



*LUCID's Land Use Change Analysis as an Approach
for Investigating Biodiversity Loss and Land Degradation Project*

**Results of Feedback Workshops In Manyatta Division, Embu
District and Siakago Division, Mbeere District: Kenya**

LUCID Project Working Paper 46

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The Land Use Change and Dynamics Project
Working Paper Number: 46

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1. INTRODUCTION/OVERVIEW

These feedback workshops were organized for farmers from Embu and Mbeere Districts of Kenya (see Appendix 1- Location of the Districts). The main aim of the workshops was to share the major findings of a study carried out by LUCID Project in the two districts on effect of Land Use Change on Vegetation/Biodiversity and Soil Degradation.

The transect used during the study runs from the Tropical Alpine, (TA) in the Embu District and ends in the Semi-Arid Mbeere District (see Appendix- 2).

Many rural development efforts have used wrong approach: top-down methods with little or no local participation by the communities resulting in frittering away of valuable resources, because their proposals are alien, bear little or no local social, economic, cultural practicability/acceptability. Briggs (1985) says that such technocrats are “rural tourists” and have no touch with the rural reality. He further points out that rural development approaches that make greater and more effective use of rural knowledge and experience in planning and implementation will often succeed because the communities will support and own such initiatives. Chalk (1993) argues that some proposals for rural development fail because change agents use stereotyped assumptions about their clients (communities) and suggests that development agents need to understand their clients by seeing “through the window” and not “through the mirror”. As early as 1964 Tully said:

Farmers cannot use information to solve a problem or improve a situation until they have defined the problem in terms of the variables to which information relates. Further, they will not use their scarce resources to make changes unless they see these variables as being important in their own situation nor will they be motivated to make such changes. In fact they will not see the information as relevant.

However, in recent times there has been growing trend to involve farmers in planning and implementing development projects to foster ownership (research projects included) Sutherland, 1997). Participatory Approaches such as the Rapid Rural Appraisal approach with its central principle of client consultation and involvement, for example, has achieved great success in fostering rural development in Kenya (Kabutha, Thomas-Slayter and Ford, 1994). Participatory Approaches emphasize involving local people in identifying and solving their own problems, through dialogue forums such as meetings, workshops during which feedback of research findings are presented and discussed. This increases local participation in the program and improves sustainability of development, including environmental management. Against this background the feedback workshops were organized, with the aim of not only presenting the major findings (including the conclusions deduced from findings) of LUCID Project but also to discuss the same in order to have CONSENSUS on the findings and therefore foster ownership of the findings by the communities in the study areas; Researcher (project)-farmer linkage was also strengthened. Participatory methodology was used during the workshop.

The main conclusions arrived at during the workshops included:

- ✓ The largest land use and cover change that has occurred in the Mt Kenya Region since the 1960s has been the expansion of cultivation from Mid-Elevation areas into the Higher Elevation and Low Elevation areas.
- ✓ Land tenure changes and rising population growth have precipitated large scale conversion from bush to farm land
- ✓ Increased land use has decreased vegetation cover and biodiversity due to habitat loss.
- ✓ Land use has led to declining biological resources and services e.g less available of water. Major loss of biological resources has resulted in greater poverty and a change of

- traditional institutions that safeguarded their availability, causing over dependence on rapidly declining resources.
- ✓ Cultivation has increased herbaceous vegetation cover without increases in species diversity
 - ✓ Land degradation has led to reduction of species richness
 - ✓ Pressure on land for cultivation has led people to migrate from Embu to Mbeere region.
 - ✓ Urbanization has created ready markets for forest product such as charcoal and timber and has led to increased exploitation of indigenous vegetation
 - ✓ Low (declining) fertility of land and crop yields are due to: reduction of fallow periods (continuous cultivation), reduced soil cover, overgrazing, Low use of inorganic fertilizers or integrated nutrient management, limited use of soil and water conservation measures, deforestation, soil erosion, cultivation on steep slopes, poor land preparation methods, leaching of nutrients and low soil pH. Underlying these causes are more fundamental factors including population growth, poverty, land tenure, access to markets and credit, government policies and institutions and limited farmer knowledge of appropriate technologies in some cases.
 - ✓ A collective approach is needed to address the negative changes in the environment that have been mainly brought about by human activity to ensure sustainable environmental management.
 - ✓ Soil degradation is on the increase and there is need to urgently reverse this trend if the battle against hunger and poverty has to be won, considering that agriculture is the backbone of the Kenyan economy. This is in line with what Lord John Boyd Orr, the first Director General of FAO said in 1948- **“If the soil on which all agriculture and human life depends is wasted away then the battle to free mankind from want cannot be won.”**

A detailed account of the discussions that led to conclusions given above is presented in section 3 of this report.

On average, 85% of the invited farmers attended the workshops at both sites (see Appendix- 3) with a higher women representation in Mbeere.

2. METHODOLOGY

Three (3) preparation pre-workshop activities contributed greatly to the success of the workshops. These are:

- Farmer selection- participant farmers were purposively selected on the basis of adequate historical experience of the area, communicativeness and professional commitment; letters of invitation were sent to them followed by personal farm visits. Fifty (50) farmers were invited for each site.
- Preparation of presentation materials – summaries of the findings and conclusions deduced from findings- **ready as short statements and questions accompanied by relevant pictorial presentation (see Appendix-4 & Changes in land use and land cover**
- A ready tentative workshop program (see Appendix- 5) – Presented and adopted unmodified by participants because the format used had in-built rapport building aspects.

The PRA tools of brainstorming and consensus- building discussions were used in both sites. The presentations were classified into three topics, namely: Land use change, Vegetation/biodiversity change and Soil degradation. For the first two topics, sets of guiding statements based on the

major findings were used starting with the findings that were generally similar for both sites followed by findings that were specific to each area.

However, for ease of comprehension of soil analyses results (minerals are not visible, but their deficiency signs are) the soil degradation presenter, using sets of questions, led discussions on signs and causes of declining soil fertility/specific nutrient deficiency in farms and strategies to cope with declining soil fertility. Scientific indicators of soil nutrient deficiency were then presented. Finally, the soil analysis farm report was presented for the farmers to verify based on the plenary discussions. This topic generated a lot of interest from the farmers because they could relate the findings /conclusions to their specific farms. The topic also explained some of the findings on vegetation/biodiversity change.

Details of the statements/questions and responses of the farmers are presented in the results section of this report.

The workshops were held in Kiriari, at the polytechnic (Embu District) and Siakago, near Divisional office (Mbeere District). In each site, participants were drawn from at least 3 sub locations. The provincial administration and Agricultural extension workers also participated. The facilitator had adequate experience in the use of participatory methods and was neither part of LUCID research team nor a member of the local community, to avoid bias.

Each guiding statement or question was read out in English (some participants understood English) and translated into kiswahili and local language; explained to the participants using pictures and illustrations on the flip charts and visual observational examples from the study area. This encouraged participation and minimized unnecessary questions. Participants were then asked whether they agreed with the statements or not, stating the reasons for their answers. To solicit more information and clarity on the responses, helpers such as “why”, “how”, “where”, “when”, “by who”, “what” were used, and occasionally, responses would be loudly restated to ensure that the response was well understood. In cases where all the participants were in agreement with a statement, explanations or examples were sought to support the response through a brainstorming session. In cases where there was divided opinion, all the reasons generated for and against the statement were recorded and subjected to a consensus building discussion session by running through all the reasons and determining the major reasons for and against the statement.

For the soil degradation, participants engaged in very lively brainstorming and discussion sessions drawing observational examples from own or neighbouring farms. All the responses related to a particular question were marshaled and summarized. At the end of the discussions the results of soil analyses were presented and participants were asked whether they agreed with the findings. Participants expressed their views freely in Kiswahili and vernacular.

A brief discussion of the findings is provided in the subsequent section

3. RESULTS

The guiding statements and/or questions are presented here below in bold and italicized. The results are presented per site.

