporobolus filipes*. The legumes include *Trifolium johnstoni*, *Medicago sativa* (Alfalfa or Lucerne), *Sesbania sesban* and *Leuceana leucusephala*.

Zone III Usin Gishu – Ainabkoi Site

This zone occurs mainly at elevations between 900-1800 m with a annual rainfall between 950 and 1500 mm. Trees are numerous here and somewhat of shorter stature than in Zone II. This zone is the most significant for agricultural cultivation and several legume fodders are found here in crop-livestock systems. It is also the most resettled by human. It occurs in the vast parts of Nyanza, Western and Central provinces, good proportion of Central Rift-Valley (Nandi, Nakuru, Bomet, Eldoret, Kitale) and a small strip at the Coast province.

The major grasses are *Hyperenia* and *Cymbopogon*, *Themeda triandra*, *Panicum maximum*, *Seteria Sphacelata*, *Sporobolus pyramidalis*, *Bracharia brizantha* (Congo signal), *Bricharia siluta*, *Chloris gayana* (Rhodes grass) and *Cynodon dactylon* (Star grass).

Zone IV Machakos – Mwala Site

This zone occupies more or less the same elevation (900-1800 m) as the previous or may be at times lower. However, it has lower rainfall of about 500-1000 mm. This is typically represented in surroundings of Naivasha, vast parts of Laikipia and Machakos districts vast parts of central and southern Coast Province. It is the home of most *Acacia* trees and shrubs including *Acacia seyal*, *Acacia Senegal*, *Acacia brevispica*, *Acacia drepanolobium* and *Acacia gerrardii*. *Euphobia* trees occur in some drier parts of this zone. *Combretum* and *Terchonanthus* spp. are also common here.

Grasses found include *Themeda triandra*, *Pennisetum mezianum*, *Pennisetum stramineum*, *Pennisetum massaiense*, *Eragrostis* spp., *Hyperenia* spp. *Seteria* spp., *Digiteria* spp., *Bothriochloa insculpta*, *Cenchrus ciliaris*. Rare grasses include *Chloris* spp. and *Cynodon* spp. Besides acacia, other important legume include *Indigoferra* and *Crotolaria*.

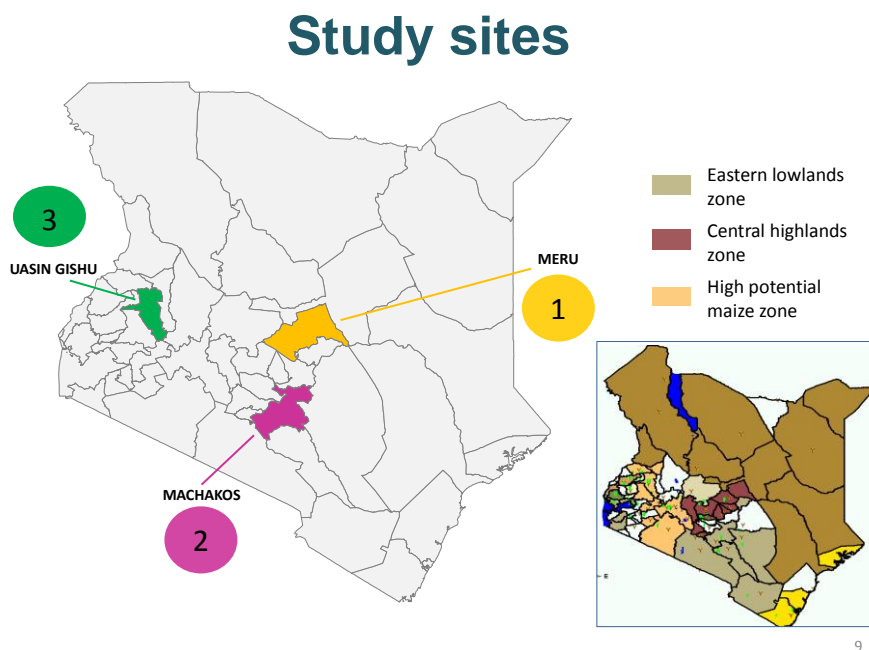


Fig. 2. Map of Kenya showing the three study sites (from Crawford presentation)

Methodology

The approach used was to conduct group discussions following pre set targeted questions. The group was required to discuss the responses to questions, correct each other and come to a conclusion or a majority accepted response.

Following a prepared form for responses, the farmers went through the areas to be filled and discussed the responses until they all came to the appropriate response for each part of the form.

The responses from the groups were agreed upon by the majority of the group members. At times when the responses varied due time lapse, especially in regards to the time the changes started to occur, some discussions among themselves were enough for them to remind each other and an agreement was reached.

The forms were developed by Jennifer Olson of Michigan State University and the information was designed to feed into a regional computer model.

Results per workshop site

The following are results of the discussions held in each of the workshops.

Meru

Meru Workshop was held at Kathita sub location, in Katheri Location, Meru County. The farmers have very small pieces of land due to subdivisions over generations. On average most farmers have 2- 3 acres of land on which they do all their cultivation. Growing of maize in the area has been both for commercial as well as domestic use. However unlike many other places maize in Katheri takes about six months to mature due to the cold weather while in other warmer places they take only three months to mature. Information from the workshop participants indicated that farmers no longer grow maize for home consumption or markets but as livestock feed. They cut down maize plants before they form maize cobs and feed the plants to livestock. They find these to be more nutritious

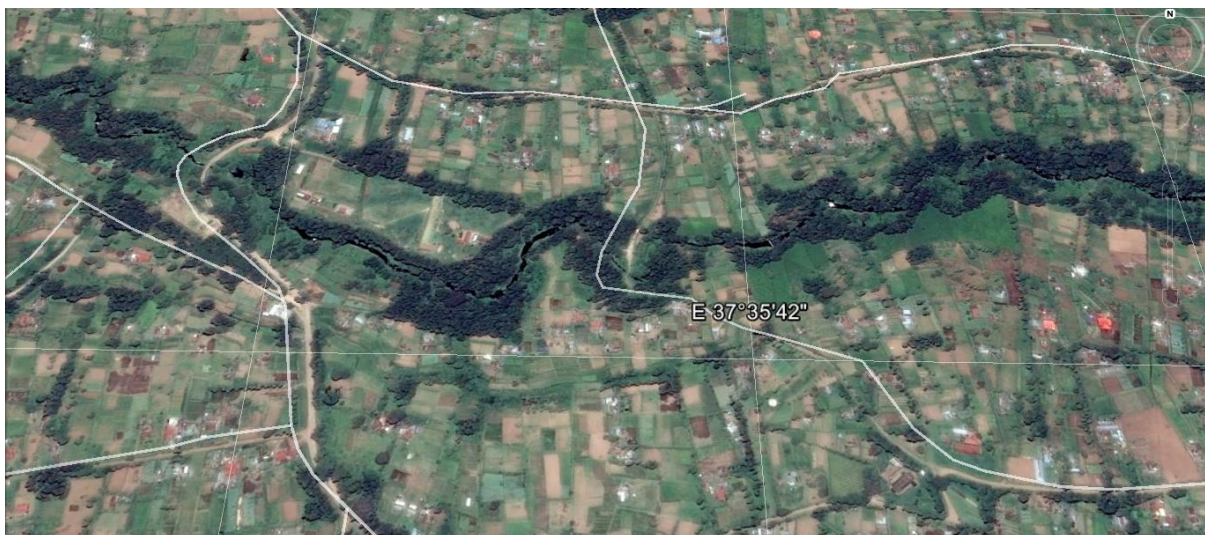


Figure 2 Google Map of land use patterns in Katheri region of Meru County

Site description

Katheri is located 7 kilometres from Meru Town towards the upper Chogoria - Embu route on the slopes of Mt. Kenya at an altitude of 1920m / 6300 ft above sea level. The site is only 5 kilometres from the edge on Mt. Kenya forest. The area has been under cultivation for many generations and land subdivisions to younger generations have occurred severally to the extent that the current average land ownership is about 2 acres. However, land is very productive and people can make a living from the small pieces of land they own.

Katheri Sub-Location Latitude	0.01667
Katheri Sub-Location Longitude	37.58333
DMS Latitude	N 0° 1' 0.012"
DMS Longitude	E 37° 34' 59.988"



Fig. 4. Map showing location of Katheri Site

Katheri, especially in the upper zones has little differentiation in times of planting and harvesting because the cold weather from the mountain can sustain cropping all the year round. They use little water to germinate the crops and there after the cold weather can sustain the crop

Farming system around Katheri: Farming in Katheri is currently dominated by irrigation with water piped from rivers. Planting is done at any time of the year because they use irrigation to germinate the seeds. The only thing they avoid is for the crop to mature in the field during the rainy season as the rain can damage the harvest if it is mature. Among the perennial crops planted, are tea, coffee, yams, and some bananas. Tea is most common perennial crop especially on the upper zones bordering Mt. Kenya forest but on the lower zones of Katheri away from the forest coffee is more common followed by bananas.

