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Land Use Change, Impacts and Dynamics

ARID AND SEMI-ARID AGRO-PASTORAL SYSTEMS IN TRANSITION

LUCID WORKING POLICY BRIEF # 2

Agro-pastoral livelihood systems in Arid and Semi-Arid Lands (ASAL) are in flux. In the past 100 years, herding systems in East Africa have experienced chronic pressure to alter their land use pattern as a consequence of multiple forces including government policy towards livestock, farming, and wildlife; in-migration and population growth; encroachment of crop agriculture; civil strife; a governmental cultural bias against herders who were viewed as resistant to economic development; and extreme environmental circumstances, particularly droughts and floods. Meanwhile many farmers are recent migrants to ASAL and have had to adapt their cultivation systems in the face of recurrent drought, changes in access to water, rainfall variability and, in some areas, declining soil productivity.

Livelihood systems in ASAL are robust. They are characterized by flexibility that enables them to adapt to changes in socio-economic and environmental conditions, and by diversified economic options that reduce risk, a fact of life in ASAL where variable rainfall and recurrent drought affect food security. The number and intensity of some of the changes in local and external economic, social, demographic, environmental and political conditions over the past 30 years have tested the robustness of livelihood systems. Their most persistent challenge is to maintain access to land and water resources of sufficient quality and quantity to sustain the population from season to season and year to year.

Key Questions

1. Where, and when is cropping more profitable than livestock?
2. What are the key processes underlying changes in the ASAL regions?
3. Which changes are making the regions less vulnerable to drought and poverty? Which are making them more vulnerable?
4. How can policy best address underlying processes to promote sustainable and equitable productivity of both livestock and cropping systems, particularly given the recurrence of drought?

Trends and Issues

1. Competition over Access to Perennial Water. In ASAL sources of perennial water are scarce. Critical to the sustainability of livestock based livelihoods is access to sufficient water and pasture at critical periods - during the annual dry seasons and recurrent droughts. During wet seasons, herders disperse their livestock over wide areas of savannah landscapes, while in dry seasons and droughts they retreat to mountain slopes and to riverine and swamp areas in the lowlands where water is available perennially. Wildlife follow a similar pattern.

Meanwhile such well-watered areas are the focus of the expansion in crop production. The largest conversion of land use in the LUCID study sites was the expansion of rainfed agriculture at the expense of grazing land. Such conversion began in the 1930s, expanded slowly in the 1950s and accelerated after Independence.

The rate of expansion appears to be slowing in many areas (e.g., around Mt. Kilimanjaro on both the Kenyan and Tanzanian sides, and on the eastern slopes of Mt. Kenya) where the frontier of conversion is now in drought-prone land, but elsewhere the expansion of agriculture has either not yet slowed (e.g., Lake Mburu in Uganda), or the conversion has not yet occurred (e.g., the predominately pastoral sites of Sango Bay and Kabale/Ntungamo in Uganda).

Competition over access to water between and within land use systems, especially between cropping, and livestock and wildlife, is widespread. This has led to privatisation of some water resources such as along streams or in swamps for cropping, reducing the amount and the quality of water for livestock, wildlife and household use.

Droughts as catalysts of change

Drought is recurrent in ASAL, occurring every 10-15 years. The potential impact has increased as the number of residents of ASAL has grown, and as access to key resources has become more competitive. During droughts, farmers and herders maintain a range of coping strategies including mobility and diversity of income sources. Droughts have been a catalyst of fundamental change, particularly where antecedent conditions have increased people's vulnerability.

When combinations of driving forces are active, such as rapid in-migration, loss of access to water and grazing, and implementation of a different policy framework, droughts have pushed livelihoods over thresholds in their capacity to cope (Fig. 1). Droughts became tipping points to fundamentally different livelihoods. Past droughts have triggered some pastoralists to adopt rainfed and irrigated cropping, migrate to towns, or invest in children's education to reduce dependency on herding.