3.1 KIRIARI, MANYATTA DIVISION, EMBU DISTRICT

3.1.1 Land Use Change

- i. ***The largest land use and cover change that occurred in the Mt Kenya region since the 1960's has been the expansion of cultivation from the higher elevation areas into the mid elevation then low elevation and most recently to the semi-arid bush. The result is a "ring" of land cover change from bush to cultivation at the base of Mt Kenya that has occurred in the mid 1980's and 1990's (see appendix –5).*** Participants disagreed with the first statement or conclusion. Instead they expressed that expansion of cultivation started in the mid elevation areas into the higher and low elevation areas. They explained that during the dry spell people move to higher elevation to graze and cultivate because upper zones have sufficiently reliable rainfall and introduction of some perennial cash crops such as tea and coffee caused expansion of cultivation into higher elevation areas. At the same time, Increasing food demand and Pressure for land for cultivation due to population rise has expanded cultivation into lower elevation areas where there are large parcels for purchase or rent
- ii. ***The large-scale conversion from bush to farm land was precipitated by implementation of a land adjudication program of the national government, and sustained by rapid population growth due to high fertility rates and in-migration.*** Participants were in agreement with this statement. They explained that the change from communal to freehold ownership of land limited household cultivation to fixed farm boundaries and where as shifting and fallow cultivation was possible with communal land tenure, it was no more possible because one was forced to cultivate within one's boundaries. This problem got worse as population grew and the farms were subdivided and more intensively cultivated characterized by continuous cultivation and total clearance of bush. Participants added that other causes of bush clearing included: commercialization of farming, timber harvesting for money (with increased urbanization), increased awareness on value for money, and increased education brought by Europeans on land utilization.
- iii. ***Farmers have been forced to respond to changing economic circumstances by modifying their farming system. Coffee and tea prices declined precipitously and many farmers eventually removed their coffee bushes to plant other, if less remunerative crops.*** Farmers confirmed that they were either cutting down or reducing number of coffee bushes (not uprooting) because of low produce prices compared to high input costs. Generally the majority of the farmers were cutting down coffee bushes in speculation that coffee prices will improve some day. In place of coffee, farmers were planting more profitable crops such as passion fruits and bananas. Farmers were doubtful about the price of coffee return and felt that price could return only if corruption both in the government and in the management of farmer coffee institutions were finished, and the coffee act was reviewed to reflect farmer needs. They also expressed that even if coffee prices were improved, some would not grow coffee for fear of recovery of huge past debts. Others would grow coffee only if institutional management would be improved. Farmers were also uprooting tea because of low prices, to create settlement

area (currently most farmers have planted tea leaving space for the homestead only). Due to population pressure land is subdivided among the children who need their own homesteads that can only be got by freeing some land under tea. Tea is also being uprooted to create room for food crops or to plant higher income generating crops (land use intensification). Other farmers are uprooting tea to reduce risk of diseases (e.g. pneumonia) associated with cold conditions in tea fields and its management.

- iv. ***Land shortage is seen as a major problem and rich families since the 1970's have been renting or purchasing land ever lower into semi- arid zones.*** Participants were in agreement with this statement and confirmed that this practice was still continuing.
- v. ***Land shortage is also being addressed by measures to reduce dependency on land: farm families have focused their investments on their children's education since 1970's so that they learn a trade other than farming, many young people seek non-farm employment, their birth rates and population growth rates have declined rapidly.*** Participants agreed that dependence on land is reducing and family sizes are getting smaller. Families are getting smaller because of shortage of land, economic hardships, death from diseases and accidents and drug abuse- people don't marry or marry late due to drugs. However, farm sizes are getting smaller because of continued subdivision.
- vi. ***Landlessness and near landlessness: Is it increasing and how are people responding?*** Participants expressed that landlessness was increasing and that people's responses to landlessness included: children going to school to increase chances of getting jobs off the farm, increased casual labour particularly in the tea farms, migration to towns (increased urbanization) looking for jobs, family planning, mushrooming of informal /micro businesses in the rural areas, and intensification of farming with emphasis on organic farming (with little use of expensive external inputs).
- vii. ***Richer families appear to put more manure, use fallow more, and use more fertilizers.*** After defining a rich family as one with a relatively higher income and has more land, participants agreed with the statement. They explained that this affects soil fertility by increasing soil nutrients, increases water- holding capacity of soil and reduces soil erosion resulting in increased crop yields.
- viii. ***One third of the families in the survey had husbands who are working elsewhere.*** Whereas participants expressed that it is important for husbands to work away from home because they would bring extra income, they disagreed with the statement presented. Out migration by husbands and children is important because it brings more income that can be used to build better houses, educate more people, and the migrants can also import better farm management technologies that can be used to improve the management of own farms. However, out migration increases risks of diseases and accidents. Generally, participants felt that out migration was on the increase in search of off farm jobs to supplement low farm income. A few felt that out migration was on the decrease because of scarcity of off farm jobs, citing example of children who were finishing school and could not get employment or got jobs whose wage rate was so low that the migrant barely survived. Farms where there was out migration had more fertile soils, and better-managed land but farms with no migration could be better managed if the owners were educated on appropriate land and soil management techniques.

3.1.2 Vegetation and Biodiversity

- i. ***Cultivation has reduced tree cover.*** Participants were in agreement with this statement. Some of the causes of reduced cover mentioned include: that trees have been cut to give room for cultivation of more crops (to reduce shading effect) as farm sizes continue to get smaller, and tree planting is less profitable compared with other crops because they take long to mature and the final value is less than the cumulative value of another shorter term crop grown on the same area. Farmers also admitted that they lacked adequate knowledge in agroforestry. As a result participants agreed that they had experienced an increase in soil erosion in their farms.
- ii. ***Change from natural vegetation to cultivated land has links to decrease in indigenous plant species richness and diversity, and an increase in exotic plant species.*** Participants agreed that increase in cultivation and other human activities have resulted in reduction in the species richness for native plants and increase in exotic species. They said that some plants they used to see before bush was cleared are rarely seen today.
- iii. ***The changes stated above have altered function of indigenous ecosystems by reducing its ability to provide services like the support of unique wildlife, availability of wild resources like food plants, medicinal plants, and other traditional plant resources that are a product of long term evolution of the ecosystems.*** Participants agreed with statement and explained that there are fewer wild animals, medicinal plants and wild plant resources than before. They said that this reduction in wild animals and native plants was associated with cultivation arguing that natural habitats of wild animals have been interfered with and in the cultivated areas only the desired plants were retained and the rest removed during weeding. Clean weeding for some crops is a requirement by the market to ensure required quality.
- iv. ***There is decrease in species diversity in monoculture as compared with polyculture systems.*** Participants agreed with this statement. They explained that in many monoculture systems quality is emphasized and therefore other plants are not allowed to grow. Other monocultures like tea do not need shade and are affected by root borne diseases from trees.
- v. ***Land degradation has led to an increase in crop diversity.*** Participants did not agree with this statement. They argued that poor/degraded soils limit the number of crops that can be grown and general knowledge of soil management is more important in crop diversity than land degradation. High fertility of soil encourages higher diversity of crops. In cases where the statement is true, the level of awareness on soil fertility management is low.
- vi. ***Decrease in species richness is linked with increase in soil erosion and loss in soil fertility. Reduced plant cover has resulted in increased soil erosion and loss of soil fertility.*** Participants agreed with this statement. They explained that we find more plant species in areas with less erosion. They further argued that in eroded areas there is seed removal by erosion, top soil is removed favouring only those species that can withstand low fertility and the ones that access the leached nutrients.
- vii. ***Reduction in vegetation cover has reduced the availability of water for domestic uses, livestock, and wildlife.*** There was agreement with this statement. Many examples of

areas where land use has led to less water availability were cited. Kamuthengi stream (permanent) in Ruguru location for instance has almost dried due to reduction in vegetation cover upstream.

- viii. ***Cultivation increases herbaceous vegetation without increasing species diversity.*** There was agreement with this statement. Using a comparison of a grazing field and a cultivated field, participants supported the statement that in a cultivated area we find a higher percentage of herbaceous vegetation cover but poorer species diversity (poorer in species numbers) because of dominance by a few weed species.

3.1.3 Soil Degradation

- i. ***What are the signs of declining soil fertility (farmers' indicators of soil nutrient deficiency) in Embu?*** Participants gave the following signs:
- Low yields
 - Weak and stunted crops
 - Appearance of some weeds/plants
 - Soil erosion features
 - Soil colour changes towards brown
 - Soil becomes compacted and hard to till
 - Plants turn yellow
 - Failure of crops to flower
 - * Presenter added- purpling of crops, curling of leaves in fruits especially from the edges
- ii. ***What are some of the causes of soil declining fertility?*** Farmers' responses included:
- Soil erosion
 - Overgrazing
 - Cultivation on steep slopes
 - Continuous cultivation
 - No soil and water conservation measures
 - Deforestation
 - Reduced soil cover
 - Limited use of compost manure
 - * Presenter added-
 - a) Low pH and explained that Ph measures the level of acidity or alkalinity in the soil and said that Embu soils were generally acidic.
 - b) Leaching of soluble nutrients to levels well below root zone, making them not available to crops-A form of soil erosion that is not visible.
- iii. ***What strategies do farmers use to cope with declining soil fertility?*** Participants' responses included the following:
- Terracing the farm like they used to do in coffee
 - Practice crop rotation
 - Use compost manure
 - Stop cultivating on steep slopes
 - * The researcher added the following strategies and explained in detail why.
 - Applying recommended fertilizer (rates at least 40 kgN/ha and at least 60 KgP₂O₅/ha) or farm yard manure (at least 10t/ha)
 - Adopt appropriate farming methods such as deep cultivation or oxen ploughing to lessen soil compaction and improve aeration

- Applying the right type of fertilizer (in Embu avoid DAP because it increases acidity) and always top dress with CAN
- Add lime or magmax in lower highlands (LH₁, UM) of Embu
- Use of biomass transfer (e.g. Tithonia spp- has high levels of nitrogen and to improve soil organic carbon) or integrated nutrient management strategies
- Agro forestry practices- (trees assist in bringing up some leached nutrients for recycling)

It was evident that farmers had little knowledge on composting, agroforestry, soil and water conservation technologies and integrated nutrient management in general. As stated earlier, this topic generated a lot of discussion and interest from the participants, particularly on the how to cope with declining soil fertility.