General Comments by participants of Meru workshop

The participants of Meru workshop had the following general comments

1. Maize is planted once a year
2. The variety planted is only the hybrid type
3. Most farms are ploughed by tractors
4. They use fertilizer mixed with manure
5. Tea and coffee are perennial therefore not planted every season
6. Usually no guarding of crops except in very rare occasions when crops like bananas ripen in the farm and not harvested
7. Problem of very small land size per household

Discussion Questions

The questions were asked to the participants and they answered together. Those who were of different opinion from others or were not in agreement with the others were allowed to give their opinions. Where there were two or more different opinions, the participants discussed with each other until an agreement was found. The opinion held by the majority was accepted as the group response to the question but for record purposes even the different opinions were noted down.

The main agenda for the meeting was to sample the views of the residents with regard to understanding their perception on climate change, the impacts climate change has on agriculture and their responses to mitigate the impacts.

Preliminary

The meeting was called to order by the convenor. A member of the audience at the request of the local area chief opened with a word of prayer.

The convenor commenced by elucidating the objectives of the meeting and the procedure of the meeting, thereafter he invited members of the audience to introduce themselves.

The audience consisted of members aged above fifty years and some well over sixty years who grew up and lived in the local area all their lives.

Crop Productivity Changes

1. *As regards to whether there have been any changes in crop productivity over the past 20-30 years?*

The respondents affirmed that there were changes in crop productivity. They reported that crop yield per acreage had significantly reduced.

2. *Which crops changed productivity?*

The audience noted that production yield per acreage of each crop plummeted over the years. These include: Maize; Sugar Cane; Tea; Coffee (Arabica); Sweet Potatoes; Yams

3. *How much have yields changed?*

The respondents reported that there was a variance in change per crop. In general, however they estimated that the percentage yield had dropped by over fifty percent (50%) in Tea and Coffee; Over seventy percent (70%) in cereals such as Maize and ninety percent (90%) to absolute failure in sugar cane production, yams and sweet potatoes.

4. *When did the change occur?*

The farmers noted that changes begun to occur in the last two decades.

5. *Why did the change occur?*

The farmers gave many reasons namely:

Soil degradation: - The respondents noted that owing to prolonged use of fertilizers the soil fertility had deteriorated, thereby being one of the causes of reduced crop production. This has resulted in the farmers incurring greater costs in purchasing more fertilizer.

Climate: - the farmers noted that temperatures have consistently been on the rise. They further noted that rainfall has consistently been on the drop. They observed that rainfall patterns have been erratic, in that the timing of the two rainy seasons has changed.

Pests and diseases:- the audience pointed out that in the recent past dating to around a decade. Their fields have been ravaged by numerous crop diseases and pests, with the latest being the Maize lethal necrosis, *Luta absoluta* amongst others.

Lack of Government and NGO support:- the farmers lamented that owing to corruption and greed, Government seeds have been inadequate and of low calibre. As a result, their crops were prone to diseases and pests. They further raised the issue of withdrawal of Government extension officers who were crucial in educating the farmers on better agricultural practices.

As regard NGOs they observed that there was only one that carried out a project in the area however they failed to monitor and evaluate the project.

6. Impact of the changes to crop cultivation?

The respondents observed that they have adopted certain measures being irrigating their farms more often; diversifying their variety to commercial food horticultural food crops such as cabbages, Irish potatoes amongst others while others noted that a number of the farmers adopted dairy farming or abandoned farming all together to go work in urban centers.

7. Wealth differences?

First of all they pointed out that the majority of the farmers are becoming poorer. They identified many reasons, these being: Sub-division; lack of government support; lack of access to information amongst the above mentioned.

They noted that to sustain higher yields one has to access more water (Irrigate), use more fertilizers and purchase better quality seeds from private seed companies. Considering these, they observed that the wealthier farmers were better advantaged to cope with the changes in maintaining their crop productivity.

Livestock

1. Have you noticed any difference in how your livestock health and numbers over the past 20-30 years

They affirmed that livestock numbers have declined.

2. Which livestock have changed?

The livestock that have changed most are cattle and goats. Respondents observed that they have resulted to rearing cross breed cows. Cross breads between the local breeds of cattle and the exotic breeds.

3. How much have they changed?

Cattle have reduced in number by about 30-40% while Goats are nearly being depleted owing to the difficulty in managing goats. The number of pedigree cows has increased owing to the increased uptake of dairy farming.

4. *When did the change occur?*

Reduction occurred in last two decades but more significantly in the last decade

5. *Why did the change occur*

a. Management

They observed farmers in area adopted dairy farming as it had better returns compared to crop farming.

b. Forage or land availability

The respondents noted that subdivision of land has led to increased zero grazing as there is not enough land for cows to roam.

c. Diseases

The respondents noted that there has been an increase of cattle diseases as compared to 20-30 years ago. This has led to increased costs in vaccinations and other veterinary services.

d. Government or NGO

There have been programs by society members encouraging the local area residents to adopt commercialized farming ventures such as growing horticultural crops and dairy cows.

e. Climate

There being insufficient rainfall, to sustain the livestock population, farmers have resulted to tapping water from streams, purchasing animal feeds as at times fodder runs out.

6. *How have these changes affected your farm or your family?*

The farmers noted that they have had to result to sparingly use water especially amongst the crops and livestock.

The respondents affirmed that they have had to result in partitioning their farms for fodder production.

7. *Wealth differences?*

The respondents observed that the richer were better placed in rearing livestock as they were better off in purchasing animal feeds, better breeds, medicines and labour.

Water Availability

1. *What changes have been noticed over the past 20 to 30 years in the quantity of water for both domestic and livestock use?*

The respondents observed that water availability was obviously on the decline. They reported that the drop in the quantity of water availability affected all sectors, as they have had to resort to rational use amongst human, crop cultivation and for livestock use.

2. *What have been the changes?*
 - a. Change in depth of water levels?

The area does not have a borehole nor shallow wells.

- b. Seasonality of streams, amount of water in streams

Some streams have dried up, while others have recorded reduced flow especially in dry seasons.

3. *When did the change occur?*

They noted that water levels begun reducing from the early 1980s

4. *Why did the change occur?*

Deforestation

They observed that water obstruction and upstream irrigation by other farmers as the major contributing cause of dwindling stream flows alongside the erratic and unfavourable climate.

5. *Impact and response: has it affected your household or farming? Have you changed anything because of water changes?*

All observed that they have had to rationalize the use of water to avoid wastage.

Some observed that they have had to result to storage of water owing to dwindling supplies.

The respondents noted an incident of insecurity where one of the residents lost their lives following an obstruction of water dispute between neighbours.

Climate Changes

1. *What changes have you noticed over the past 20 to 30 years on temperatures and rainfall?*

Temperatures have constantly been on the rise while rainfall has been on the decline. There have also been changes in rainfall patterns.

2. What have been the changes?

a. Temperature during the different seasons?

It has been getting sunnier and hotter during the dry seasons. The dry seasons have also been more prolonged.

b. Changes in the amount of rainfall during the growing season

Rainfall during the planting season has not been adequate especially during the short rain season which has resulted in us adopting irrigation.

c. Changes in the timing of rainfall?

The rains patterns have changed with the long rains no longer commencing in mid-march but in the first week of April to mid April. The short rains have also changed from the usual mid October to mid November.

d. Changes in rainfall variability?

The rains have been inadequate especially for the short rains seasons. Downpour is very intense when it rains though for a shorter period and not continuously for a whole day as before.

e. Extremes: droughts, floods

There are no reported cases of floods in the area as the area is a highland, however we hear and read of more flash floods from the lower zones especially after an intense rainfall.

3. When did the changes occur?

These changes started to occur in the 1980s and got more intense as the years progressed. The change of rainfall patterns has taken place in the last 10-15 years.

4. Why did the changes occur?

Increased deforestation. The forest cover has been on a decline due to illegal logging, cutting down of forest cover for tea zone plantations and uncontrolled human encroachment generally.

5. Impact and response:

a. Are there other impacts of climate change that have affected village?

Poverty- with dwindling yields and higher costs in farming, many farmers are unable to sustain their needs and that of their families.

Human Conflicts and Hostility- residents have been up in arms against each other especially because of obstruction of irrigation water pipes from streams to individual farmers.