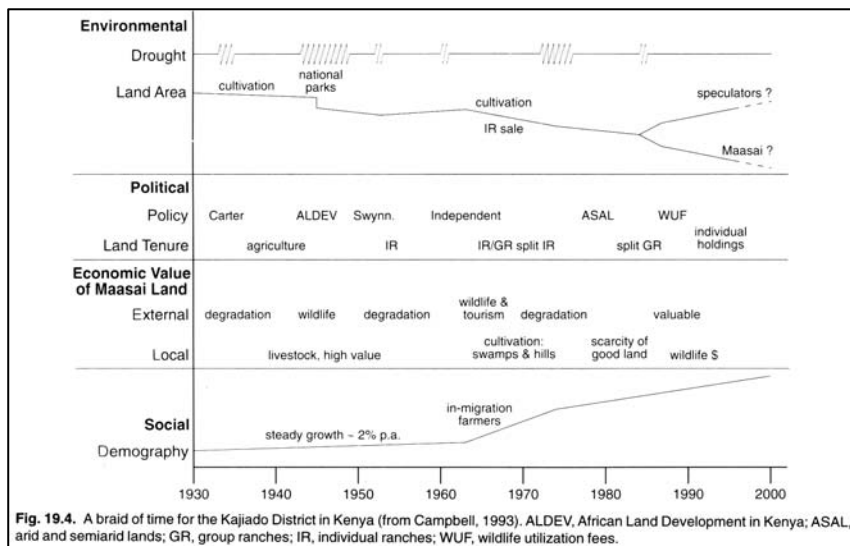


Fig. 19.4. A braided time line for the Kajiado District in Kenya (from Campbell, 1993). ALDEV, African Land Development in Kenya; ASAL, arid and semiarid lands; GR, group ranches; IR, individual ranches; WUF, wildlife utilization fees.

Figure 1. Time Line of Significant Events and Processes in the Loitokitok Area , Kajiado

2. **Reduction in economic viability of pastoralism?** A variety of factors has threatened the viability of extensive livestock production. These include the encroachment of farming reducing access to dry- season water and grazing resources, the demarcation of national parks that enclosed perennial water and grazing, and highly variable rainfall and severe droughts. In addition, civil strife has disrupted livelihoods, altered access to land, and dislocated marketing systems.

The relatively high profitability of the cropping systems that have encroached upon traditional herding resources has resulted in in-migration by

non-herders, and many herders settling and diversifying into farming. Others continue their extensive herding systems and where civil strife has occurred, as in Uganda, systems are under reconstruction and adjusting to altered socio-economic and political conditions.

Where herders have diversified into farming they have become more sedentary, and their home herds tend include more sheep and goats and fewer cattle. There is evidence from the Loitokitok case study in Kenya that those who remain in the traditional herding economy are poorer than those who have successfully diversified into farming (WP 1, 14, 17, 19, 20, 25, 44, 47).

3. Land tenure as a driving force of change

The increase in the area under cultivation, both rainfed and irrigated, has been facilitated by changes in land tenure policy, both official and customary. The general trend has been towards land privatisation, and fragmentation of former communal holdings. For example, former agro-pastoralists in lower parts of Mt. Kenya such as Mbeere and Tharaka have been confined to family plots following land adjudication. This has resulted in bush clearing and a change in land use from animal grazing to cropping. Continuous cropping has led to signs of rapid soil degradation. The number of livestock, especially goats, kept per family have significantly dropped. In 1979, 56% of farmers had more than 10 goats while in 2001, only 12% of farmers had more than 10 goats. The public land parcels set aside for grazing during adjudication are insufficient particularly during droughts (WP 11, 20, 47).

In Kajiado immigrant farmers settled initially under informal arrangements with members of group ranches. Fears that younger members of group ranches (GRs) would be deprived of land rights, led to calls for subdivision of GRs to individual ranches by 1980.

The profitability of farming in wetlands furthered this impetus to subdivide. Many GRs are now subdividing and herders are becoming herder-farmers alongside the immigrants. These changes in land tenure are affecting who has access to what land resources, such as along streams and in wetlands, dry season grazing, and wildlife migration corridors. These changes impact how livestock are raised, wildlife viability, and have social effects regarding the distribution of resources (WP 7, 19).

4. Impact of Other Past Policies.

More gradual if similarly influential government decisions have affected land use such as: regional and temporal variations in government investment in road infrastructure, agricultural extension, primary education and health care. Non-policy impacts of government such as civil unrest and corruption have also had major impacts on land use, particularly by affecting agricultural and non-agricultural economic costs and opportunities, and migration (WP 44, 47).

5. Rainfed and Irrigated Farming have extended into ASAL over the past 40 years.

Under certain conditions of rainfall amounts, soil conditions, and availability of transportation, land and labour, economic returns to cropping have been shown to be higher than economic returns to livestock in ASAL. This has driven a large expansion of rainfed cultivation into former grazing areas - the largest land use conversion observed in the LUCID sites.