- iv. ***Based on the Soil analyses, the Scientific indicators of soil nutrient deficiency in the Embu region included (see Appendix-6):***
- ***Nitrogen levels declining as demonstrated by yellowing of leaves and stunted growth and reduced yields***
 - ***Declining levels of phosphorous as demonstrated by purpling of plant leaves and stems***
 - ***Declining levels of organic carbon leading to low moisture holding capacity***
 - ***Potassium is adequate in the soils for general crops like maize but there was need to add more for vegetables and fruit trees as demonstrated by curling of leaves especially from the edges in these crops.*** Participants were in agreement with these findings. They explained that all these signs were found in the farms.
 - * Generally, the analyses showed that Nitrogen, Soil organic carbon and phosphorous decreased from the forest, lower highlands of Embu to the lower midland zones (LM3-LM5) of Mbeere District

3.2 SIAKAGO DIVISION, MBERRE DISTRICT

3.2.1 Land Use Change

- i. ***The largest land use and cover change that occurred in the Mt Kenya region since the 1960's has been the expansion of cultivation from the higher elevation areas into the mid elevation then low elevation and most recently to the semi-arid bush. The result is a "ring" of land cover change from bush to cultivation at the base of Mt Kenya that has occurred in the mid 1980's and 1990's (see appendix -5).*** Participants concurred with the farmers in Embu region this conclusion is not true. Instead participants expressed that expansion of cultivation started in the mid elevation areas into the higher and low elevation areas. They explained that during the dry spell people moved to higher elevation to look for pasture and food because in these areas, cultivation was possible through out the year because of adequate rainfall and irrigation using permanent streams, found in these areas. Also, introduction of some perennial cash crops such as tea and coffee caused expansion of cultivation into higher elevation areas. At the same time, increasing food demand and pressure for land for cultivation due to population rise have expanded cultivation into lower elevation areas where there are larger parcels.
- ii. ***The landscape of Mbeere has changed from one dominated by communally managed bush savannah and woodland to one almost completely covered by individual farms, if***

not all cropped. Participants agreed that most land is adjudicated but little is cultivated. They advanced the following reasons to explain the non cultivation:

- People own large farms or several pieces of land that they can not possibly cultivate due to non-availability (or cannot afford) of facilities such as tractors to cultivate big portions.
- The region is sparsely populated (suffered family raids in the old days) and labour is a problem.
- Some land is not arable
- Some land is owned by small children (land adjudicated to children)
- Poverty in the area limits the amount of land one can cultivate
- Still there are some clan lands (e.g. around Rwika) that cannot be cultivated but only be grazed.

Participants agreed that adjudication increased conversion of bush to farm lands and increasing population also contributed to increased bush conversion.

iii. ***Indeed, these areas are the poorest despite low population densities, and many husbands and adult children have left the family farm to search for other sources of income. Half of the families in the survey had husbands who were working elsewhere.***

Participants agreed with these statements They expressed that husbands and children out-migration was important and was increasing for these reasons:

- Lack of profitable employment at home and in the farms – farm incomes are low resulting in low returns to labour (this situation may gradually change with introduction of high value farm activities such as irrigated flower, and fruits cultivation in the region)
- Lack of industries in Mbeere
- Increasing level of poverty as economic times become harder and droughts (crop failures) become frequent

Participants had this to say about impact of out migration on families left behind and land/soil management:

- In some cases the migrants earned less than can be generated at the farm
- In most cases, out migration helped to bring income- in such cases poverty was reduced.
- Out migration increases risks to contract diseases, which may end up impoverishing families further.
- Out migration families had better managed farm lands because the extra income earned by the migrant was used for land management and also the migrants brought with them new technologies in land management.
- Families without out migrants could have better land management if they had adequate knowledge in appropriate land management techniques.
- Generally, men planted trees and therefore out migration reduced trees planted on the farm.
- Other participants felt that that the condition of the land depended on the management ability of the woman- in recent times women have formed groups that deal with tree nurseries and on farm tree planting by women. All in all, men planted trees but the woman took care of them.
- Unanimously, it was resolved that land management depended on the cooperation between the husband working away and the wife working at home.

Land shortage is a problem only among some families. There was agreement with this statement. There were few people with small pieces of land. ***Some*** could not make meaningful land use because of land shortage. Such families either hired or purchased ***Indeed, these areas***

are the poorest despite low population densities, and many husbands and adult children have left the family farm to search for other sources of income. land.

- iv. ***Wealthy farmers since 1970's have been renting or purchasing land ever into semi-arid zones.*** Participants agreed with this conclusion and confirmed that the practice was still continuing. Majority of these rich people were from outside Mbeere and their farms were better managed than the farms of original (native) people.
- v. ***The semi-arid zones appear to be in danger of worsening soil degradation due to expansion of cropping into environmentally fragile and climatically risky areas.*** Participants were in agreement with this conclusion and added that soil degradation was getting worse in the farms due to:
 - Reduced rainfall over time
 - Over dependence on inorganic fertilizers
 - Continuous cropping
 - High rate of deforestation
 - Rising level of poverty
- vi. ***Richer families appear to put more manure, use fallow more, and use more fertilizers.*** There was agreement with this conclusion; they explained that this improved soil fertility resulting in increased yields and higher farm income. Total crop failure was also less common in these farms.
- vii. ***Overgrazing- a problem, getting worse and where?*** Participants expressed that overgrazing was uncommon in the upper parts of Mbeere (farmers either tether or zero graze animals) but it was a problem in the lower areas of Mbeere (e.g. Kirie and Kiambere).
- viii. ***The only large areas remaining of natural vegetation types are in protected areas or on rocky, steep hills, but even there many of the woodlands have been cleared or thinned.*** Participants agreed with this observation. They further explained that:
 - Wildfire causes loss of vegetation in protected areas
 - Woodlands have been thinned or cleared for charcoal, for timber
 - Burning also done to reduce tick populations
 - Tree cutting and burning is increasing- because of poverty
 - All land on steep hills and rocky places will one time be cultivated due to population pressure.
- ix. ***There is a large amount of bush in lower Mbeere not cultivated (near KenGen land).*** There was agreement with this statement. Participants explained that:
 - The land was adjudicated
 - The land belonged to Tana River Development Authority (TARDA)
 - The land was uncultivated because it dries faster than upper parts of Mbeere
- x. ***What might be the future sources of income in this area? What might happen to cotton, goats, irrigation, any new crops?*** In response participants said future income would come from:
 - Extension of cultivation
 - Growing more of cash crops such as cotton, keeping more goats
 - Growing new crops such as mangoes and paw paws under irrigation
 - Dry land rice may also be tried.

3.2.2 Vegetation and Biodiversity

- i. ***Land use change is reducing the extent of natural vegetation cover and as a result there is loss of natural plant resources like medicinal plants, wild food plants and other economically useful plant resources.*** There was agreement with this conclusion. Participants confirmed that these plant resources were becoming fewer and gave the following strategies to address the problem:
 - Re-afforestation on the farms
 - Stop bush burning on the hill slopes
 - Protect the remaining resources
 - Substitute indigenous plants with exotic ones
 - Increase awareness on usefulness of native plants

- ii. ***One reason for the loss in natural vegetation is charcoal burning and cutting of trees for posts.*** There was agreement with this statement. Riandu area was said to be notorious for this. The practice was getting worse because of the rising level of poverty. To solve this problem, they suggested these strategies:
 - Enforcement of the environmental law
 - Planting more trees
 - Enlightening community on cheaper/alternative sources of energy and energy conservation techniques
 - Increasing security on forests- the community to participate in protecting the forests
 - Collective involvement of all beneficiaries in the conservation of natural vegetation.

