# Land cover, land use change and related issues in the Lake Victoria basin: States, drivers, future trends and impacts on environment and human livelihoods

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## ABSTRACT

*Land is a critical resource for the survival of the over 25 million inhabitants of the Lake Victoria basin in which agriculture contributes immensely to local and national economies. The steady decline in per capital land holding and escalating land degradation are posing serious concerns to food security and environmental integrity thus threatening economic, social and physical survival in the lake region now and in the future. The key land degradation issues addressed in this paper include escalating soil erosion, declining soil fertility, agro-chemical pollution, salinization and loss of land cover. Using the following driving force framework, that is, pressures-states-impact-response (DPSIR), the paper presents a synthesis of the state of land use and land degradation in the basin, their causes and impacts on human and environmental security. The paper notes that protecting the land quality for the benefit of people is a major challenge in the basin and that the dilemma in sustainable land management in the basin is that land use changes needed to promote the survival of society in the long-term are at crossroads with what is essential to the survival of the population in the short-term. An analysis of future scenarios of the Lake Victoria land resources and land use change is presented based on plausible futures through long-term interactions between economic development and environment with a reflection on the future state of available arable land in 2025. The social, biophysical and institutional mitigations measures proposed are based on these interactions.*

**Keywords:** *Integrated water resources management, Lake Victoria basin, land use, land cover, land degradation, scenario, sustainable land management, wetlands*

## INTRODUCTION

Lake Victoria basin is located in the upper reaches of the Nile River Basin and occupies an area of about 251,000 km$^2$ of which 46% is in Tanzania (URT 1995). Kenya, Uganda, Rwanda and Burundi share the remainder of the area. The basin contains Lake Victoria, which is the largest freshwater lake in Africa and the second largest lake of the world. Lake Victoria has three riparian countries, namely, Kenya, Uganda and Tanzania, and draws its water from direct rainfall as well as from several rivers such as the Kagera, Mara, Simiyu, Gurumeti, Nyando, Migori and Sondu-Miriu. Its catchment area is surrounded by mountains on all sides except for the north (Figure 1). The average population density in the basin is 165 persons/km$^2$.

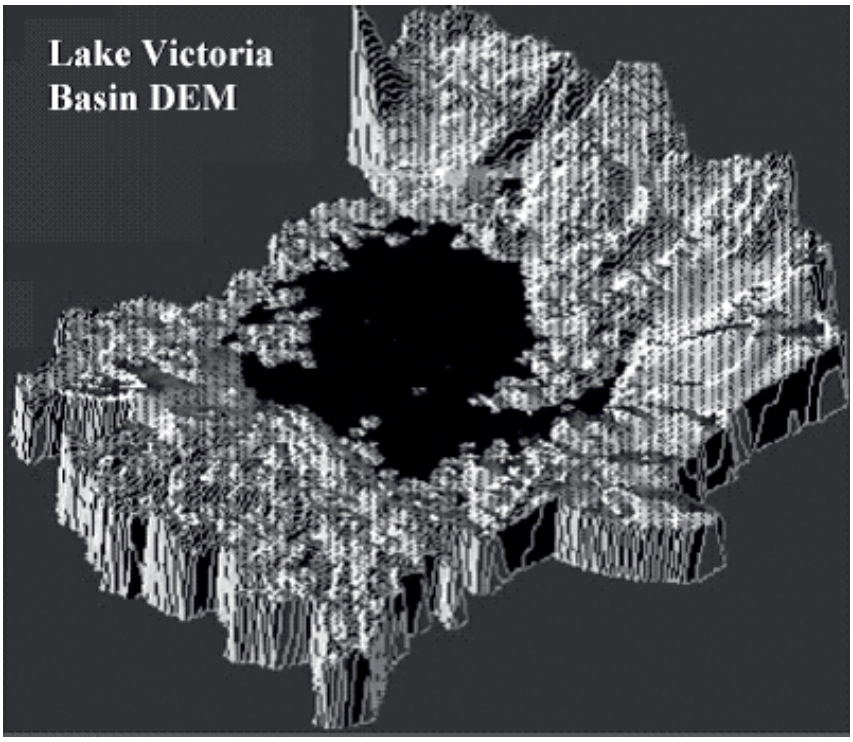


**Figure 1: A digital elevation model DEM) of Lake Victoria basin**

*Source: FAO (2002).*

Land is a critical resource for the survival of the over 25 million inhabitants of the Lake Victoria basin. In all the riparian countries, agriculture contributes over 30% of the GDP and employs close to 60% of the labour force (World Bank 1998). There has also been witnessed a steady decline in the size of per household land holding in the decades leading to 2004 (Figure 2). This coupled with the basin's population growth rate of about 3% per year underscores the need to slow down the rate of land degradation. It is estimated that the availability of agricultural land *per capita* will fall from the current 0.75 ha to a paltry 0.35 ha in 2025. Growth in the agriculture sector should be accelerated at a rate of over 8% in real terms by the year 2025 and beyond. It will be inconceivable for the region to achieve this growth target without sustainable land management efforts.

