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Land Use Change, Impacts and Dynamics



Biodiversity in Agricultural Productive Systems

LUCID WORKING BRIEF 3

Biodiversity in agricultural productive systems of east Africa is changing very rapidly. Natural habitats are being converted into cultivations and the remaining areas are under severe competition between livestock grazing and wildlife conservation. Within the already cultivated areas land use is intensifying more and more due to land subdivisions and the need to diversify production. Many woodlands and forests without enforced protection status have been reduced in size and/ or their vegetative cover has diminished (fig. 1). They have either been converted to pasture for grazing, to fields for rainfed agriculture, or their woody plants have been extensively cut for charcoal production. These changes are taking place without considerations of their effects on key elements that sustain production. One such element is biodiversity and natural resources in general.

Over the last 50 years land use change in east Africa has been characterized by two major processes:

- Extensification of cultivation especially in the semiarid areas and
- Intensification of production especially in the humid and sub-humid zones.

These changes have affected the composition and distribution of plant and animal species across the landscape. In the semi-arid areas where land use extensification has been the major trend, all types of natural ecosystems have shrunk and agro-ecosystems including modified grazing lands have increased. In these lower altitude areas expansion of cultivation has focused mainly on the unique ecosystems like swamps and flood plains, thickets, riverine forests and fertile areas in the rangelands.

Key Questions

1. What role(s) should the different actors (scientists, donors, governments, Civil Societies, Communities) play in addressing issues of biodiversity change and development?
2. Where and when should we try to maintain biodiversity on-farm or in agro-pastoral systems? How?
3. How can decisions about who gets access to key resources, such as water, be made?

Trends and issues:

Some of the main observations of land use change with implications on biodiversity include:

1. **Reducing complexity, diversity and distribution ranges of all ecosystems due to habitat fragmentation.** As cultivated areas expand the continuum of natural ecosystems fragment into smaller patches reducing the diversity of ecosystems and the species found in them (figure 1). In Amboseli for example, land use change has resulted into significant impacts on the composition and spatial distribution of the large herbivores. It has cascading effects on biodiversity and ecosystem resilience and alters fundamentally the interaction between local people and their environment (WP 41 page 7-8)
2. **Reducing biodiversity of key species of conservation concern and an increase in numbers of more common species, due to conversion of natural vegetation into agro-ecosystems** (figure 3). As the natural vegetation is replaced by croplands, key species migrate or are made locally extinct giving way to the more common species (largely herbaceous weeds and pests). Clearing of natural habitats for cultivation at moderate levels increases the diversity of plant and small mammal species (figure 2) due to the increase in habitat diversity. However, as land use further intensifies, species diversity decrease as habitats start to simplify into large blocks of cropland without intermittent patches of native vegetation (WP 42, pgs 16, 17).