- iii. ***Removal of vegetation from the farm makes the land poor. This is true even for crop residues like remains of maize, millet, and others that are used for livestock feeds. Many farmers collect these residues from their farms and sell them to buyers who take them to their farms which in many cases are outside Mbeere. In so doing, they rob their farms of many essential nutrients thereby rendering their farms poorer. The same case applies to manure from their livestock.*** There was agreement with this observation. They said there was movement of manure and crop residues to other farms/zones and gave these reasons for the practice:
 - Poverty
 - Lack of general understanding of its usefulness
 - Seeking after short term gains and ignoring long term gains (addressing practical needs versus strategic needs) This is characteristic of the poor: their immediate problems are usually too pressing to allow them to take a longer-term view
 - Carelessness and ‘don’t care’ attitudeThis problem could be solved if:
 - More jobs were created within Mbeere and the economy generally improved.
 - People put more effort in farming
 - Farmers followed instructions from Agricultural Extension Officers

- iv. ***Cultivation along rivers, wells, and water catchment areas is found to be taking place and it is increasing overtime. This is causing shortage of water for people, livestock and wildlife.*** Participants were in agreement with this observation and said it was necessary to stop it because eventually all of them would suffer lack of water because

the streams will dried up. This cultivation was also not sustainable and it was only benefiting a few. To address the problem farmers proposed the need to:

- Plant more trees in the affected areas
- Enforce the law governing management of these areas
- Increase awareness on relevant legal regulations
- Intensify community participation in protecting these areas because they are the direct beneficiaries.

- v. ***The African tradition of conserving forests or vegetation in sacred places has been abandoned leading to cultivation and tree cutting in the sacred places.*** There was agreement with this statement. Participants used the “once upon a time sacred ITITU forest, that has been adjudicated; people accepted the subdivision and initially sold bits to foreigners to experiment whether the foreigners would suffer any curse. Eventually, the curse belief died out and today people cultivate in these areas. This is likely to lead to deforestation, reduced vegetation cover, loss of important plant resources and land degradation.

3.2.3 Soil Degradation

- i. ***What are the signs of declining soil fertility (farmers’ indicators of soil nutrient deficiency) in Mbeere?*** Participants gave the following signs:
- Low yields
 - Weak and stunted crops
 - Appearance of some weeds/plants
 - Soil erosion features
 - Soil colour
 - Soil becomes compacted and hard to till
 - Plants turn yellow
 - Failure of crops to flower
 - * Presenter added- purpling of crops, curling of leaves in fruits especially from the edges
- ii. ***What are some of the causes of soil declining fertility?*** Farmers’ responses included:
- Soil erosion
 - Overgrazing
 - Cultivation on steep slopes
 - Continuous cultivation
 - No soil and water conservation measures
 - Deforestation
 - Reduced soil cover
 - Limited use of compost manure
 - Burning of crop residues- in line with Ehui, S.K., et al (1990) that organic carbon in such areas miss in the soil because there is high demand to use it for other purposes such as burning and grazing.
 - Selling out crop residues and manure to others
 - In appropriate cultivation methods e.g. shallow tilling when there is need for deeper cultivation
 - * Presenter added-
 - a) pH and explained that Ph measures the level of acidity or alkalinity in the soil and said that Mbeere soils were generally alkaline (pH of 5.7- 7)

b) Leaching of soluble nutrients to levels well below root zone, making them not available to crops- a form of soil erosion that is not visible.

- iii. ***What strategies do farmers use to cope with declining soil fertility?*** Participants' responses included the following:
- Stop residue burning
 - Practice crop rotation
 - Use compost /FYM manure
 - Stop cultivating on steep slopes
 - Terrace the farm and maintain terraces
 - * The researcher added the following strategies and explained in detail why.
 - Applying recommended fertilizer (rates at least 40 kgN/ha and at least 60 KgP₂O₅/ha) or farm yard manure (at least 10t/ha)
 - Adopting appropriate farming methods such as deep cultivation or oxen ploughing to lessen soil compaction and improve aeration
 - Applying the right type of fertilizer and always top dress with CAN
 - Use of biomass transfer (e.g. Tithonia spp- has high levels of nitrogen and to improve soil organic carbon) or integrated nutrient management strategies
 - Use soil from charcoal burning pits/ termite mounds when planting
 - Agro forestry practices- (trees assist in bringing up some leached nutrients for recycling)

Just like in Embu, it was evident that farmers had little knowledge on composting, agroforestry, soil and water conservation technologies and integrated nutrient management in general. As stated earlier, this topic generated a lot of discussion and interest from the participants, particularly on the how to cope with declining soil fertility.

- iv. ***Based on the Soil analyses, the Scientific indicators of soil nutrient deficiency in the Mbeere region included (see Appendix-6):***
- ***Nitrogen levels declining as demonstrated by yellowing of leaves and stunted growth and reduced yields***
 - ***Declining levels of phosphorous as demonstrated by purpling of plant leaves and stems***
 - ***Declining levels of organic carbon leading to low moisture holding capacity***
 - ***Potassium is adequate in the soils for general crops like maize but there was need to add more for vegetables and fruit trees as demonstrated by curling of leaves especially from the edges in these crops.*** Participants were in agreement with these findings. They explained that all these signs were found in the farms.
 - **** Generally, the analyses showed that Nitrogen, Soil organic carbon and phosphorous decreases from the forest, lower highlands of Embu to the lower midland zones (LM3-LM5) of Mbeere Districts***

4. CONCLUSION

In both sites, participants agreed with most findings and conclusions for various reasons. However, participants disagreed with few conclusions related to land use change and Vegetation and Biodiversity change.

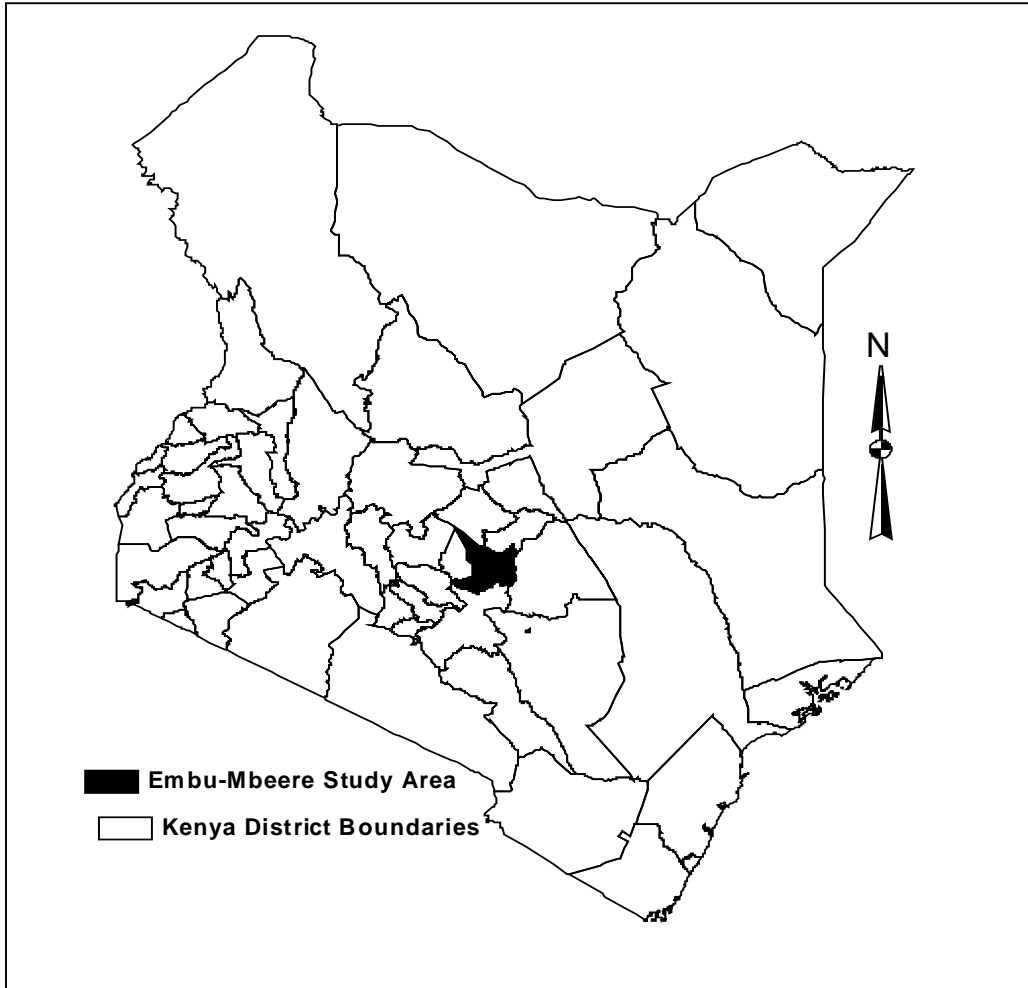
* Tip for future- Allocation of more time per site would afford time for focused group discussions to allow quieter members of community to give their opinions.