The continuous decline of per household land size and cultivated land per person constitute threats to food security, especially where rural populations depend on local land resources for their livelihoods. Land resources in the Lake Victoria basin present the inhabitants and their development partners with monumental paradoxes including:

- ❑ Enormous natural resource wealth with potentially high endowment value yet majority of the people live in abject poverty;
- ❑ It is the home of incredible land use diversity yet the ecosystems are fragile and easily degraded by unsustainable land use.

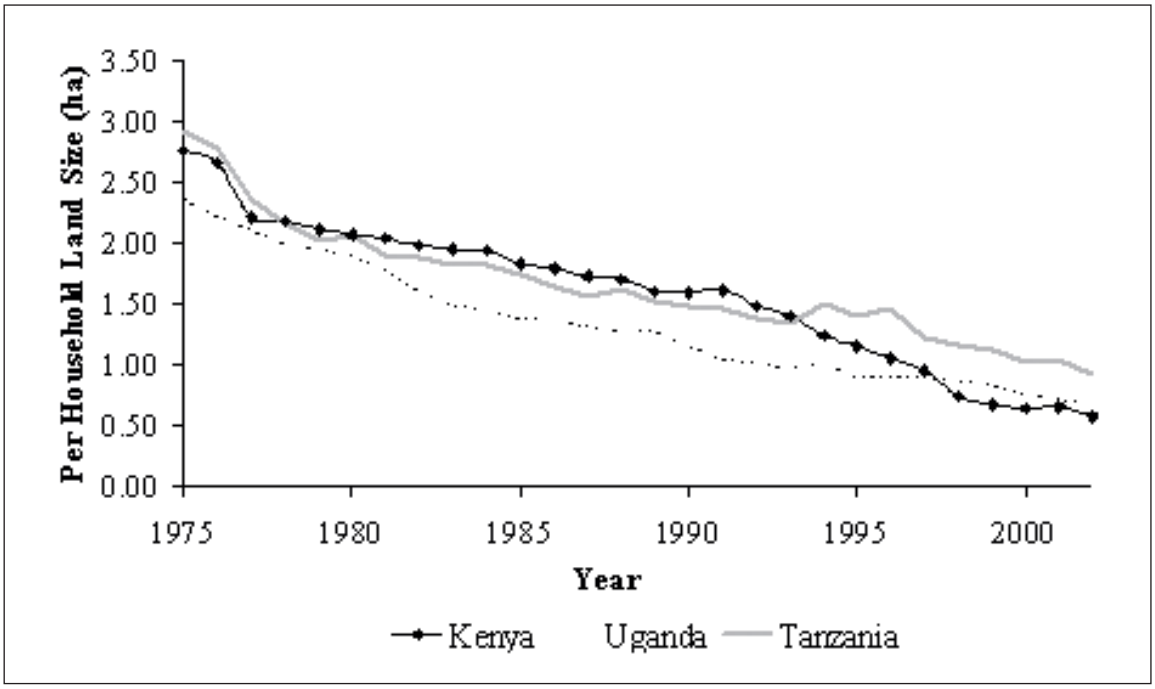


**Figure 2: *Per capita* land holding of countries in the Lake Victoria basin.**

Like in many other parts of sub-Saharan Africa, land degradation is threatening economic, social and physical survival in the lake region. The key land degradation issues include escalating soil erosion, declining soil fertility, agro-chemical pollution, salinization and loss of land cover. There also exists incremental wetland loss occasioned by natural hazards and intensification of land use as well as other malign anthropogenic activities. The continued poverty of the majority of the inhabitants of the Lake Victoria region is linked to the continued land degradation. The present land use and environmental courses of action are largely unsustainable and no longer constitute options to a sustainable future.

## LAND USE

Land use in Lake Victoria basin has been characterised by two-riding trends over the past three decades. First, the land resources are greatly threatened by grave imbalances in productivity and environmental integrity. This worsens the state of food security and integrity of the environment, which in turn threaten the stability of societies and the regional environment. Secondly, the region is undergoing accelerated change, with land stewardship lagging behind economic and social development. Land productivity is being overtaken by population growth. The processes of social and economic development need to be directed towards resolving rather than aggravating land resource issues and concerns. Box 1 presents some statistics pertaining to land use and land issues in the basin.