Insecurity- cases of theft of livestock, food crops amongst others have been on the rise as a result of increased poverty levels.

Domestic conflicts- instances of domestic conflict have been on the rise for example , spouses or children stealing chicken to go sell in the market owing to urgency to satisfy pressing needs.

Drug abuse- owing to frustrations and increased domestic conflicts, more men and youth have resorted to camping in bars instead of their homes to avoid conflicts. This has led to increased alcohol abuse and consumption of illicit brew as the poor farmers cannot afford processed beers and other safe alcoholic drinks.

- b. Have you changed anything else because of climate change?
- c. Do you think climate change is affecting crops more than livestock?

The impact is greater on crops.

6. Wealth differences

The richer better placed than the poor as they can afford to mitigate the measures. Being more financially empowered they can afford high quality seeds, fertilizers, better irrigation equipments, pesticides and other farm machinery. The richer are also better advantage as they can afford to lease land from other farmers who have abandoned farming and hiring labour.

7. Gender differences:

The impacts have not affected one gender more than the other in our area.

Projects or Programs

1. Have there been any government or NGO projects in your village related to climate change?

Yes, there have been projects but there were no follow ups on the project.

2. What activities have they done?

A decade ago the government begun a project on encouraging farmers to grow eucalyptus trees to increase forest cover. Following complaints that the eucalyptus trees were consuming a lot of water causing to the drying up of wells and streams the Government abandoned the project. Farmers have since abandoned the project by cutting down the trees while others still grow the trees with commercial interests i.e. timber alongside the other benefits such as soil retention and cooling of the air.

There was an NGO that encouraged farmers in area to grow onions alongside other horticultural crops. After a few training workshops the NGO persons stopped coming. They had guaranteed us a ready market for our produce. Majority of us had to sell to

brokers at farm gate prices that were very low. Others with the resources were able to take their produce to the market.

3. Have they helped you?

Yes and No.

Yes in that, we acquired new skills especially in horticultural farming, timber amongst others. Generally we acquired the knowhow of diversifying into (horticultural) commercial crops.

No in that we have developed a level of mistrust to outside people who come telling people to grow this or that we have a ready market for you. Instead, they disappear without fulfilling their promises. Farmers risk a lot in adopting a new crop and after investing new ventures a ready market is of paramount significance.

Mwala – Machakos

Mwala Location (Mwala Location) is an administrative division in Machakos County. It is located at an elevation of 1,335 meters above sea level.

Its coordinates are 1°19'60" S and 37°28'0" E in DMS (Degrees Minutes Seconds) or - 1.33333 and 37.4667 (in decimal degrees). Its UTM position is CU25 and its Joint Operation Graphics reference is SA37-05.

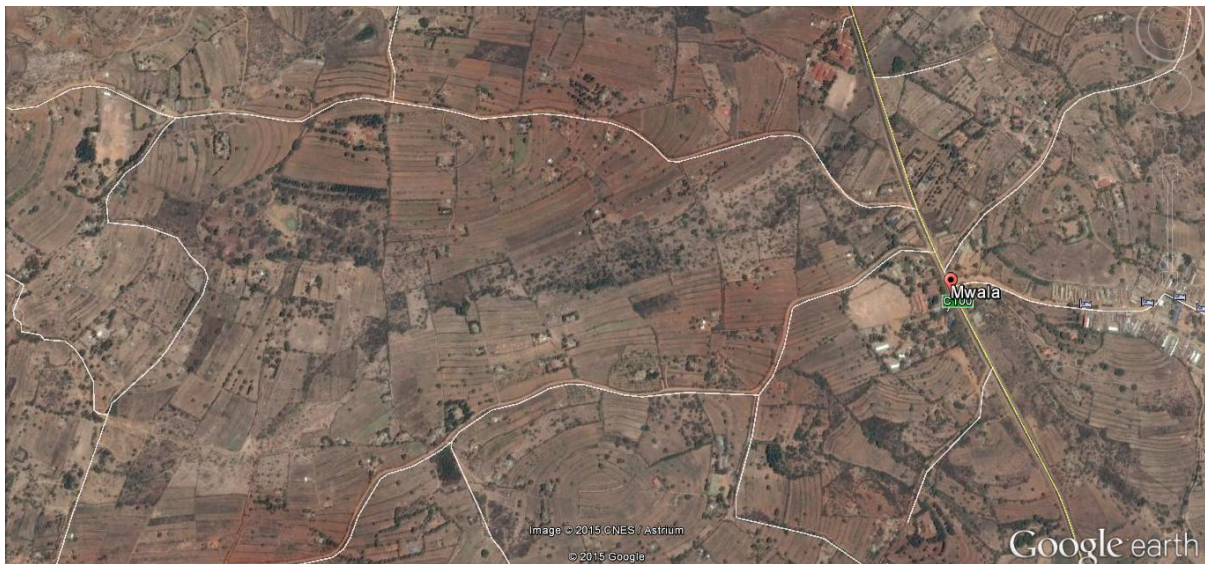


Figure 5. Google Map of Mwala Region, Machakos County

General Comments by participants of Mwala workshop

The respondents had the following general comments

1. They plant maize twice a year
2. The maize variety they plant is usually the Hybrid type
3. They till their land using oxen as tractors are very expensive and often not readily available
4. Most farmers use animal manure because fertilizers are too expensive. Others use no fertilizer for some of the crops other than maize
5. In many cases they intercrop maize with beans with wider spacing of maize to allow beans in between the rows of maize. If the rains are too little to support growth of maize, various amounts of beans can be harvested
6. Guarding of the crops against pests is usually done by all members of the family, depending on who is available and only at the times the crop is in the garden

Mwala group discussions

Crop Production Changes

1. *Have you noticed any changes in crop productivity (yields, or kg/ha) over the past 20-30 years?*

There has been a reduction from 20 bags to 5-8 bags per acre

2. *Which crops changed productivity? (e.g., maize, a maize variety, etc.).*

All crops have reduced their productivity. Maize has experienced the highest change as in all most seasons rainfall is never enough to satisfy rainfall needs for maize crop. Beans have also been affected heavily because they dry up faster (after a few days without rain). While a maize crop can withstand a few days of delayed rainfall, beans cannot.

3. *How much have yields changed?*

Like for maize productivity has reduced from 20 bags per acre to about 5-8 bags per acre.

4. *When did the change occur?*

Changes started around 1980. Some respondents said changes started to occur when president Moi took power which was in 1978 following the death of President Kenyatta.

5. *Why did the change occur?*

- a) *Management: How crop is planted, variety, fertilizer used, etc.*

Some farmers said that the cost all farm inputs went up with a big increase and most farmers could not afford. Also the types of fertilizers in the market these days are not effective as they used increase productivity in the past. The respondents believe the qualities of all fertilizers in the market have deteriorated. Due to the changes in weather insect populations have also increased and thus crop loss to pests is bigger.

- b) *Soil degradation*

A general agreement is that the soil tremendously reduced in fertility everywhere compared to the past. The farmers think that the loss in soil fertility has occurred due to the way people use land these days. In old days people used to abandon fields for a while after several years of cultivation in order to gain fertility but these days land is cultivated continuously without any crop rotation. Because of need for cash people tend to plant a particular crop for years and years on the same piece of land.

- c) *Pest and diseases*

The number of insects has increased and as well the crop pests have also increased. Crop diseases have also increased. The farmers said as all the challenges are increasing, pesticides are becoming in effective. One has to use for pesticides to avoid losing his harvest to pests

and diseases. These days there are no cattle dips like in the past the dip were contribution to reducing the insect pests. The cost for the pesticides has gone up.

d) Government or NGO program

In the old days i.e., 1970s and 1980s when most of the current farmers were young there were more government programmes in farming than there are now. There were government programmes to assist farmers with tractors to plough the land. Crops like cotton used to be sprayed by government with an aeroplane even though areas planted were much smaller than these days. There are very few government programs these days compared to the 1970&80's

e) Climate & what. Not enough rain, rainy season changes, etc.

Rains have reduced; there are more droughts or periods with unreliable rainfall than before. Sometimes, harsh climatic conditions where the residents complain of hail storms; frost that kill crops and very hot day time weather.

Boreholes have dried up and their water level has sunk deeper.

6. *Farmer's responses: Have the changes affected how you cultivate? How?*
EXAMPLES, changes in crop variety, type of crop, management practices, etc.

Farmers / respondents stated that the changes have been slow. Some have recently embraced horticulture and others are slowly adapting to new technology though expressed that cost of the technology is the biggest hindrance.