5. REFERENCES

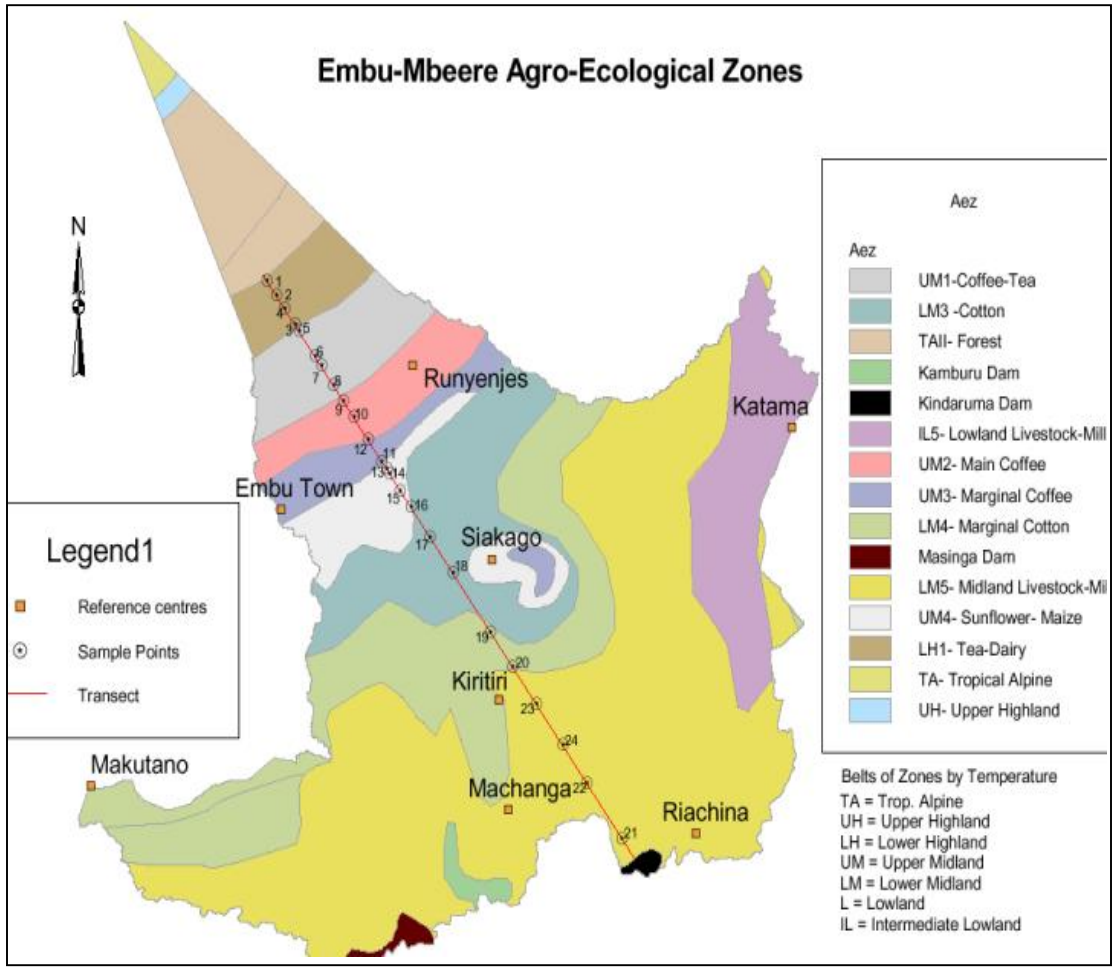
- Briggs, J. (1985), 'An exploratory study of farmers' choice of crops in Central Sudan', *Transactions of the Institute of British Geographers: New Series* 10, 170-80.
- Chalk, D. (1993), 'Equitable extension- seeing through the looking glass' in *Proceedings of the Australian-Pacific Extension Conference*, Gold Coast, October 12-14, Dove Rural Media, Newstead, Australia, 535-40.
- Ehui, S.K., Kang, B.T., and Spencer, D.S.C. (1990), 'Economic analysis of soil erosion effects in alley cropping, no-till and bush fallow systems in South Western Nigeria', *Agricultural Systems* 34: 349-368.
- Kabutha, C., Barbara, P.T.S., and Ford, R. (1993), 'Participatory rural appraisal: a case study from Kenya', in *Rapid Appraisal Methods*, ed. K. Kumar, World Bank, Washington D.C., 176-190.
- Olson, Jennifer M. , Bilal Butt, Fred Atieno, Joseph Maitima, Thomas A. Smucker, Eric Muchugu, George Murimi, and Hong Xu. 2004. Multi-scale analysis of land use and management changes on the Eastern Slopes of Mt. Kenya. Land Use Change Impacts and Dynamics (LUCID) Project Working Paper 20. Nairobi: International Livestock Research Institute.
- Tully, J. (1964), 'Operational research in agricultural extension in Queensland ', *Agricultural Progress* 39, 1-11.
- Sutherland, A.J. (1997), ' Involving other stakeholders through participatory research planning workshop in *Conference proceedings on participatory Dryland Agricultural research East of Mt Kenya*, Jan 21-24, Isaac Walton Inn, Embu.

6. APPENDICES

APPENDIX –1 Map of Kenya showing location of Embu and Mbeere Districts



APPENDIX –2 Map showing vegetation and soil sampling transect



APPENDIX –3 Attendance Lists

KIRIARI -MANYATTA DIVISION- EMBU DISTRICT

S/NO	NAME	LOCATION/SUBLOCATION	OCCUPATION
1.	Simon Njiru Muchiri	Ruguru/Kiriari	Farmer
2.	Joseph Njagi	Ruguru/Kiriari	Farmer
3.	Patrick M. Njeru	Nginda/Mbuvori	Farmer
4.	Shadrack Mwaniki	Ruguru/Kiriari	Farmer
5.	Gladys Gicuku	Nginda/Mbuvori	Farmer
6.	Izaak Nyaga	Ruguru/Kiriari	Farmer
7.	Benson Nyaga	Ruguru/Kiriari	Farmer
8.	Njeru Gitangaruri	Nginda/Mbuvori	Farmer
9.	Johnson Njoka	Ruguru/Kiriari	Farmer
10.	Salesio Nthiga	Ruguru/Kithunguriri	Farmer
11.	Salesio Njeru	Ruguru/Kiriari	Farmer
12.	Samwel Njeru Njaga	Ruguru/Kiriari	Farmer
13.	Njoka Macharia	Ruguru/Kiriari	Farmer
14.	Edward Njaga Mukono	Ruguru/Kiriari	Farmer
15.	James Muriuki Gitari	Nginda/Mbuvori	Farmer
16.	Harrison Ndwiga	Nginda/Mbuvori	Farmer
17.	Wilson Muchira Ndugu	Ruguru/Kiriari	Farmer
18.	Njiru Njoroge	Ruguru/Kiriari	Farmer
19.	Patrick Njeru Stephen	Nginda/Mbuvori	Farmer
20.	Muriuki Jacob	Nginda/Mbuvori	Farmer
21.	Mwaniki Samwel	Kiriari/Kithunguriri	Farmer
22.	Kathuri Samwel	Nginda/Mbuvori	Farmer
23.	Antony Njagi	Nginda/Mbuvori	Farmer
24.	Mirugi Njambere	Nginda/Mbuvori	Farmer
25.	Murithi Gikombo	Nginda/Mbuvori	Farmer
26.	Samwel Muturi	Ruguru/Kiriari	Farmer
27.	James Njururi	Ruguru/Kiamweja	Farmer/Retired Ass.chief
28.	Nyaga M. Cini	Nginda/Mbuvori	Farmer
29.	Alex I. Moko	Ruguru/Kithunguriri	Farmer
30.	Salesio k. Kananake	Ruguru/Kithunguriri	Farmer
31.	Moses N. Kanambiu	Ruguru/Kithunguriri	Farmer
32.	Patrick N. Nguru	Ruguru/Kithunguriri	Farmer
33.	Michael Nyaga Kavuri	Ruguru/Mbuvori	Farmer
34.	Johnson Mbogo M. Njeu	Nginda/Mbuvori	Farmer
35.	John Muthua	Nginda/Karau	Farmer
36.	Simon Mucangi	Ruguru/Kiriari	Farmer
37.	Jese Ndwiga	Ruguru/Kiamweja	Farmer
38.	Lydia Warumi	Ruguru/Kiriari	Farmer
39.	Isaya Njiru	Ruguru/Kiriari	Farmer