**Box 1: Some statistics ...**

- Average regional *per capita* land holding is about 0.75 ha.
- Average regional *per capita* income is under 250 US$
- Population increases at an annual rate of 3%
- The efforts needed to meet land use needs for the additional 5 million people in the next 30 years will be immense.
- A two-fold reduction of degraded land is necessary in the next 20 years for the growing needs of the inhabitants.
- An estimated 150, 000 km² of land has been affected by soil degradation since 1980 including as much as 60% of agricultural land.
- About 75% of wetland area has been significantly affected by human activities and about 13% is severely degraded.

## LAND DEGRADATION

Over the past three decades, intensified cultivation of marginal areas and clearance of natural habitats like wetlands, forests and mountainous areas have been witnessed. These have been the main driving forces behind the escalating land degradation in region. The forces are so intense that many wetlands such as Nakivubo Wetland in Uganda and Yala Swamp in Kenya are heavily degraded (Abila 2002).

The Nakivubo Urban wetland is held in trust by the government, but the surrounding lands are privately owned. This has led to confusion about the boundaries, ownership and status of the wetland. Approximately 100,000 people reside in the wetland. Due to its close proximity to Kampala, the capital city of Uganda, the wetland is an important sink for domestic and industrial discharge from three main sources (Nakivubo Channel; Bugolobi sewage treatment works; and run-off, seepage and point sources from households and adjacent farmlands). The major threat to the agro-ecosystems health and integrity of Nakivubo Urban wetland is reclamation for agricultural, industrial and residential expansion. About half of the total area (5.29 km²) has been modified or reclaimed for agriculture, industry and settlement and there is eminent threat of complete loss of the entire wetland through modification and conversion into urban uses. The degradation process is exacerbated by unsustainable exploitation of the wetland resources such as crop cultivation, papyrus harvesting and brick making.

The Yala swamp is one of the few extensive wetlands found in western Kenya. The wetland covers an area of 17,500 ha and contains three freshwater lakes, Kanyaboli, Sare and Namboyo (LBDA 1989). The swamp vegetation comprises mainly of papyrus (*Cyperus papyrus*) and *Phragmites* reeds. This wetland is nationally important in that it is one of the few habitats where the threatened Sitatunga antelope (*Tragelaphus spekeii*) is found in Kenya. The wetland is important for biodiversity, but also has great socio-economic value to the local communities, for whom the wetland has long been a source of fish, vegetables, medicinal plants, building materials, and agricultural land. Since the wetland is not protected, it is vulnerable to overexploitation. There are conflicts over issues with regard to its utilization – community-based resource management, agro-industrial development, or biodiversity conservation. The wetland can be sustainably utilized without undue degradation through its exploitation by the papyrus industry, brick making, aquaculture, ecotourism and energy extraction. Unlike other wetlands in Kenya, the Yala swamp does not have a protected status, therefore uncontrolled exploitation of the wetland and its resources can take place. It has been subject to reclamation since the 1960s, mostly for agricultural purposes, such as the growing of rice, groundnuts, cassava, yams and sugarcane. The threats to the wetland are twofold: population growth that drives the unsustainable use of the wetland's resources; and government initiatives on reclamation of the wetland for agricultural purposes.

The incremental loss of natural habitats has reduced vegetation cover exposing soils to both wind and water erosion, further worsening the degradation problem. Water erosion is extensive in many parts of Lake Victoria basin with approximately 45 percent of the land prone to water erosion (Reich and others 2001) and riverbanks are destroyed by gulley erosion (Plate 1). Siltation of dams and the increased risk of flooding in rivers and estuaries are the direct effects of soil erosion and other degradation forces in the basin. The near annual flash floods in Budalangi and Kano plains have been linked to such forces emanating from point and non-point processes (Gichuki 2003).