7. *Wealth differences: Are there differences between rich and the poor people? Why?*

About a 1/4 of the people in the area are those that can afford to increase inputs e.g. fertilizer, service dam, labour. The rest constituting about 3/4 are those who cannot afford to increase farm inputs and rely on manure instead of fertilizer. The farmers who do not buy pesticides harvest nothing. Most farmers buy pesticides but many do not buy the required quantities and end up putting less than required for their lands.

Livestock

8. *Have you noticed any changes in how your livestock is doing health or number you have over the past 20-30 years?*

Numbers of cows have reduced

9. *Which livestock changed?*

Cows have reduced from an average of about 20 in the 1980's to about 5 per household

10. *How much have they changed?*

1983-1984 is when the largest reduction occurred when a cow was fetching shs.80.00 because of poor health attributed to drought. Whereas in the 1980's they fetched shs.3, 000/=.

Due to high frequency of droughts prices of cattle fluctuate and the fluctuations have made the farmers to reduce the numbers.

11. When did the change occur?

1983-1984

12. Why did the change occur? Examples of reasons, leave it open ended

f) Management:

Reduced land portions, Drought and increase in insects or pest infestations

g) Forage or land availability

The elderly cannot manage to get fodder; size of land has reduced drastically

h) Diseases

The diseases have increased some say they don't have explanation on how to deal with them.

i) Government or NGO program

The programs have been fewer and some of them don't target them and address their issues.

j) Climate & what.

Drought has been the key reason of having no fodder as well as reduced land portions

13. Farmer's responses: Have the changes affected how your farm or family? How?

Farmers have reduced the intake of meat example the respondents stated that approximately 1 hen is eaten per day, in some cases a house hold of 10 are forced to share ¼ kg of meat.

14. Wealth differences: Are there differences between families? Is there difference between rich and poor people? Why?

Poor persons tether their animal and go do other jobs that will bring income to the family, while the rich family buy animal feed and hire land to graze their animal, can afford vet nary services

Water Availability

1. What are the changes that you have noticed over the 20 – 30 years in the quantity of water for you, your crops and your animals?

The amount of water has reduced. Many rivers are dry for most of the year while others have dried up almost completely. Some rivers channels that carried water the year round have now turned into drainage waterways during the wet seasons.

2. What have been the changes? EXAMPLES

- a) *Changes in depth of ground water (well or bore hole; ask for meters difference).*

The boreholes water levels have sunk deeper. Based on shallow wells in their homes they approximate a lowering of water table by about 5 feet.

- b) *Seasonality of streams, amount of water in streams*

Water in streams has reduced tremendously. In most streams water has dried up completely except during the rainy seasons when water collects and flows for some time.

3. When did the changes occur?

The greatest change occurred in 1989-90 but initially started in the 1970's

4. *Why did the changes occur?*

The changes occurred because of increased cutting of wood for charcoal. Respondents also said the changes occurred because of high frequency of drought. They also were in agreement that interference of shrines hence prayers have reduced

5. Impact & response: Has it affected your household or farming? Have you changed anything because of water changes?

Some of the responses include drilling of boreholes, developing of dams. Some dams are developed by individuals and do collect water from rain. Some farmers have tried new variety of seeds for planting. In some homes some members of the family especially the house heads have gone to work elsewhere in order to generate extra income for the family.

Climate

1. *What are the changes that you have noticed over the past 20 to 30 years in temperature and rainfall?*

The respondents were in agreement that day temperatures have gone up and the night temperatures have fallen down. It is these variations that have killed the crops.

2. *What have been the changes? EXAMPLES*

- a) *Changes in how warm it is during different seasons*

The changes in between the season have been very drastic with rainy season very cool and the dry season very hot though they states the rainy season is very short.

- b) *Changes in amount of rainfall during the growing season*

The amount of rainfall is very little for the amount of time the rainfall takes place is shorter and very unpredictable

- c) *Changes in timing of rainfall*

The short rains used to start in October but now it starts in November and sometimes start in late November

Long rains used to be March and pour through to June. Now these rains may start in July. In general the length of rainy periods have become shorter

d) Changes in rainfall variability

Rainfall variability has also increased significantly and in some cases there is little or no rainfall. Sometimes there is a lot of rain that come within a short period of time.

Respondents approximated about 50mm of rain per week during the short rains and about 100 mm per week during long rains.

e) Extremes: droughts, floods

The most common extreme even in Mwala was reported to be drought.

3. When did the changes occur

Droughts have been in occurrence for a long time but since 1970s they started to be more frequent such that now they occur almost every year.

4. Why did the changes occur

The farmers associated the increase in droughts to cutting down of trees

5. Impact and response:

a) Are there any other impacts of climate change that have affected the village?

Reduced work time due to being too hot. People are forced to take a midday rest from work because of high temperature during the day. Family sizes have reduced in number due to movement to towns to look for jobs as a result of drought. People now eat only one meal a day as opposed to older times when there were well defined three meals (breakfast, lunch and dinners).

In the old days only men used to go source for employment but these days both men and women are sourcing for income by working in other people's farms. Sometimes even children when they are not in school, they work for money in other people's farms.

Traditionally, people in Mwala claim to practiced more herding of livestock than farming but recently turned more to farming due to land demarcations. These days it appears they may have to go back to herding because people who cultivate are losing more to climate change than those who are herding.

b) Have you changed anything else because of climate change? (e.g., out-migration, off-farm income, etc.)

More and more men are seeking employment outside their homes than before and have to play a bigger role to provide food and cash for the family than before.

c) Do you think that climate change is affecting crops more than livestock?

Crops are affected more by climate change than livestock. While livestock to travel far to graze, crops have to face the conditions in one stationery location. Livestock can also be fed with feed from other places and thus are able to withstand droughts for limited period of time.

6. Wealth differences: are there differences between rich and poor people in the impact of climate change, or in how they adapt?

Yes the poor have hard time adjusting their way of life and the rich can increase inputs move their family or even hire land elsewhere and conduct their farming there.

Projects or Programs

1. Have there been any government or NGO projects in your village related to climate change?

Yes, there have been a number of NGO dealing in activities in the area.

Ministry of Agriculture
FAO
ICRAF
World Vision

2. What are they, and what activities have they done?

They mostly conduct training on methods of dealing or coping with climate change. E.g. world vision has proposed beekeeping, planting of drought resistant crops such as cassava and other NGO have introduced dairy cows

3. Have they helped you?

They believe that most programs have not incorporated their views as most of them are elderly

Others who attend those training activities don't even own land hence the lessons or impact intended is limited.

Usin Gishu

The reference for the discussion group was at Ainabkoi in Usin Gishu County in the former Rift Valley province. Maize is the major crop grown in the area. Most households have large land sizes and grow maize at commercial production. Most households produce maize in land parcels measuring in excess of 100 acres.



Figure 6. Map showing Ainabkoi region, Uasin Gishu County

Latitude in decimal degrees: 166667

Longitude in decimal degrees: 35.516667

Latitude in degrees, minutes, and seconds: 00° 10' 00" N

Longitude in degrees, minutes, and seconds: 35° 31' 00" E

General Comments

Uasin Gishu County enjoys two rainy seasons with an annual rainfall ranging between 900 to 1200 mm. Sited on a plateau, the county has a cool and temperate climate, with annual temperatures ranging between 8.4 °C and 27 °C. The wettest season in Uasin Gishu County is experienced between the months of April and May while the driest season comes between January and February.

Uasin Gishu's main economic activities are large scale wheat and maize farming, dairy farming, horticulture and sports tourism - the result of terrific performances of its world famous athletes. The county is also a manufacturing hub, with numerous industries and factories providing employment to thousands of its urban population.

Discussion Answers:

Crop Productivity Changes

1. *Have you noticed any changes in crop productivity (yields, Kg/ha) over the past 20 – 30 years?*

Yes. All crops harvests have reduced in the amount harvested per acre for all the seasons.

2. *Which crops changed productivity? (e.g., Maize , a Maize variety Etc)*

All maize varieties (i.e., H614D, 629, 6213 etc)

3. *How much have yields changed?.*

Reductions have been variable season after season depending on the amount of rainfall. The following are the crops and the varieties affected:

Potatoes – Varieties affected e.g., Annet, Tigoni White Asant, Nyayo. Some varieties disappeared completely e.g., Nyayo, White others have declined in Yield 30% .