3. **Increasing conflicts between herders, cultivators and conservationists.** Increasing livestock-crop conflict is a major problem in most areas especially around national parks and gazetted forests where there is rapid encroachment by cultivators (WP 47 pg 7) (WP 14 part 2 see map). In particular, due to fewer watering points and dry season pasture points, there are frequent cases of livestock trampling and grazing on crops. In Kajiado the proportion of respondents reporting conflict with wildlife increased from 32% in 1977 to 75% in 1996 (WP 18 pg 10). The problem has worsened over the past five years with the main trouble animals being antelopes, porcupines and hyenas.
4. **Reduced accessibility to key resources in grazing areas, and wildlife movement corridors.** With individualization of land ownership in many areas (e.g., Tharaka district in Kenya), land for free range grazing has reduced. Hence the number of livestock kept has significantly dropped. Most affected are goat holdings which showed significant drop. For example in Tharaka, in 1979, 56% of farmers had more than 10 goats while in 2001; only 12% of farmers had more than 10 goats. Farmers reported that the parcels of public land that were set aside during adjudication are insufficient to provide additional land for grazing during drought periods (WP 11 pg 21)
5. **Moderate grazing preserves biodiversity better than in crop cultivation.** Pastures with moderate grazing support more plant species than un-grazed pastures. Some of the new species in grazed areas are weeds, but the majority are native plants. Pastoral areas are the only places outside protected areas that are still rich in large wild native plant and animal species. There were 50% more plant species, a higher diversity and a more even distribution of species in grazed than in un-grazed sites in Embu, Kenya (WP 42 pg10).
6. **Farms with many crops conserve native plant species better than those with only one crop.** It was observed that species diversity was low in monoculture and high in poly-culture systems. Single cash crops demand more intensive land management compared to mixed cropping grown mainly for subsistence by farm families (WP 42 pg 12)
7. **As native vegetation is lost, indigenous plant and animal biodiversity and plant cover are lost.** Many indigenous species, products of long-term evolution of these ecosystems, do not tolerate heavy land use by farmers, grazers and settlers. Indigenous plant species decline whereas exotic and common species increase. This means that availability of wild resources that people value, like food plants, medicinal plants, and other traditional plant resources is declining. Indigenous wildlife species have become fewer and fewer (WP 42. Pg 10).
8. **Erosion has been on increase.** Soil erosion has been on the increase in all the areas studied besides the efforts to contain it. Yields from the cultivated land have been decreasing, and food insecurity creeping in fast with some households becoming more vulnerable to food insecurity. The people in the study areas respond to these effects by migrating to other areas in search for food, water and areas to farm (WP 42 pg 25; WP 9 Pg 5; WP10 Pg 11).
9. **Reducing availability of pasture and fodder.** Livestock also fall victims of the changes in land use, pastureland has declined while unpalatable species for livestock are fast growing in some places. Acute water shortage has severely affected livestock and humans such that there is a fierce competition for water from humans, livestock and wildlife (42 Pg 13; 36 Pg 8).
10. **Increasing competition for reducing key resources.** As competition for the available resources continues, there have been rising levels of human-wildlife conflicts. Despite intensive efforts at community involvement in wildlife management, 75% of herders and 90% of farmers reported problems with wildlife (WP 18 Pg 5). Eating and trampling of crops were the most frequently reported problems. Predation, damage to property and personal injury were also reported. Much of this conflict is attributed to extending of cultivation to areas that had been the preserve of wildlife.

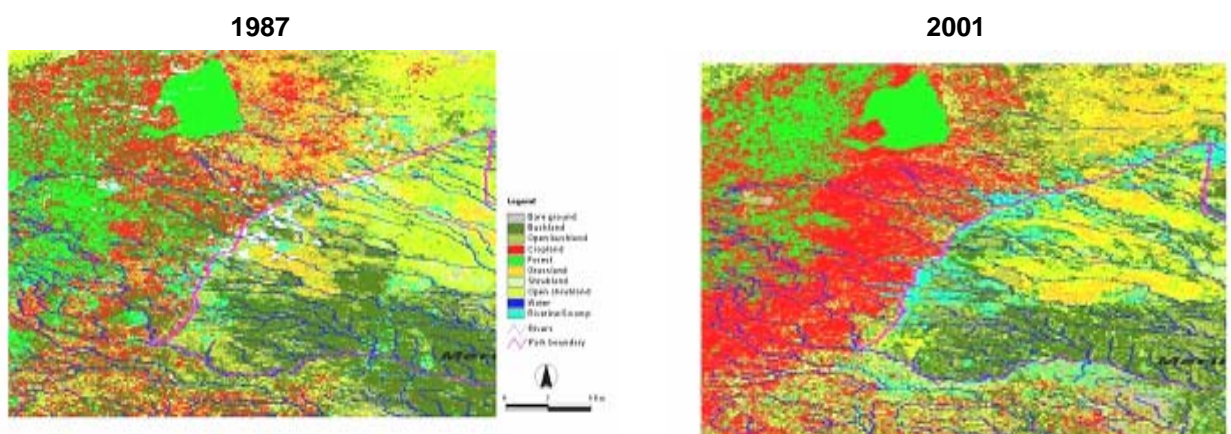


Figure 1. Land Cover Changes Along Meru Park (WP 39)