However, many of the fields are not intensely cultivated. The crops are of low value, and risks of drought and pests are high. The cropped land in ASAL is experiencing rapid soil degradation. Indeed, there are signs of farmers switching to crops more tolerant of degraded soils, and the rate of expansion of cropping into semi-arid zones has slowed in the Kenyan and Tanzanian study sites. Poverty is severe among many of those dependent on rainfed cropping in ASAL. Out-migration by husbands seeking off-farm work in some zones, such as Mbeere, reaches over 50% (WP 8, 9, 19, 20, 38).

Concurrently, the amount of land under irrigation has grown rapidly due to high returns. In the Kajiado, Kenya site, for example, irrigated land expanded from 245 to 4768 hectares between 1973 and 2000 (Figure 2), and in the Kilimanjaro/Tanzania site from 336 to 4078 hectares during the same period.

The source of the water is usually rivers or swamps except for the sugarcane plantation in Kilimanjaro/Tanzania, which uses water being pumped from pumped from aquifers. The crops are destined for both national and export markets. Some of these high input systems have been developed by large scale producers from outside the area or by the government, while others by wealthy locals. The benefits are often concentrated in a few hands, however, and the environmental impacts especially on water quality and quantity are already negative in some areas. Water sources for livestock, wildlife and people have become scarcer (WP 19, 35, 44, 49).

6. Impacts of the Changing System

- a. **Pastures.** The influence of livestock on biological resources is through the reduction of above ground biomass and cover, and through enhancing plant species diversity through the dispersal of seeds in their manure. The LUCID study results indicate that livestock grazing enhances plant species diversity richness at a local scale by providing opportunities for increaser (common) species to establish. Conversely, grazing decreases diversity at a regional scale by removing the most grazing- sensitive decrease (rare) species.

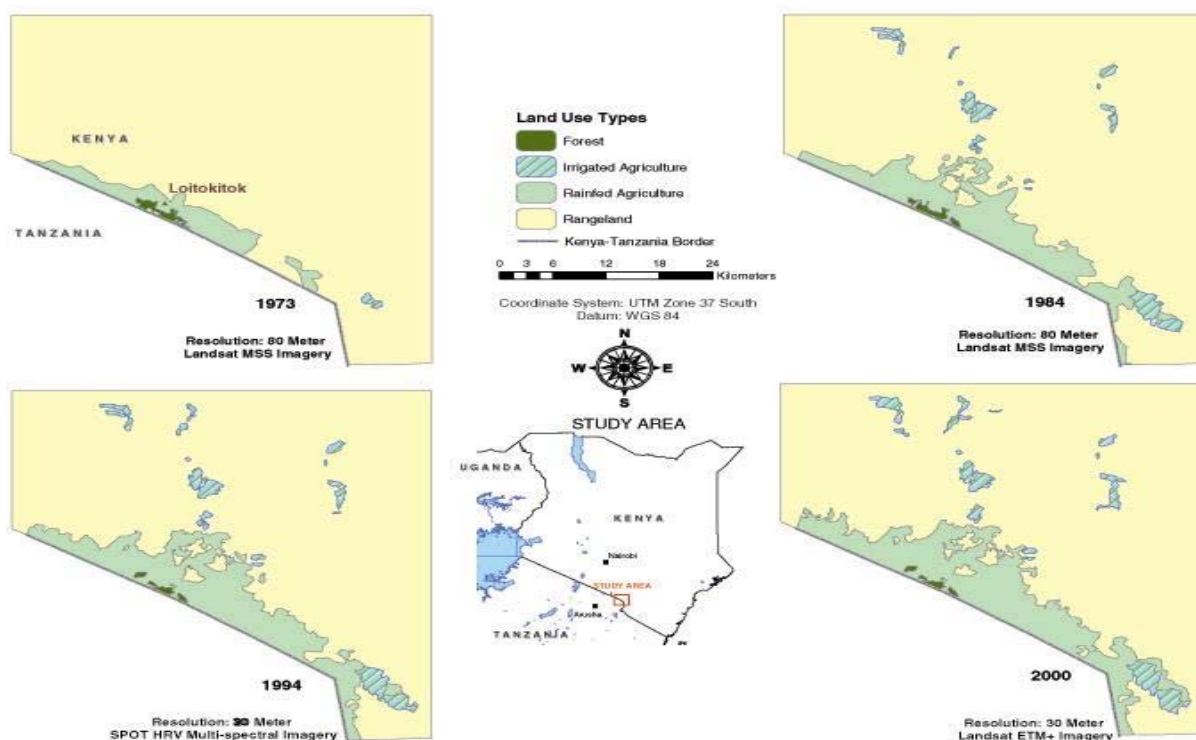
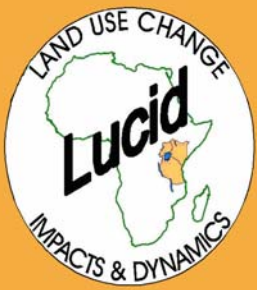