Reduced substantially; initially it used to be 10 bags per acre; currently it is 4 bags per acre

Wheat- Tembo. kiongoni and Kwale varieties. – some varieties were eliminated by diseases e.g., Kwale; While others have substantially declined in Yield below 30%

Beans –Rosoco, Mwitmania, Bulter bean varieties

Cabbages –Cappenhagen, Gloria F, Sugar leaf, Drum head

Peas -Balozi

Maize – Reduced from about 35 bags per Acre to about 18 bags per Acre especially H614D

Potatoes –Wheat Beans –

Kales-most varieties have disappeared

Cabbages- Varieties like sugar leaf have disappeared

4. *When did the change occur?*

Most changes started (began) to be noticed from 1984 (This year is well remembered since there was drought)

5. *Why did the change occur?*

A) Application of acidic fertilizers e.g., DAP 18:46

- Poor methods of planting e.g., planting maize and beans on the same hole
- lack of knowhow by most farmers

- inadequate extension services

B) Soil degradation

- Soil erosion
- Burning of Maize and Wheat stalks on the farm

C) Pests e.g., Weevil, aphids , Mice, Stalk Boer, cut worms, lady bird
Diseases e.g., Rust, Lethal maize necrosis

d) Inadequate NGOs Services to support little government effort on the ground

6. *Farmers' responses: Have the changes affected how you cultivate? How? EXAMPLES, Change in crop variety, type of crop, management practices, etc.*

Yes

- Most farmers have shifted from growing crops that take long time to grow to growing crops like cabbages, kales, peas etc that take shorter time to grow
- crop rotation

7. *Wealth Differences: Are there differences: Are there differences between families in changes in crop productivity? Is there a difference between rich and poor people? Why?*

Yes

- Ability to buy farm inputs have created a big difference
- Poor farmers face a problem of marketing their produce

Livestock

8. *Have you noticed any changes in how your livestock is doing health or numbers you have over the last 20-30 years?*

Yes

9. *Which Livestock changed?*

Cattle, sheep, goats and poultry

10. *How much have they changed?*

Most farmers were having more than 10 heads of cattle but today majority have less than three

11. *When did the change occur?*

Early 1990s

12. *Why did the change occur?*

- A. Land fragmentation: poor breed (indigenous)
- B. Lack of proper feeding.
 - a. -Lack of forage and no land
- C. – Foot and Mouth, anthrax, black water, ECF, bloat, East coast fever, mastitis brucella , Newcastle, coccidiosis
- D. No NGO activities in the area to support farmers
- E. Low rainfall leading to shortages of water, food and high incidences of diseases
- F. -Lack of water and pasture

13. Farmers Responses: Have the changes affected your farm or your family How?

Yes

- a. Because of Different income generated
- b. -low production of yield and livestock

14. *Wealth differences: Are there differences between families? Is there a difference between the rich and the poor people? Why?*

Yes

- a. Lack of money for artificial insemination, medicine and feeds
- b. Because of different income generated
- c. Can't afford veterinary services

Water Availability

1. *What are the changes that you have noticed over the past 20 – 30 years in the quantity of water, for you, your crops and livestock?*

- a. It has drastically reduced
- b. Water levels have gone down (Jan to March)

2. *What have been the changes? EXAMPLES*

- a. Changes in the depth of ground water (well or bore hole; ask for meters difference)
- b. Depth of ground water has increased from around 15 feet to cover 20 feet underground.
- c. Seasonality of streams, amount of water in the streams
- d. During dry seasons, most streams are dry.

3. *When did the changes occur?*

a. Most Changes occurred in the 1990's

4. *Why did the changes occur?*

- a. Deforestation is the most named responsible for this
- b. Cultivating near water catchment areas

5. *Why did the change occur?*

Deforestation and cutting down of trees

6. Impact and Response: Has it affected your household or farming? Have you changed anything because of water changes?

- Yes
- Yield declined
- level of poverty increased
- Crop rotation
- Purchasing water storing equipment
- Harvesting of Water Planting indigenous trees
- Digging boreholes

Climate

1. *What are the changes that you have noticed over the past 20 – 30 years on temperatures and rainfall?*

Rising of temperatures

2. *What have been the changes?*

Reduction in rainfall amount and duration

- a) Warm even during rainy seasons
- b) Reduced
- c) Rainfall has become predictable
- d) Poor
- e) Yes

3. *When did the changes occur?*

1980's

4. *Why did the changes occur?*

Deforestation, pollution, destruction of water catchment areas

5. *Impact and response*

Fire outbreaks

6. *Wealth differences: Are there differences between rich and poor people in the impacts of climate change, or in how they adapt?*

Yes: the rich will do irrigation and can afford veterinary services

7. *Gender Differences: Is there any difference between men and women in the impacts of climate change, or how they adapt?*

Yes

Women are willing to adopt new farming charges but men are difficult in finances

Projects or Programmes

1. Have there been any government or NGO projects in your village related to climate change?

Yes, water activities

2. *What are they, and what activities have they done?*

Tree Planting

3. Have they helped you?

Yes

Purchasing water tanks in schools

Digging boreholes in villages

Table 1 Table Responses in Group Discussions

Question for discussion	Katheri - Meru	Mwala – Machakos	Ainabkoi – Usin Gishu
AGRICULTURE			
Noticing of changes in crop productivity	Drop in productivity of all crops	Drop in productivity of all crops	Drop in productivity of all crops
The crops that changed most	Maize; Sugar Cane; Tea; Coffee (Arabica); Sweet Potatoes; Yams	Maize	All maize varieties (H614D, 629, 6213 etc). Also beans, cabbages, Potatoes and peas
How much the crops changed	over fifty percent (50%) in Tea and Coffee; Over seventy percent (70%) in cereals such as Maize About ninety percent (90%) to absolute failure in sugar cane production, yams and sweet potatoes.	Maize has reduced from 20 to 8 bags per acre	Maize potatoes, beans and cabbages have reduced by about 30%
When the change occurred	During the last 2 decades	1980	1984
Why the change occurred	Soil degradation Climate Change Increase in pests and diseases Lack of adequate government and NGO support	Poor land management Soil degradation Increased pests and diseases Poor assistance from government and NGOs Climate change	application of acidic fertilizers Soil degradation Increase in pests and diseases Inadequate NGO support to supplement government efforts
How the changes affected cultivation	Farmers now using more irrigation Farmers diversifying to	The changes have been slow so responses are also slow.	Most farmers shifting to early maturing crops Farmers practicing

	<p>other crops like horticultural crops (cabbages, carrots, etc.)</p> <p>More farmers practicing dairy farming</p>	<p>Some farmers have embraced horticulture</p> <p>Some farmers have adapted new technologies e.g., irrigation, but the costs are prohibitive</p>	<p>shifting cultivation system</p>
<p>Wealth differences between families</p>	<p>Majority of farmers becoming poorer</p> <p>Increased use of fertilizers</p> <p>Increased use of irrigation technologies</p>	<p>Only 25% can afford farm inputs. 75% cannot afford farm inputs like fertilizer instead use animal manure.</p>	<p>Wealthy farmers able to afford farm inputs</p> <p>Wealthier farmers able to market their produce behold farm gate markets</p>
<p>LIVESTOCK</p>			
<p>Noticing of changes in livestock types and numbers</p>	<p>Changes to reductions</p>	<p>Yes big changes</p>	<p>Yes</p>
<p>What the changes in livestock have been</p>	<p>General decline in the numbers of cattle and goats</p>	<p>A general trend of reduction in numbers</p>	<p>Cattle, sheep, goats and poultry</p>
<p>How much the livestock changed</p>	<p>Cattle have reduced by about 30-40%</p> <p>Goats are nearly being depleted.</p> <p>Cross breeds cows have increased owing to the increased uptake of dairy farming.</p>	<p>Cows have reduced from an average of about 20 in the 1980's to about 5 per household</p>	<p>Most farmers were having more than 10 heads of cattle but today majority have less than three</p>
<p>When the change occurred</p>	<p>Reduction occurred in last two decades but more significantly in the last decade</p>	<p>1984</p>	<p>1990s</p>
<p>Why the change occurred</p>	<p>Poor land management</p> <p>Changes in forage and</p>		<p>Land fragmentation: poor breed (</p>

	land availability Increase in diseases Poor government assistance to farmers Climate change.		indigenous) Lack of proper feeding. Lack of forage and no land Diseases No NGO support Low rainfall
How the changes have affected livestock rearing	Partitioning of land between crop food production and fodder production	Reduced the intake of meat	Poor income discouraging livestock keeping generated Poor yield yields keep off farmers
Wealth differences between families	The wealthy are able to feed their livestock better by buying feeds	Poor persons tether their animals The rich buy animal feeds and hire land to graze their animal, The rich can afford veterinary services	The poor lack money for artificial insemination, medicine and feeds Can't afford veterinary services
WATER AVAILABILITY			
Change noticed over 20-30 years	Decline in water availability	Reduction in the amount of water Many rivers are dry for most of the year	It has drastically reduced Water levels have gone down (Jan to March)
What the changes are a. ground water depth b. Seasonality of streams	The area does not have a borehole and no shallow wells. Seasonality of streams, amount of water in streams Some streams have dried up, while others	The changes in between the season have been very drastic with rainy season very cool and the dry season very hot Rainy season is very short.	Changes in the depth of ground water (well or bore hole; ask for meters difference) Depth of ground water has increased from around 15 feet to cover 20 feet underground. Seasonality of streams,