Red = Cropland; Green = Forest; Dark Green = Bush; Yellow = Grassland

Brief summary on changes

1. **Conversions of natural vegetation** lost 19% of natural vegetation to agriculture between 1987 – 2000 WP 37 pg 8
 - a. Mt Kilimanjaro – the forest cover decreased from 194.4 km² to 156.8 km² between 1952 – 2000. WP 30 pg 17 and 19
 - b. Medicinal plants declined in abundance in Mt. Kilimanjaro (Machame area). WP 38 pg 11
 - c. Bush and scattered trees in the wildlife corridors decreased from 7067 ha to 2631 ha between 1952 – 2000 WP 31 pg 13
2. **Species extinction**
 - a. Uganda is known to be losing biodiversity at the rate of 10% per decade. This is particularly high in savannas where they are reaching 20%. WP 12 pg 1
 - b. Vegetation change and bush meat poaching has led to local extinctions of some precious common herbivores and carnivore species in Mbeere district. e.g., the rhino, lions etc. WP 37 pg 7-9
 - c. Loss and decline in the distribution of medicinal plants in Kajiando district over a period of 10 years. Report 19 pg 19-20
 - d. Elephants and Sitatunga are locally extinct from Rubaale area in Uganda. WP 12 pg 6-7
 - e. Extinction of the rhino from the Kilimajaro Kitendeni corridor. WP 31 pg 26-27
3. **Species declines**
 - a. Decline in lions, leopards and ostrich numbers in Kitendeni wildlife corridor between 1960-2001. report no. 31 pg 26-27
 - b. Decline in browser species giraffe and gerenuk in the lower Amboseli national park due to habitat change. WP 27 pg 12
 - c. Diversity of bird species has reduced in cultivated areas in Lake Mburo national park in Uganda. WP12 pg 9

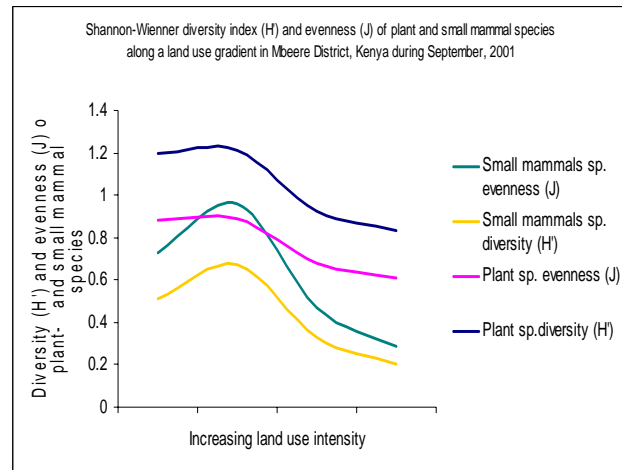


Figure 2. Impacts of land use intensification on plants and small mammals. Mbeere - Kenya (WP 8)

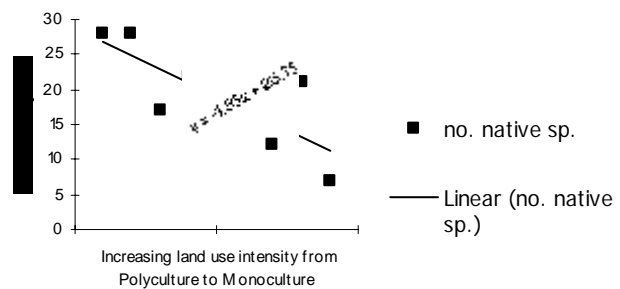


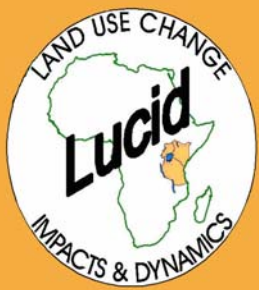
Figure 3. Effects of Crop intensification on native plant species. Embu - Kenya (WP 32)

Summary Implications

The overriding finding of the LUCID land use changes analysis is that there has been rapid increase in cultivation of crops and a corresponding decrease in areas used for livestock and wildlife grazing especially in the semi-arid zones of East Africa. New land use types have been adopted and existing ones transformed. These changes have had a number of implications such as:

- Increased poverty of the pastoralists;
- Increased grazing intensity, thereby leading to land and pasture degradation;
- Decreased biodiversity;
- Insufficient water to meet domestic, irrigation, livestock and wildlife needs;
- Human-wildlife conflict; and Water pollution.

In order to address these problems, there is need to determine how biodiversity can be increased on-farm and in agro-pastoral areas and mechanisms for equitable sharing of key resources among different land users.



LUCID is a network of scientists who have been studying land use change in East Africa and its implications for land degradation, biodiversity, and climate change for many years.

Data collection methods include Remote Sensing (RS) and Geographic Information Systems (GIS), vegetation surveys, soil sampling, wildlife counts, household surveys, group and individual interviews, and literature reviews.