Figure 2. Land Use in 1973, 1984, 1994 and 2000 in the Loitokitok area, Kajiado District, Kenya



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

CONTACTS:

Joseph M. Maitima
International Livestock
Research Institute
P.O. Box 30709
Nairobi 00100, Kenya
Email: j.maitima@cgiar.org
Tel. +254-20-4223000
Fax. +254-20-4223001

Jennifer M. Olson

International Livestock
Research Institute

And, Department of
Geography

Michigan State University
East Lansing MI 48824
USA Tel: +1-517-432-9998

Email: j.olson@cgiar.org
and olsonj@msu.edu

Also, areas where grazing has ceased have been invaded by woody plants. Grazing of adequate frequency and intensity plays an important role in maintaining diversity of the rangelands. In the absence of grazing, shrubs gradually replace grasses.

Land use change from bush to open grazing tends to reduce organic carbon content, soil moisture, pH, bulk density and nitrogen. This does not appear to affect forage productivity until grazing intensity reaches a certain level. Continuous grazing is apt to have a negative impact on soil, forage production and plant diversity (WP 36, 42).

b. Human-wildlife conflict. As competition for the available resources continues, there have been rising levels of human-wildlife conflict. This includes injury and loss of life, and crop damage. Many farmers have responded by fencing land. With increased individual tenure, the impact of fencing upon livestock management, and upon wildlife dispersal, will increase (see LUCID Working Brief 3) (WP 18, 35, 49).

c. Impacts of expansion of cropping on social systems. The land use conversion has led to higher land productivity per hectare but these gains are offset by the reduced productivity of livestock and wildlife systems. The people who are gaining may thus be different from those who had depended on the resources in the past. Competition over limited grazing and, increasingly, over water is of critical concern (WP 17, 19, 25, 47). *Continued on Page 5*

References to Lucid Working Papers

- WP 1: Campbell, D. 1999. Response to drought among farmers and herders in Southern Kajiado District, Kenya: A comparison of 1972-1976. *Human Ecology* 27, 3: 377-416.
- WP 9: Gachimbi, L. 2002. Technical report on soil survey and sampling: Embu - Mbeere Districts, Kenya.
- WP 10: Gachimbi, L. 2002. Technical report on soil survey and sampling: Loitokitok Division, Kajiado District, Kenya.
- WP 14: Mugisha, S. 2002. Root causes of land cover/use change in Uganda: An account of the past 100 years.
- WP 17: Tukahirwa, J. 2002. Policies, people and land use change in Uganda: A case study in Ntungamo, Lake Mburo and Sango Bay sites..
- WP 19: Campbell, D. *et al.* 2003. Root causes of land use change in the Loitokitok Area, Kajiado District, Kenya.
- WP 20: Olson, J. *et al.* 2003. Multi-scale analysis of land use and management changes on the Eastern Slopes of Mt. Kenya.
- WP 23: Wangui, E. 2003. Links between Gendered Division of Labour and Land Uses in Kajiado District, Kenya.
- WP 25: Mbonile, M *et al.* 2003. Land use change patterns and root causes of land use change on the southern slopes of Mount Kilimanjaro, Tanzania.
- WP 26: Majule, A/ 2003. A study on land use types, soils and linkage between soils and biodiversity along the slopes of Mt. Kilimanjaro, Tanzania.
- WP 31: Noe, C. 2003. The Dynamics of land use changes and their impacts on the wildlife corridor between Mt. Kilimanjaro and Amboseli National Parks, Tanzania.
- WP 34: Norton-Griffiths, M. and B. Butt. 2003. The Economics of Land Use Change in Loitokitok Division of Kajiado District, Kenya.
- WP 35: Githaiga, J. *et al.* 2004. Survey of Water Quality Changes with Land Use Type in the Loitokitok Area, Kajiado District, Kenya.
- WP 36: Kamau, P. 2004. Forage Diversity and Impact of Grazing Management on Rangeland Ecosystems In Mbeere District, Kenya.
- WP 38: Misana, S. 2003. Linkages between Changes in Land Use, Biodiversity and Land Degradation on the Slopes of Mount Kilimanjaro, Tanzania.
- WP 42: Maitima, J. *et al.* 2004. The Linkages Between Land Use Change, Land Degradation and Biodiversity Across East Africa.
- WP 44: Campbell, D. *et al.* 2004. Comparing the Kenyan and Tanzanian Slopes of Mt. Kilimanjaro: Why are the adjacent land uses so distinct?
- WP 47: Olson, J. *et al.* 2004. The Spatial Patterns and Root Causes of Land Use Change in East Africa.
- WP 49: Reid, R. *et al.* 2004. Linkages between Changes in Land Use, Biodiversity and Land Degradation in the Loitokitok Area of Kenya.