40.	Francis Njagi Kiura	Ruguru/Kiriari	Farmer
41.	Mwasniki Njeru Kariuki	Nginda/Mbuvori	Farmer
42.	David Muriuki	Ruguru/Kithunguriri	Farmer
43.	Kagane Joshua	Ruguru/Kiriari	Farmer
44.	Anderson N. Tai	Ruguru/Kiriari	Farmer/Ass.Chief
45.	Dominic Ndovo	Ruguru/Kiriari	Farmer/Polytechnic Manager
46.	Francis Kitai	Ruguru/Kiriari	CPL i/c Security
47.	Kioi Ruguru	Ruguru /Kiriari	Chief Ruguru Location
48.	Daniel Muthee	Manyatta Division	Agric. Extension Worker
49.	Soil Conservation OFFICER	Manyatta Division	Agric. Extension Worker
50.	FEW	Ruguru Location	Agric. Extension Worker

SIKAKAGO DIVISION-MBEERE DISTRICT

S/NO	NAME	LOCATION/SUBLOCATION	OCCUPATION
1.	Simon Njue Nthabiri	Nthawa/Riandu	Farmer
2.	Dionisio Njue Njiru	Nthawa/Siakago	Farmer
3.	Danson Mati Njoka	Nthawa/Riandu	Farmer
4.	Saverino M. Namu	Gitiburi/Gitiburi	Farmer
5.	Niceta Ndegi Njue	Nthawa/Riandu	Farmer
6.	Elizabeth Nyambura Kinyua	Nthawa/Riandu	Farmer
7.	Avinja Ita Njeru	Nthawa/Riandu	Farmer
8.	Kunseta Kaari Mwangi	Nthawa/Riandu	Farmer
9.	Susan Njoki Njeru	Nthawa/Riandu	Farmer
10.	Domiano Njeru Ngari	Gitiburi/Thura	Farmer
11.	Angelica M. Muthoni	Nthawa/Riandu	Farmer
12.	Mavrian Muthoni	Nthawa/Riandu	Farmer
13.	Catherine Wanjiru	Nthawa/Riandu	Farmer
14.	Elizabeth Waturi	Nthawa/Riandu	Farmer
15.	Josphine M. Njiru	Nthawa/Riandu	Farmer
16.	Daniel Njue Mboru	Gitiburi/Gitiburi	Farmer
17.	Lawrence Njeru	Nthawa/Riandu	Farmer
18.	Felista Wawira	Nthawa/Siakago	Farmer
19.	Sivio Njeru	Gitiburi/Thura	Farmer
20.	Mary Wambui	Nthawa/Riandu	Farmer
21.	Michael Njeru	Gitiburi/Gitiburi	Farmer
22.	Benson G. Kiura	Gitiburi/Thura	Farmer
23.	Alucia Muthanje	Nthawa/Siakago	Farmer
24.	Justa Mwingi Kitheka	Nthawa/Siakago	Farmer
25.	Joseph Munyiri	Nthawa/Siakago	Farmer
26.	Paul Ngotho	Nthawa/Siakago	Farmer
27.	Jacinta Ndwiga	Nthawa/Siakago	Farmer

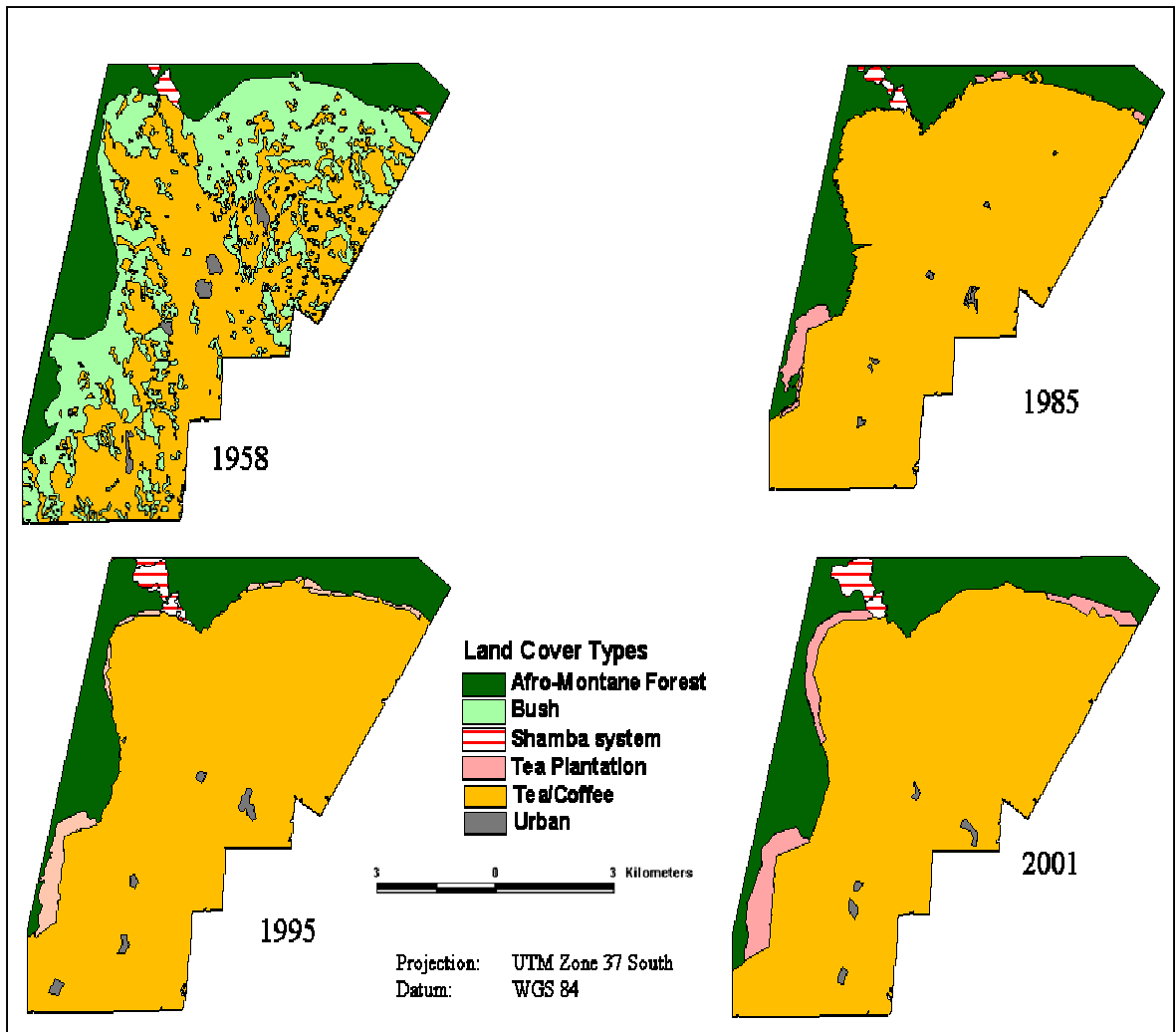
28.	Njenia Wakere	Nthawa/Siakago	Farmer
29.	Ngari Nyaga	Gitiburi/Thura	Farmer
30.	Ngari Maguta	Gitiburi/Thura	Farmer
31.	Lucy Sammy	Gitiburi/Thura	Farmer
32.	Syombua Mugo	Gitiburi/Thura	Farmer
33.	Lydia Githi	Gitiburi/Thura	Farmer
34.	Isabella Gaku	Gitiburi/Gitiburi	Farmer
35.	Jane Nduta	Gitiburi/Gitiburi	Farmer
36.	Serenia Mbuya	Gitiburi/Gitiburi	Farmer
37.	Judy Ndegi	Nthawa/Siakago	Farmer
38.	Miriam Wakere	Gitiburi/Gitiburi	Farmer
39.	Patricia Marigu	Gitiburi/Gitiburi	Farmer
40.	Peter Njeru Ngari	Gitiburi/Gitiburi	Farmer
41.	Beatrice Ndegi	Gitiburi/Gitiburi	Farmer
42.	Jane I. Daudi	Nthawa/Siakago	Farmer
42.	Namu	Siakago Division	Agric.Extension Worker
43.	SOILCONS.officer	Siakago Division	Agric. Extension Worker
44.	FEW	Nthawa Location	Agric. Extension Worker
45.	CHIEF	Nthawa Location	Chief