Major institutional partners include the International Livestock Research Institute (ILRI) in Kenya, the University of Dar es Salaam in Tanzania, Makerere University in Uganda, the University of Bordeaux 3 in France, and Michigan State University in the USA

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Water Resources

The study also established that increased intensity of land use in wetlands is one of the critical recent changes that have implications for sustainability of wetland resources. The irrigation systems in these fragile ecosystems have:

- Disrupted the pre-existing distribution and mobility of herding of livestock and wildlife movements;
- Affected access to water resources for people, livestock and wildlife;
- Reduced water quality and quantity for many users; and

Increased socio-economic disparities by concentrating economic benefits to a few who can access the water.

In order to reduce this problem, there is need to direct attention on the issues of water quality, quantity, flow and distribution. How can the scarce water resources available be shared among the land users such that their different productive systems are sustainable?

Human-wildlife conflict

The importance of wildlife in tourist attraction and thus foreign exchange earnings cannot be overemphasized. The study reported rising human-wildlife conflict in various parts of the study area. This arises due to settlement of people in areas that have hitherto been used by wildlife for grazing and watering. What steps can governments take to reduce the conflict without compromising on the poverty reduction goals? One issue that should be looked into is active participation of local communities in wildlife management. A system may need to be developed based on the current Community Based Wildlife Management (CBWM) programme that will besides ensuring that local communities benefit from wildlife, reflect that complexity of ecological systems, human systems and their interactions. In addition, there is also need to develop clear land use policy that will substantially reduce the conflict.

References

- WP 8: Mbugua, S., 2002. Influence of land use patterns on diversity, distribution and abundance of small mammals in Gachoka Division of Mbeere District, Kenya.
- WP 10: Gachimbi, L., 2002. Technical report on soil survey and sampling: Loitokitok Division, Kajiado District, Kenya.
- WP 11: Smucker, T. 2002. Land tenure reform and changes in land use and land management in semi-arid Tharaka, Kenya.
- WP 12: Pomeroy, D., *et. al.* 2003. Linkages between changes in land use land degradation and biodiversity in S.W. Uganda.
- WP 14: Mugisha, S., 2002. Root causes of land cover/use change in Uganda: An account of the past 100 years.
- WP 18: Campbell, D., 2002. Interactions between People and Wildlife in S.E. Kajiado District, Kenya.
- WP 19: Campbell, D., *et. al.*, 2003. Root causes of land use change in the Loitokitok Area, Kajiado District, Kenya.
- WP 27: Worden, J., *et. al.* 2003. Land-Use Impacts on Large Wildlife and Livestock in the Swamps of the Greater Amboseli Ecosystem..
- WP 30: William, Christopher M. 2003. The Implications of Land Use Change on Forests and Biodiversity: A Case of the "Half Mile Strip" on Mount Kilimanjaro, Tanzania.
- WP 31: Noe, Christine. 2003. The Dynamics of land use changes and their impacts on the wildlife corridor between Mt. Kilimanjaro and Amboseli National Parks, Tanzania.
- WP 32: Maitima, J., *et. al.*, 2004. The linkages between land-use change, land degradation and biodiversity in Embu – Mbeere
- WP 37: Chira, Robert. M. 2004. Changes in Wildlife Numbers and Conservation in Embu and Mbeere Districts, Eastern Province, Kenya.
- WP 38: Misana, S., *et. al.*, 2003. Linkages between Changes in Land Use, Biodiversity and Land Degradation on the Slopes of Mount Kilimanjaro, Tanzania.
- WP 39: Otuoma, John. 2004. The Effects of Wildlife-Livestock-Human Interactions on Habitat in the Meru Conservation Area, Kenya.
- WP 41: Tukarhirwa, J., 2004. Land Use Change-Associated Deterioration in Soil Quality in Uganda: A Case Study from Sango Bay, Lake Mburo National Park Area and Kabale/Ntungamo Districts Border Area.
- WP 42: Maitima, J., *et. al.*. 2004. The Linkages Between Land Use Change, Land Degradation and Biodiversity Across East Africa.
- WP 47: Olson, J., *et. al.* 2004. The Spatial Patterns and Root Causes of Land Use Change in East Africa.

This brief was prepared under the "Land Use Change Analysis as an Approach for Investigating Biodiversity Loss and Land Degradation" project funded by UNEP-GEF and other donors.

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