	<p>have recorded reduced flow especially in dry seasons.</p>	<p>The amount of rainfall is very little for the amount of time the rainfall takes place is shorter and very unpredictable</p> <p>The short rains used to start in October but now it starts in November and sometimes start in late November</p> <p>Long rains used to be March and pour through to June. Now these rains may start in July.</p> <p>In general the length of rainy periods have become shorter</p> <p>Rainfall variability has increased significantly</p>	<p>amount of water in the streams</p> <p>During dry seasons, most streams are dry.</p>
When the changes occurred	Early 1990s	1989-90 but initially started in the 1970's	1990s
Why the changes occurred	<p>Deforestation</p> <p>Water obstruction and upstream</p> <p>Irrigation by other farmers</p> <p>Erratic climate change</p>	<p>Increased cutting of wood for charcoal.</p> <p>High frequency of drought.</p> <p>Interference of shrines hence prayers have reduced</p>	<p>Deforestation and cutting down of trees along river banks</p>
Impacts and responses	<p>Water rationalization the use of water.</p> <p>Increased use of storage tanks</p> <p>Increased incidences</p>	<p>Yes the poor have hard time adjusting their way of life and the rich can increase inputs move their family or even hire land elsewhere and conduct their farming there.</p>	<p>Yield declined</p> <p>level of poverty increased</p> <p>Crop rotation</p> <p>Purchasing water storing equipment</p> <p>Harvesting of Water</p>

			Planting indigenous trees Digging boreholes
CLIMATE			
Change noticed over 20-30 years	Temperatures have constantly been on the rise while rainfall has been on the decline. There have also been changes in rainfall patterns.	The respondents were in agreement that day temperatures have gone up and the night temperatures have fallen down. It is these variations that have killed the crops.	
What the changes have been a. Changes on warmth b. Changes in amount of rainfall c. Changes in timing of rainfall d. Changes in rainfall variability e. Changes in extreme events	More sun and hotter during the dry seasons. The dry seasons more prolonged. a. Less rainfall during the growing season b. Less rainfall c. Timing of seasons come late d. Less rainfall e. Increased extreme events	The changes in between the season very cool rainy seasons Very hot dry seasons Little rainfall Rainfall shorter and very unpredictable Rainfall variability has increased significantly The most common extreme even in Mwala was reported to be drought.	Reduced rainfall amount and duration Warm even during rainy seasons Rainfall un predictable Extreme events more frequent
When the changes occurred	1980 s	1974	1980s
Why the changes occurred	Increased deforestation due to illegal logging, Deforestation to plant tea Uncontrolled human	Cutting of trees	Deforestation, pollution, destruction of water catchment areas

	encroachment generally.		
Impacts and responses	<p>Increase in poverty, human conflicts</p> <p>Increase in insecurity, domestic violence</p> <p>Increased use of drugs</p>	<p>Reduced working hours due to excess heat</p> <p>Families are smaller</p> <p>Changed eating habits</p>	Increased fire outbreaks

Summary of Discussions

How Climate Change is affecting areas differently

Availability of water

In Machakos most people obtain their water from seasonal rivers, surface dams and shallow boreholes. People living close to rivers fetch water from the rivers but most of them have water only during the rainy seasons. After the water in the rivers dry up people remain digging holes in the river sand to collect water.

Their experiences is that water in river sand dry up much faster that before, the surface dams last for a short time and the depth of water in the shallow boreholes get deeper. People are forced to travel far in search for water, and others keep on extending the depth of their boreholes.

In Usin Gishu most people have piped water. The big change they are experiencing is that water pressure in the pipes has reduced significantly. The same is also the same in Meru. In Meru the farmers reported that as rivers shrink in volume, the riverine vegetation (riparian) has reduced to a great deal mainly due to cultivations along the rivers and cutting down of trees in the riverine forests. They also blamed people who are planting Eucalyptus trees near the rivers as they claim Eucalyptus trees take too much water leaving the rivers dry.

Amount and timing of Rainfall

In Machakos the farmers reported that rainfall comes very irregularly and in most times in insufficient amounts to support crop growth. Crops like beans the need a lot of rain are the most affected. Maize crop that needs rain for a little longer period is also affected when the rains disappear for longer periods. In Usin Gishu, rainfall timing is also irregular and the amounts are also less than before, but the soils never get too dry. The crops can still grow but the harvest reduces significantly. In Meru rainfall is also irregular but soils never get too dry because of the cold weather from Mt. Kenya. Farmers in Katheri grow crops through irrigation and the cold weather can support cropping throughout the year. They can plant any time of the year

Crop disease and pests

Crop pest are more due to scarce vegetation. There are more pests than diseases. Wildlife herbivores invade the farms and cause damage on crops. People living close to areas where wildlife is found have more incidences of wildlife damage than before. In Uasin Gishu and Meru the problem is the different in that they experience more problems from crop diseases than pests.

Vegetation cover

In Machakos grass cover has generally reduced much more than the thickets. They associate this to over grazing. In Uasin Gishu there is always a grass cover even during the dry seasons, In Meru, land is intensively cultivated to the extent that no place has unmanaged grasslands. There is always a substantial vegetation cover even during the dry seasons.

Farming or cropping systems

In Machakos, farmers plant twice a year in two distinct seasons. Farmers are adapting to climate change by changing crops and crop varieties to more drought resistance varieties. They plant maize twice a year, during the long and short rains. They harvest more maize during the long rains and less during the short rains corresponding to the different amounts of rain in the two seasons.

In Usin Gishu they plant late maturing maize varieties. The time between maize harvest and planting in April is usually very short.

In Meru farmers plant most crops any time of the year because they use irrigation water. However, because of low yields and poor economic returns from maize, most farmers have turned into cultivating maize only as a livestock feed and not for grains.

While Machakos farmers are adapting to poor crop yields by extensification (expanding their cultivated areas), and others are abandoning some fields to open new others. Farmers in Usin Gishu are responding to poor yields by increasing farm inputs like fertilizers to increase yields. Farmers in Katheri Meru, are adapting to poor yields by diversifying crop types to cultivating more vegetables than grains, Horticultural crops fetch more money per unit area than grain crops

In Machakos more farmers are using animal manure because they cannot afford fertilizers. Some argue that fertilizers are not effective on their farms. In Usin Gishu farmers use fertilizers in their maize fields because they are large and cannot get enough manure to apply. In Meru farmers use both manure and fertilizers

Pastures for livestock

In Machakos where farmers graze their livestock in open fields, the amount of pastures is reported to have reduced significantly and now farmers are adapting by reducing their livestock types and numbers. They are now keeping fewer cattle than goats and sheep. In Uasin Gishu, Livestock keepers use fenced paddocks to keep dairy cows and graze them in maintained pastures. In Meru land sizes are much smaller, livestock keepers use zero grazing to feed their livestock. They feed them in closed sheds where they feed them through cut and carry of feeds to the cows. Both in Usin Gishu and Meru farmers keep dairy cows but a few have dairy goats as well.

Gender and wealth

Gender gap in Machakos has increased mainly due to poverty arising from climate change. The farmers reported that there are more families with domestic quarrels than before mostly due to less available financial and food resources. More people are turning to seek for off farm income to subsidize farm produce. Women who never used to work outside own farms are now working in other people's farms to earn some money.

In Uasin Gishu and Meru sites the problem of gender is not a big issue except that women are finding it more difficult to get firewood than before. Many homes have to spend money to buy firewood or charcoal from vendors in order to cook food.