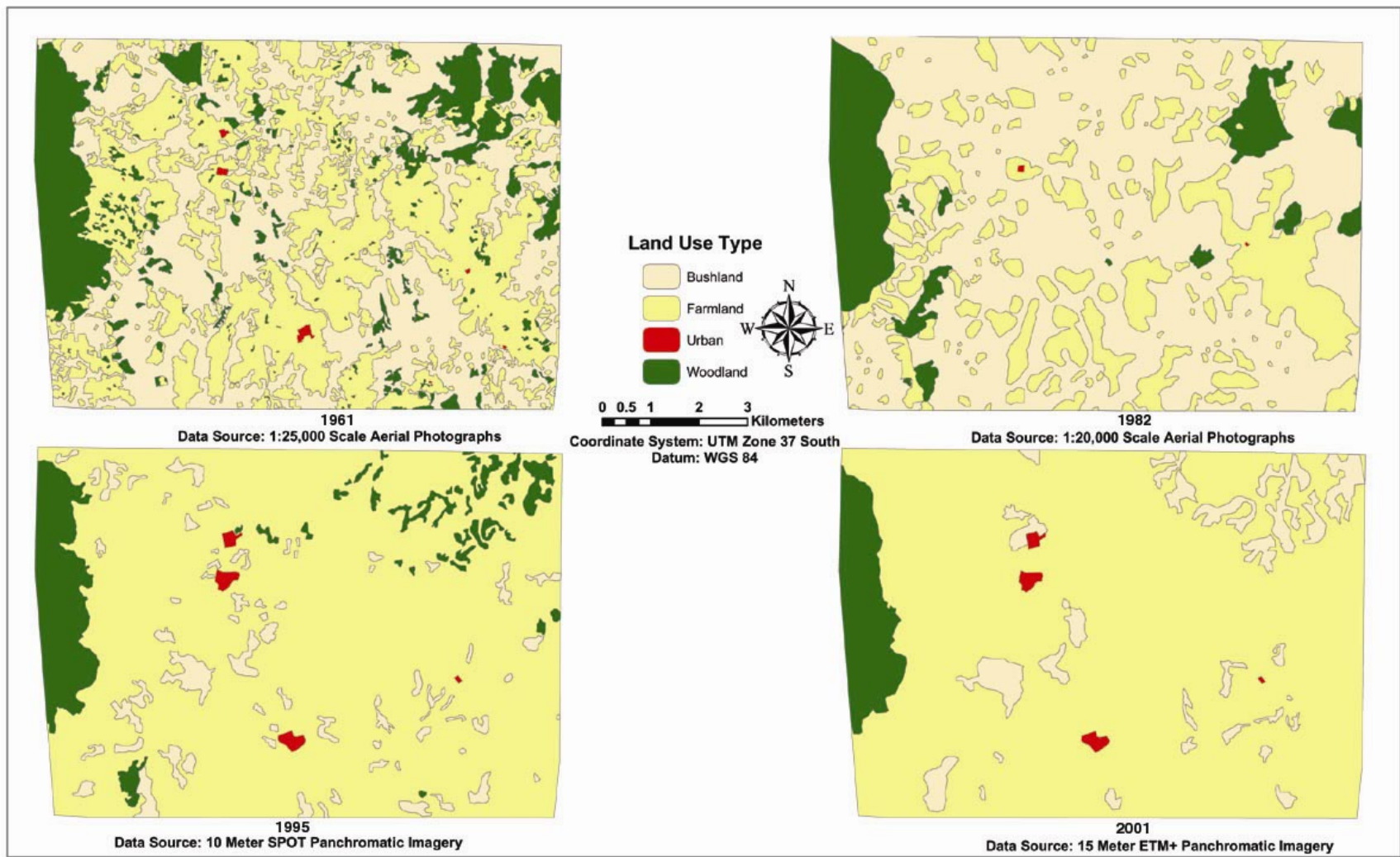
APPENDIX-4 Workshop Programme

Activity	Person responsible
1. Registration	Agric. Extension Worker
2. Opening prayers	Farmer
3. Introduction	Agric. Extension Worker and workshop organizers
4. Workshop Objective/ purpose	workshop organizers
5. Workshop methodology/ norms	Facilitator
6. Presentation	LUCID Project research team
7. Wrap up/ Evaluation	Facilitator and Farmer
8. Closing	Provincial Administration/ Agric Ext. Worker
9. Closing prayer	Farmer
10. Departure	

APPENDIX-5 Maps of land use change

Embu District (Ndunduri area) 1958 to 2001. Source: Olson et al. 2004





Mbeere District (Kiritiri area), 1961 to 2001. From Olson et al 2004.

APPENDIX 6. Participants' Major Responses in Table Form

KIRIARI, MANYATTA DIVISION, EMBU DISTRICT		
Statement/Questions	Response	Comments
Land Use Change		
The largest land use and cover change that occurred in the Mt Kenya region since the 1960's has been the expansion of cultivation from the higher elevation areas into the mid elevation then low elevation and most recently to the semi-arid bush	FALSE	<ul style="list-style-type: none"> * Cultivation started in Mid elevation and expanded into upper and lower elevations * Into upper elevation for grazing and cultivation during dry spell because of sufficient rainfall and to plant perennial cash crops such as tea and coffee * Into lower elevation due to population pressure & demand for food – areas had large land parcels to
The large-scale conversion from bush to farm land was precipitated by implementation of a land adjudication program of the national government, and sustained by rapid population growth due to high fertility rates and in-migration.	TRUE	<ul style="list-style-type: none"> * Adjudication fixed farm boundaries and discouraged shifting and fallow cultivation * Rise in population encourages land subdivision and intensive cultivation and bush clearing * Commercialization of farming and urbanization also increased bush clearing
Farmers have been forced to respond to changing economic circumstances by modifying their farming system. Coffee and tea prices declined precipitously and many farmers eventually removed their coffee bushes to plant other, remunerative (even less profitable) crops	TRUE	<ul style="list-style-type: none"> * Coffee cut back to plant bananas and passion fruits * Tea uprooted for settlement, to plant food crops, plant more profitable crops, reduce cold related diseases
Land shortage is seen as a major problem and rich families since the 1970's have been renting or purchasing land ever lower into semi- arid zones.	TRUE	<ul style="list-style-type: none"> * The practice is still continuing
Land shortage is also being addressed by measures to reduce dependency on land: farm families have focused their investments on their children's education since 1970's so that they learn a trade other than farming, many young people seek non-farm employment, their birth rates and population	TRUE	<ul style="list-style-type: none"> * Many young people learn pursue careers suitable for off farm employment. * Families getting smaller due to land shortage, economic hardships and death from diseases, accidents and drug abuse

growth rates have declined rapidly		
Landlessness and near landlessness: Is it increasing and how are people responding?		<ul style="list-style-type: none"> * Landlessness increasing. In response: * Schooling increasing to increase chances of off farm employment * Casual employment in tea farms * Migration towns in search of jobs * Family planning * Starting micro businesses * Intensification of farming
Richer families appear to put more manure, use fallow more, and use more fertilizers.	TRUE	* Improves soil fertility resulting in increased yields
One third of the families in the survey had husbands who are working elsewhere.	FALSE	<ul style="list-style-type: none"> * 80% for out migration increasing and 20% for out migration decreasing * Out migration important to supplement farm income * Out migrants imports agricultural technologies * Out migrants have better managed land * Out migration increases risk of death through diseases and accidents * Out migration decreasing because of scarcity of off farm jobs
Vegetation and Biodiversity		
Cultivation has reduced tree cover.	TRUE	<ul style="list-style-type: none"> * Increased tree felling * Tree planting not as profitable as crops * Land of knowledge in Agro forestry
Change from natural vegetation to cultivated land has links to decrease in indigenous plant species richness and diversity, and an increase in exotic plant species.	TRUE	* Some plants seen before bush clearing are not seen today
The changes stated above have altered function of indigenous ecosystems by reducing its ability to provide services like the support of unique wildlife, availability of wild resources like food plants, medicinal plants, and other traditional plant resources that are a product of long term evolution of the ecosystems	TRUE	* Fewer wild animals, wild resources of plants, medicinal plants, other traditional plant resources due to loss of natural habitat of animals and selective weeding in favour of desired plants/crops
There is decrease in species diversity in monoculture as compared with polyculture systems	TRUE	<ul style="list-style-type: none"> * Quality expectations in monoculture encourage clean weeding in these systems * Other monocultures do not like shade and are affected by root borne disease from trees.
Land degradation has led to an increase in crop diversity.	FALSE	<ul style="list-style-type: none"> * Degradation limits number of crops * Level of knowledge of soil management