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7. Diversification of the economy

- a. **Mixed crop-livestock systems.** A significant response to the changing economy, land tenure regime, rainfall variability and population densities has been an increase in the numbers of people adopting mixed crop and livestock system. There is evidence that these promote more sustainable livelihoods through diversification of economic opportunity, and reduced vulnerability to declines in production of one facet of production due to drought, disease or economic forces. They also address degradation / poverty linkages through allowing people a more balanced diet and diverse economic opportunities; and by providing for more effective land management through access to manure and in some cases animal traction (WP 1, 20, 44, 47).
- b. **Dairy in former pastoral areas.** In many farming areas, the value of livestock as producers of milk and manure has resulted in the adoption of exotic species of dairy cows in systems of limited or zero grazing.
- c. **Tourism.** Revenues from tourism can be significant, but tend to be concentrated in selected localities. The main sources of tourism income are from revenues to landowners from public conservation (revenue sharing from governmental parks and reserves, and from NGOs), and revenues from private conservation ranches. Income is generated from both non-consumptive (access to land to view wildlife) and consumptive (bird shooting, wildlife farming and wildlife cropping) uses (WP 31, 34).

The income earned by land owners and land users from tourism is highly variable, and depends on 1) the agreement between the landowner and the tour operator (e.g. on access fees, bed night fees, concession fees), 2) the abundance and diversity of wildlife, 3) the nature of the landscape, 3) the number of tourists, 4) the extent to which local employment is generated and 5) the policy environment (e.g. whether hunting is permitted) (WP 34).

However, key constraint to ASAL development has been that the vast majority of people are engaged in land-based livelihoods - herding, farming, crop-livestock mix, and to some extent wildlife-based. As long as most people remain dependent on the land, the prospect for depletion of land and water resources is amplified. A number of these activities have the potential for value-added through processing of crop and livestock products, processing that will provide local off-farm employment.

- d. **Processing of livestock products.** There is renewed interest in developing decentralised slaughtering and associated industries to promote economic opportunities in ASAL. The meat industry has been centralized in a few large facilities that benefit from economies of scale. A decentralized meat industry located in ASAL towns would bring value added to the localities. Meat processing would provide direct employment in the plants and indirect employment through multiplier effects in the service sector and in activities using bi-products such as leather and bonemeal. This would stimulate the local economy, offer off-farm employment, reduce the prospect for land degradation and stem rural-urban migration (WP 19).

CONCLUSIONS

The LUCID research findings of past and current trends in ASAL indicate that improved management and productivity of the natural resources will require enhancing the inherent flexibility and diversity of the livelihood systems. Key issues related to sustainable livelihood and ecological systems include:

- Dependable access to clean water supplies is essential to sustainable livelihoods.
- Enhanced diversification of income sources and livelihood strategies, e.g. promotion of local processing of livestock and crop products, supports sustainability of livelihoods.
- The flexibility and adaptability of the various land use systems in ASAL facilitates their ability to accommodate and respond to economic, policy, demographic and environmental variability and change.
- A multi-scale participatory approach to ASAL management is required to ensure that the decisions of individual farmers and herders sustain, not undermine, the system they live in.
- Cross-sectoral approaches to address root causes. Sectoral strategies are likely to address symptoms, while system sustainability requires a cross-sectoral approach.