Table 2. An outline of ways in which climate change is affecting areas differently

Mwala - Machakos County	Ainabkoi -Uasin Gishu County	Katheri – Meru County
Dams and shallow bore holes drying too quickly	Rivers have reduced. Most people have piped water whose pressure has reduced due to lower levels of rivers	Rivers reducing in volume Pressure of piped water Riverine vegetation disappearing reducing and water not enough for all members
Rainfall insufficient for crops – comes too late, irregular and may not be enough	Rainfall comes regularly comes but sometimes insufficient	No defined seasonality – cold weather and irrigation water allows them to plant almost all the time
Crop pest are more	Crop pests a much bigger problem than in Machakos	Crop pest have increased but it appears to be to lesser extent than in Uasin Gishu and Machakos
After the rains soils keep water for very short time due to lack of vegetation cover and high heat intensity	Soils dry faster than before but they appear to retain water longer than in Machakos	Soils dry faster than before
During the dry season soils are bare without any vegetation cover	Crop grown is mainly maize in large fields that are bare during off season	Many crops are perennial and retain substantial amount of vegetation cover all the time. Irrigated crops are on land

		even during the dry season
Farmers changing crop types and also varieties	Farmers keep on planting maize year after year – some change varieties	Farmers have changed from growing maize for food (grains) to growing maize for livestock (cut green stalks before they develop the cobs)
Fertilizer application not very effective, Does not significantly improve yields. More farmers have turned animal manure.	Farmers constantly use fertilizers in the maize fields	Fertilizer application better effective than in Machakos and Usin Gishu
Reduction in crop yields – loss in crop productivity very severe especially for maize, beans and other seasonal crops	Reductions in maize yields than before. Have to use fertilizers to improve on yields	Reduction in yield but better output per acreage than in the other two sites. Maize planted once a year
Pastures disappearing as more land is put into cultivation - extensification of farming	Animals graze in paddocks with managed grass fields. Only a few cut and carry feeds to tethered animals	All animals are Zero grazing – fed by Napier grass, maize stalks and vegetable wastes
Farmers diversifying to other crops	farmers adding more fertilizers	Farmers changing to more dairy farming and planting maize as livestock feed and not for harvesting the grains
Farmers changing fields – some left to fallow	Farmers continue farming on the same fields and increase productivity by increasing inputs	Farmers continue farming on the same fields and increase productivity by increasing inputs
Early planting	Late planting	Plant vegetables and maize any time through irrigation
Livestock types changing to more shoats (goats and sheep) than cattle	Changing to more dairy cows than other livestock	Changing to

Observations common across all sites

- a) In all the sites water was reported to be getting scarcer and the situation is getting worse over time. The impacts of this common situation on farming are different from site to site according to agro-ecological characteristics.
- b) All sites are experiencing variabilities in the timing of rainfall. Most of times the rain starts latter and sometimes it starts and then disappears after the crops have germinated leaving the crop to dry.
- c) All sites reported changes in the distribution of rainfall across the season. Heavy rain may come within a short time causing floods and then followed by long periods of time within which crops dry out.
- d) Land degradation is reported everywhere in all the sites. Although land degradation could be a result of many factors including unsustainable land management, farmers measure land degradation by poor crop yields and associate land degradation to lack of rain or bad weather or what they have lately come to understand as climate change.
- e) Reduction in crop productivity is reported everywhere. Productivity is reducing in all the crops planted
- f) Livestock feeding is changing in all the sites but the methods of feeding differ from site to site due to different land sizes available

Table 3. *Common across sites*

Mwala - Machakos	Ainabkoi – Usin Gishu	Katheri – Meru
Water is getting scarce everywhere		
Crop productivity is reducing in all the sites and for all crops		
Soils are now much more degraded than before in all the sites		
Livestock are now being feed in all the sites but methods of feeding vary		
Changes in distribution of rainfall within the season		

Effects of climate change on gender and nutrition

The effects of climate change on gender are being felt more in Machakos than in Uasin Gishu and Meru. In Machakos women reported that men especially the younger generations have turned more into drinking local brews because of poverty related frustrations and have left their wives to do all the work at home. Many husbands have moved into towns to seek jobs. Women, who used to work only in their homes, are now forced to work on other people's

farms to get cash. In the other sites Uasin Gishu and Meru the effect of climate change on gender is not felt much except the women has to spend more time looking for firewood.

On nutrition, again it is the Machakos site that expressed difficulties for some families to get enough food for the family. People have learnt to eat less food. Meat in particular is eaten rarely in most families because it has become un- affordable. Many homes now have chicken from where the families can get meat. The other two sites did not report the same experiences on nutrition.

Table 4. Effects of climate change on gender and nutrition across

Mwala Machakos	Ainabkoi – Uasin Gishu	Katheri – Meru
More women are household heads as their husbands go for employment elsewhere	Most people with land are able to employ themselves on their farms – no climate change related changes in household heads	Almost all people with land are able to employ themselves on their farms – no climate change related changes in household heads
More women working as labours in other people’s farms	There people who provide labour in the farms but there is no much change due climate change	There people who provide labour in the farms but there is no much change due climate change
Less food to eat	No climate change related changes in the amount of food people eat	People have more diversified foods due a wider variety in production.
More dependent on chicken for meat as many cannot afford to buy meat	Generally meat less available as it has become more expensive	Meat more expensive and less affordable – less available for some people

Differences due to variabilities in Agro-ecological zones and farming systems

In Machakos farmers plant early maturing maize varieties, while in Uasin Gishu and Meru at higher elevations farmers plant late maturing varieties. In Machakos, irrigation is done along the rivers and near water dams while in Uasin Gishu irrigation is not common. In the Meru site all farming is by irrigation. In Machakos farmers have dug shallow wells (boreholes) in their homes to provide domestic water which is usually used by neighbours who have not dug theirs. In Usin Gishu many homes have piped water while a small minority fetch water from fivers. In Katheri Meru all homes have piped water that run throughout the year.

In Machakos farmers rare local breeds of cattle and crosses between local breeds and exotic breeds. In Uasin Gishu most farmers have high yielding exotic breeds of cattle and in Katheri Meru all farmers have exotic dairy cows.

In Machakos many farmers (people with land) depend on off farm income – labor on other people’s farms or away from the village while in Uasin Gishu fewer people with land depend on income from labor to other people’s farms. In Meru all people with farms depend on their farm produce.

Soils getting more disaggregated in Machakos producing more dust. Winds carry more dust than before. In Uasin Gishu farmers think soils are getting drier and lighter than before because it is easier to plough with tractors. Farmers in Katheri Meru have not experienced many changes in soil particle sizes.

In Machankos soils are much more eroded as they appear to have deep gullies indicators for sheet erosion everywhere. In Uasin Gishu water erosion is visible especially on steep slopes and river banks while in Meru farmers reported serious erosion problems.

Table 5. What is different because of AEZ

Mwala – Machakos	Ainabkoi – Uasin Gishu	Katheri – Meru
Agro Ecological Zone IV	Agro Ecological Zone III	Agro Ecological Zone II
Planting early maturing maize- small scale	Planting late maturing – medium to large scale	Planting late maturing maize – small scale
Irrigate along the rivers and streams	Little irrigation	All farmers irrigate
Shallow bore holes common source of water for domestic use	Most have piped water	All have piped water
Have local breeds of livestock	Most have high yielding dairy cows	All have high yielding dairy cows
many people (people with land) depend on off farm income – labour on other people’s farms or away from the village	Fewer people with land depending on income on providing labour to other farms.	All those with farms depend on their farm produce
Soils getting more disaggregated – more smaller particles – more dust	Soils drier and lighter than before. Easier to plough with tractors.	Soil particles not very much affected
Water carrying more soils –	Rivers appear to carry more	River water is clear – no

gets browner due to more soils	soils as they have become darker in colour	signs of carrying more soils
Soils are much more eroded - deep gullies more common -sheet erosion everywhere	Water erosion is visible especially on slopes and river banks	No visible erosion

Knowledge Gaps – Need for further investigations

A part from low and un- evenly distributed rainfall, the most common and serious observation reported everywhere is that of land gradation. Farmers rightly associate poor harvest with land degradation. They also think land degradation is caused by climate change alone.

From science, land degradation can also be caused by poor land management leading to poor crop harvests. It is almost certain that a combination of unsustainable land management and climate change are the causes of poor crop productivity.

The knowledge gap is the understanding is what changes are due to climate change and what changes are due to land management.