		is more important than crop diversity in determining number of crops * High fertility encourages high crop diversity
Decrease in species richness is linked with increase in soil erosion and loss in soil fertility. Reduced plant cover has resulted in increased soil erosion and loss of soil fertility	TRUE	*More plant species are found in less eroded soils * Top soil removal and leaching favour species that can withstand low fertility and those that access leached nutrients
Reduction in vegetation cover has reduced the availability of water for domestic uses, livestock, and wildlife.	TRUE	* Examples were cited to support statement e.g. Kamuthengi river has almost dried up
Cultivation increases herbaceous vegetation without increasing species diversity.	TRUE	* Comparison between species diversity in a grazing field and a cultivated field was used to support response
Soil Degradation		
What are the signs of declining soil fertility (farmers' indicators of soil nutrient deficiency) in Embu?		*Low yields * Weak stunted plants * Appearance of some weeds/plants * Soil erosion features * Soil colour changes towards brown * Soil becomes compacted and hard to till *Plants turn yellow *Failure of crops to flower
What are some of the causes of soil declining fertility?		* Soil erosion * Overgrazing * Cultivation on steep slopes * Continuous cultivation * No soil and water conservation measures * Deforestation * Reduced soil cover * Limited use of compost manure
What strategies do farmers use to cope with declining soil fertility?		* Terracing the farm like they used to do in coffee * Practice crop rotation * Use compost manure * Stop cultivating on steep slopes
Based on the Soil analyses, the Scientific indicators of soil nutrient deficiency in the Embu region included: * Nitrogen levels declining as demonstrated by yellowing of leaves and stunted growth and reduced yields *Declining levels of phosphorous as demonstrated by purpling of plant leaves and stems	TRUE	* As indicated by gullying on farms, yellowing of crops and purpling of plants

<p>*Declining levels of organic carbon leading to low moisture holding capacity</p> <p>*Potassium is adequate in the soils for general crops like maize but there was need to add more for vegetables and fruit trees as demonstrated by curling of leaves especially from the edges in these crops.</p>		
<p>SIAKAGO DIVISION, MBEERE DISTRICT</p>		
<p>Land use Changes</p>		
<p>The largest land use and cover change that occurred in the Mt Kenya region since the 1960's has been the expansion of cultivation from the higher elevation areas into the mid elevation then low elevation and most recently to the semi-arid bush</p>	<p>TRUE</p>	<ul style="list-style-type: none"> * Cultivation started in Mid elevation and expanded into upper and lower elevations * Into upper elevation for grazing and cultivation during dry spell because of sufficient rainfall and irrigation water, and to plant perennial cash crops such as tea and coffee * Into lower elevation due to population pressure & demand for food – areas had large land parcels to rent and buy
<p>The landscape of Mbeere has changed from one dominated by communally managed bush savannah and woodland to one almost completely covered by individual farms, if not all cropped</p>	<p>TRUE</p>	<ul style="list-style-type: none"> * Most Land adjudicated but little crops cultivated and for reasons: * Some people own large or several land pieces- no facilities to cultivate big portions * Labour a problem * Some Land not arable * Small children owned land * Poverty * Prohibition of cultivation in existing clan land
<p>Indeed, these areas are the poorest despite low population densities, and many husbands and adult children have left the family farm to search for other sources of income. Half of the families in the survey had husbands who were working elsewhere</p>	<p>TRUE</p>	<ul style="list-style-type: none"> * Out migration of husbands and children important for reasons: * Farm incomes low and out migration supplements income * No industries in Mbeere * Increasing poverty and frequent crop failures * Families with outmigrants had better managed farm lands * Out migration increases risk for death through diseases and accidents * Level of land management depends on cooperation between wife and husband
<p>Land shortage is a problem among some families.</p>	<p>TRUE</p>	<ul style="list-style-type: none"> * Few have small land pieces * Such people hire or purchase land

Wealthy farmers since 1970's have been renting or purchasing land ever into semi-arid zones.	TRUE	* Practice still continuing * The rich people from outside Mbeere and their farms are better than locals
The semi- arid zones appear to be in danger of worsening soil degradation due to expansion of cropping into environmentally fragile and climatically risky areas	TRUE	* Soil degradation getting worse for reasons: * Reduced rainfall overtime * Over dependence on inorganic fertilizers * Continuous cropping * Deforestation * Poverty
Richer families appear to put more manure, use fallow more, and use more fertilizers	TRUE	* This improved soil fertility and yields and reduced chances of crop failure
Overgrazing- a problem, getting worse and where?		* Over grazing a problem in Lower areas of Mbeere where animals are open grazed
The only large areas remaining of natural vegetation types are in protected areas or on rocky, steep hills, but even there many of the woodlands have been cleared or thinned.	TRUE	* For reasons: * For charcoal and timber * Burning to reduce tick populations * Poverty * All land on steep and rocky places will one time be cultivated because population pressure
There is a large amount of bush in lower Mbeere not cultivated (near KenGen land).	TRUE	* Land adjudicated and owned by TARDA * Land uncultivated because area dries faster than upper areas
What might be the future sources of income in this area? What might happen to cotton, goats, irrigation, any new crops?		Possible sources of future income: * Extension of cultivation * Growing cotton, keeping more goats * Growing mangoes and pawpaws under irrigation * Dry land rice farming
Vegetation and Biodiversity		
Land use change is reducing the extent of natural vegetation cover and as a result there is loss of natural plant resources like medicinal plants, wild food plants and other economically useful plant resources.	TRUE	* Natural plants loss and strategies to address problem: * Re-afforestation on farms * Stop bush burning * Protect remaining plants * Replace exotic with indigenous plants * Increase awareness on native plants usefulness
One reason for the loss in natural vegetation is charcoal burning and cutting of trees for posts	TRUE	* It is getting worse * Strategies to address problem: * Enforcement of relevant law * Plant more trees * Using Cheaper /alternative sources of energy, and energy conservation techniques

		<ul style="list-style-type: none"> * Increased security on forests * Collective action in protecting vegetation
Removal of vegetation from the farm makes the land poor. This is true even for crop residues like remains of maize, millet, and others that are used for livestock feeds. Many farmers collect these residues from their farms and sell them to buyers who take them to their farms which in many cases are outside Mbeere. In so doing, they rob their farms of many essential nutrients thereby rendering their farms poorer	TRUE	<ul style="list-style-type: none"> * Reasons for vegetation movement: * Poverty * Low understanding of its usefulness * Short term gains * Carelessness and ‘don’t care attitude’ <p>To address problem;</p> <ul style="list-style-type: none"> * Create jobs in Mbeere and improve economy * Put more effort in farming * Farmers follow agricultural officers instruction
Cultivation along rivers, wells, and water catchment areas is found to be taking place and it is increasing overtime. This is causing shortage of water for people, livestock and wildlife.	TRUE	<ul style="list-style-type: none"> * Need to stop practice because it is drying rivers and benefiting a few- not sustainable. To address problem; * Plant more trees in affected areas * Enforce relevant laws * Teach community on relevant laws * Initiate collective action
The African tradition of conserving forests or vegetation in sacred places has been abandoned leading to cultivation and tree cutting in the sacred places	TRUE	<ul style="list-style-type: none"> * Example of ITITU forest used to explain response * Leading to deforestation, land degradation, species loss vegetation cover loss
Soil Degradation		
What are the signs of declining soil fertility (farmers’ indicators of soil nutrient deficiency) in Mbeere?		<ul style="list-style-type: none"> * Low yields * Weak stunted plants * Appearance of some weeds/plants * Soil erosion features * Soil colour changes towards brown * Soil becomes compacted and hard to till * Plants turn yellow * Failure of crops to flower
What are some of the causes of soil declining fertility?		<ul style="list-style-type: none"> * Soil erosion * Overgrazing * Cultivation on steep slopes * Continuous cultivation * No soil and water conservation measures * Deforestation * Reduced soil cover * Limited use of compost manure * Burning of crop residues * Selling out crop residues and manure * Inappropriate cultivation methods-

		shallow tillage
What strategies do farmers use to cope with declining soil fertility?		<ul style="list-style-type: none"> * Stop residue burning * Terracing the farm and maintain terraces * Practice crop rotation * Use compost manure/FYM manure * Stop cultivating on steep slopes
<p><i>Based on the Soil analyses, the Scientific indicators of soil nutrient deficiency in the Mbeere region included:</i></p> <ul style="list-style-type: none"> * Nitrogen levels declining as demonstrated by yellowing of leaves and stunted growth and reduced yields *Declining levels of phosphorous as demonstrated by purpling of plant leaves and stems *Declining levels of organic carbon leading to low moisture holding capacity *Potassium is adequate in the soils for general crops like maize but there was need to add more for vegetables and fruit trees as demonstrated by curling of leaves especially from the edges in these crops 	TRUE	* All the signs found in farms in Mbeere