Suggestion for further investigations

There is a need to investigate on the impacts of land management on land degradation in all the three sites. There is a need to conduct Sustainable Land Management Impacts Monitoring (SLM-IM). This is a standard well developed approach with guidelines on the methodologies. Benefits for this undertaking will include:

- Identification of unsustainable farming activities
- Better informed decision-making on how to promote sustainability
- Incremental improvement of intervention approaches
- Better integration of local knowledge and capabilities
- Improved goal orientation of land management projects

Appendices

Lists of participants

List of Mwala workshop participants

List of Uasin Gishu - Ainabkoi workshop participants

Gender	No	Name	Location
Females	1	Agnes Tuwei	Tingwa
	2	Ann Thairu	Olare
	3	Betty Kurgat	Chepngoror
	4	Catherine J. Cheron	Chepngoror
	5	Elseba Kipyego	Kapngetuny
	6	Emily Cheron	Ndanai
	7	Evalyne Rotich	Kipkabus
	8	Grace Mwongong	Ndanai
	9	Grace Tungo	Tingwa
	10	Jeniffer Cherop	Chepngoror
	11	Karren J. Kongeluu	Kewet
	12	Lenah Gathoni Ngugi	Ainabkoi
	13	Lilian Ndungu	Olare
	14	Rose Mengich	Kipkabus
	15	Rusellah Chebon	Ainabkoi
	16	Ruth Cheruyot	Olare
Males	17	Daniel K. Ngeno	Tarakwa
	18	Daniel Kotut	Chepngoror
	19	Daniel Rotich	Olare
	20	David Gikendi	Chepngoror
	21	Edwin Rongei	Kapilat
	22	Emmanuel Cheboi	Tingwa
	23	Nicholas Kurgat	Chepngoror
	24	Nicholas Marindich	Kipkabus
	25	Richard Baliat	Ainabkoi
	26	Samwel N. Kuria	Olare
	27	Simon Muchiri	Olare
	28	William Rotich	Burnt Fores

Climate change impact on Agriculture

Attendance list

Date:

Village: Myangani

No. of Yrs in Area

	Name	ID no:	Telephone no:	Occupation	Email address:	Sign
1	Patrice Nzau Nzau	Myangani	0716 293547	Farmer	52 yrs	
2	Peter Makumbi	Kiwanza	0726 128 400	Farmer	4/40	
3	Gregory Wambua	Kitulia	0728 210 719	Farmer	67 yrs	
4	Joseph Mutari	Myangani	070 7278366	Farmer	65 yrs	
5	Mutunga Ngungu	Kyambaa	0714 477 194	Farmer	67 yrs	
6	John Nziou	Kandul	0702 194401	Farmer	65 yrs	
7	Gregory Muti	Makumbi	0716 450 744	Farmer	80 yrs	
8	Maurice Murega	Kandul	0724 240 408	Farmer	35 yrs	
9	PAULINE M. KINGSI	Nhuleni	0739836070	Alchemist	59 yrs	
10	Maria Mutono	Myangani	0704 286322	Farmer	60 yrs	Mutono



11	Martha Kamwe	Malumani	0718 257 455	Farmer	56 yrs	Martha
12	Marayline Kithaka	Kisumu	0723 549473	Farmer	60 yrs	Marayline
13	Miriam Syombua	Miyangani	0706 153 331	Farmer	50 yrs	Miriam
14	Ann Kyallo	Misikani	0704 286112	Farmer	38 yrs	Ann
15	Ndunge Kisio	Ngomano	0710 934788	Farmer	55 yrs	Ndunge
16	Jacinta Mutunga	Kyambae	07 - - - -	Farmer	65 yrs	Ka
17	Patricia Mbula	Kitulia	07 - - - -	Farmer	65 yrs	PATRICIA
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Questions used in the discussions

Kenya Focus Group Questions

Addressing the Impact of Climate Change on Agricultural Systems

Michigan State University, Ecodym, KARI and the Rockefeller Foundation

DRAFT February 18, 2012

Introduction to the Project

This is a joint KARI, Ecodym and MSU, USA project. MSU has been working in Kenya since 1998 with the ministry of Agriculture, conducting surveys and providing ministry advice on agricultural policies, and environmental changes. The topic the project is examining is, how are crops and crop yields changing, what the possible role of environmental and climate changes, and what impact is it having on local farming systems?

We would like your ideas regarding this village, not necessarily only your farm. Why do we ask for separate men and women meetings? So as to get the perspective of both men and women for sometimes women may not speak up larger meetings and we want to hear from both.

Introduction to the researchers and to the participants

Ask each participant to provide a brief autobiographical narrative – how long in the area? What are your main livelihood strategies?

How will use the information?

These meetings are to discuss changes in the farming system of this village and this area – how crops are changing, if environmental resources such as water are changing and why those changes are occurring.

Rights as participants in meeting

1. All responses are confidential
2. Information from workshop will not be associated with individuals, but it is to get a general understanding of the village
3. Respondents are free to answer any question
4. Do participants agree to participate in the meeting? Ask for verbal consent from each.

Discussion Questions

A. CROP PRODUCTIVITY CHANGES

1. Have you noticed any changes in crop productivity (yields, or kg/ha) over the past 20-30 years?

2. Which crops changed productivity?
3. How much have yields changed?
4. When did the change occur?

5. Why did the change occur? EXAMPLES, Leave it open ended.
 - (a) Management. How crop is planted, variety, fertilizer used etc

- 6 Farmers' responses: Have the changes affected how you cultivate? How? EXAMPLES, Change in crop variety, type of crop, management practices, etc.

B.LIVESTOCK

8. Have you noticed any changes in how your livestock is doing health or numbers you have over the past 20 – 30 years?

9. Which livestock changed?(e.g., more cross-breed cows, number of goats e.t.c)

10. How much have they changed?(estimated change in numbers of livestock)

11. When did the change occur?

12. Why did the change occur? EXAMPLES of reasons, leave it open ended.
 - (a) Management: introduction of new breeds, market, etc
 - (b) Forage or land availability
 - (c) Diseases
 - (d) Government or NGO program
 - (e) Climate - & what .Not enough rain, rainy season changes, etc
13. Farmers' responses: Have the changes affected your farm or your family? How?
14. Wealth differences: Are there differences between families? Is there a difference between rich and poor people? Why?

C. WATER AVAILABILTY

1. What are the changes that you have noticed over the past 20 to 30 years in the quantity of water for you, your crops and your livestock?

2. What have been the changes EXAMPLES
 - (a) Changes in depth of ground water (well or bore hole; ask for meters difference
 - (b) Seasonality of streams, amount of water in streams

3. When did the change occur?

4. Why did the change occur?

5. Impact & response: has it affected your household or farming? Have you changed anything cause of the water changes.

D. CLIMATE

1. What are the changes that you have noticed over the past 20 to 30 years in temperatures and rainfall?

2. What have been the changes? EXAMPLES

- A. Changes in how warm it is during different seasons
- B. Changes in amount of rainfall during the growing season
- C. changes in timing of rainfall

- D. Changes in rainfall variability

- E. Extremes: droughts, floods

3. When did the changes occur?

4. Why did the changes occur?

5. Impact and response:

Impacts: Increased in Malarial attack cases, Houses got destroyed, Plenty of food some got spoiled while others got spoiled.

a. Are there any other impacts of climate change that have affected village?

D) Those near rivers grow fast maturing crops- vegetables, sweet potatoes, cassava under irrigation using dams

b. Have you changed anything else because of climate change? (e.g. out migration, off-farm income etc?)

c. Why do you think that climate is affecting crops more than livestock? Why?

6. Wealth differences: Are there differences between rich and poor people in the impact of climate change or in how they adapt?

7. Gender differences: Is there any difference between men and women in the impact of climate change or how they adapt?

D. PROJECTS OR PROGRAMS

1. Have there been any government or NGO projects in your village related to climate change?

2. What are they and what activities have they done?
3. Have they helped you?

Any questions for us?

1. Could the government come to our rescue for we lack fertilizer inputs to better our annual crop yields for this are expensive for us to buy?
2. We appreciate the hybrid the government have given us, however, we request that an all round variety be formulated for it is hard for us to predict which type of seed to plant for which season as the seasons themselves have become unpredictable
3. Due to scarce water sources and our rivers close to drying up, we are requesting for construction of more boreholes. Can government support?
4. Due to the many services and training received from the Government and several NGO's our produce has improved but we do not make much profits as expected due to lack of market info such as prices, expo e.t.c. Can we be supported in this area please?
5. We have the potential of livestock rearing, especially grade goats. Can we be supported in this area please?

Thank you

Meru Workshop attendance List

Gender	Name	Location	Phone No.
Women	Edith Kinanu	Katheri	0702086151
	Mecy Mwongera	Katheri	0711385750
	Roise Nkabla Murungi	Katheri	0736899503
	Naomi Musa	Katheri	0727227709
	Faith Makena	Katheri	0717203607
	Joyce Karimi	Katheri	070129975
	Makena Kimathi	Katheri	-
Men	Erastus Mbithi	Katheri	0715010055
	Joseph M'Kunyua	Katheri	0727000919
	Julius Gitonga Marete	Katheri	0722845170
	John Maingi Kirera	Katheri	0729791894
	John Murugu	Katheri	-
	Joshua Kithure	Katheri	-

Some photographs of the discussion groups



Women in a discussion group in Ainabkoi Uasin Gishu



Participants in Katheri – Meru County



Workshop Participants in Mwala – Machakos County