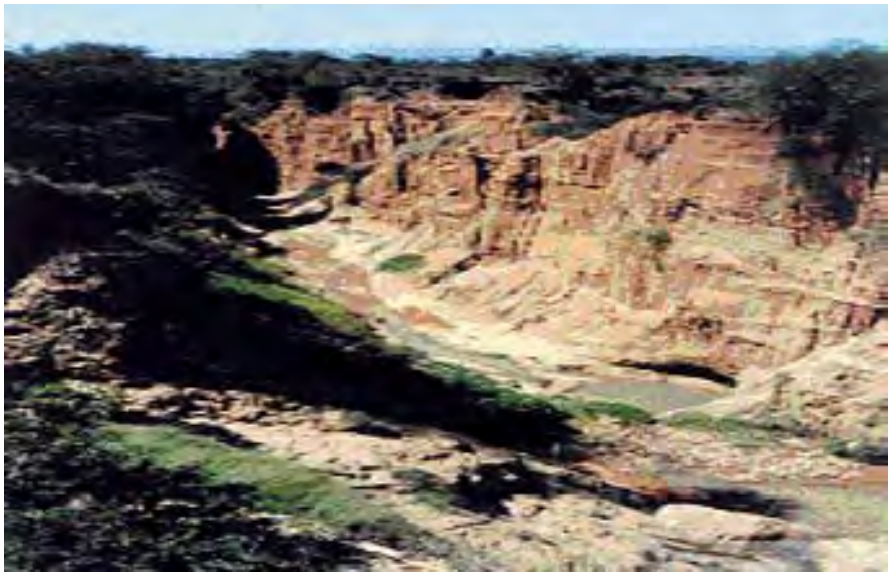

**Plate 1: Gullies causing destruction of the banks of a seasonal tributary of River Nyando.**

*Source: van der Kwast (2002).*

Owing to the realization that the Lake Victoria basin is endowed with largely untapped resources and that there is a potential threat posed by these degradative forces, the East African Community (EAC) and other development partners like the Governments of Sweden, France and Norway, the World Bank and the East African Development Bank (EADB) have entered into a long-term partnership on the promotion of sustainable development of the basin. This was in response to the realization that the potential of the basin cannot be sustainably developed unless problems related to environmental degradation, deepening poverty and poor health standards are addressed in a broad and coordinated manner. The partnerships have seen the institutionalization of intergovernmental and international arrangements that largely focus on activities related to the sustainable development in the region including: the Lake Victoria Environment Management Project (LVEMP); the Nile Basin Initiative (NBI) and its sub-affiliate, the Nile Equatorial Lakes Subsidiary Action Program (NELSAP); the Lake Victoria Fisheries Organization (LVFO); the Lake Victoria Region Local Authorities Cooperation (LVRLAC); the Inter-University Council of East Africa; and ECOVIC, a consortium of Community-Based Organizations and Non-Governmental Organizations in the basin.

Hitherto, land use policies have not adequately addressed the root causes of land degradation. The recent trends in land degradation can be linked to imbalances in land distribution, lack of incentives for conservation, insecure tenure and the failure to provide for diversified rural production systems (Moyo 1998). The United Nations Convention to Combat Desertification (UNCCD) asserts that land degradation is intricately linked to poverty and that addressing this problem requires the participation of the resource users and, where appropriate, providing them with alternative livelihood options (UNCCD 2001). Jones (2002) presents a framework grounded on the “sustainable livelihoods” approach that generates a clear understanding of the social causes of environmental degradation and factors that affect land use decision-making. The “sustainable livelihoods” approach advanced by Scoones (1998) has three inherent dimensions (Birch-Thomson, and others 2001): how wider socio-economic and socio-political change relate to local changes; emphasis on importance of social differentiation and agency in determining outcomes of local change; and the importance lent to both physical and social resources employed in shaping livelihood strategies. The approach resonates well with the driving forces (pressures – states – impacts – response (DPSIR)) and opportunities frameworks which are used in presenting the state, trends, indicators and opportunities for sustainable land management in this review.

The Lake Victoria basin states have signed and ratified several regional and international conventions. Although this has served to enlist government commitment and raise public awareness about issues of sustainable natural resource management, the resources required to enforce these plans have frequently been inadequate (UNCCD 2001). Studies have estimated that land degradation processes affect up to 60 percent of the basin's land area (Figure 3). The areas adjoining the shores of the lake are at greatest risk of degradation with about 65 percent facing high or very high risk of degradation (UNEP 2002a). Degradation vulnerability in Lake Victoria basin is severe with 46 percent of the area at risk, of which 55 percent is at high or very high risk (Reich and others 2001).

Sustainable land management initiatives and programmes are closely linked to socio-economic conditions and other factors, which determine their success. SARIPS (2000) identifies improvement in wealth distribution, access to resources and economic opportunities as key factors. The benefits of improved land management, or the negative consequences of land use practices on water resources, might not only be felt by resource users who cause them, but also by others who live downstream or make use of the affected resources.

The land degradation problems facing the Lake Victoria basin are multi-faceted. The country specific extent of land degradation is shown in Figure 3. The factors are several and include both natural and human-induced driving forces (Figure 4). The effects of these factors have been exacerbated by the consequences of decisions and policies as well as cultural, social and economic circumstances. These factors over the years, especially within the last twenty, have considerably changed the basin's ecosystems and this in turn rendered the population dependant on its vast natural resources vulnerable and insecure in terms of poverty, food security and health. The transboundary characteristics of the lake basin present it with unique opportunities and challenges in the attempts to address land related issues. Decisive and appropriate actions that take into account these facets can significantly reduce vulnerability and increase human security through programmes that strengthen coping capacities at all levels.

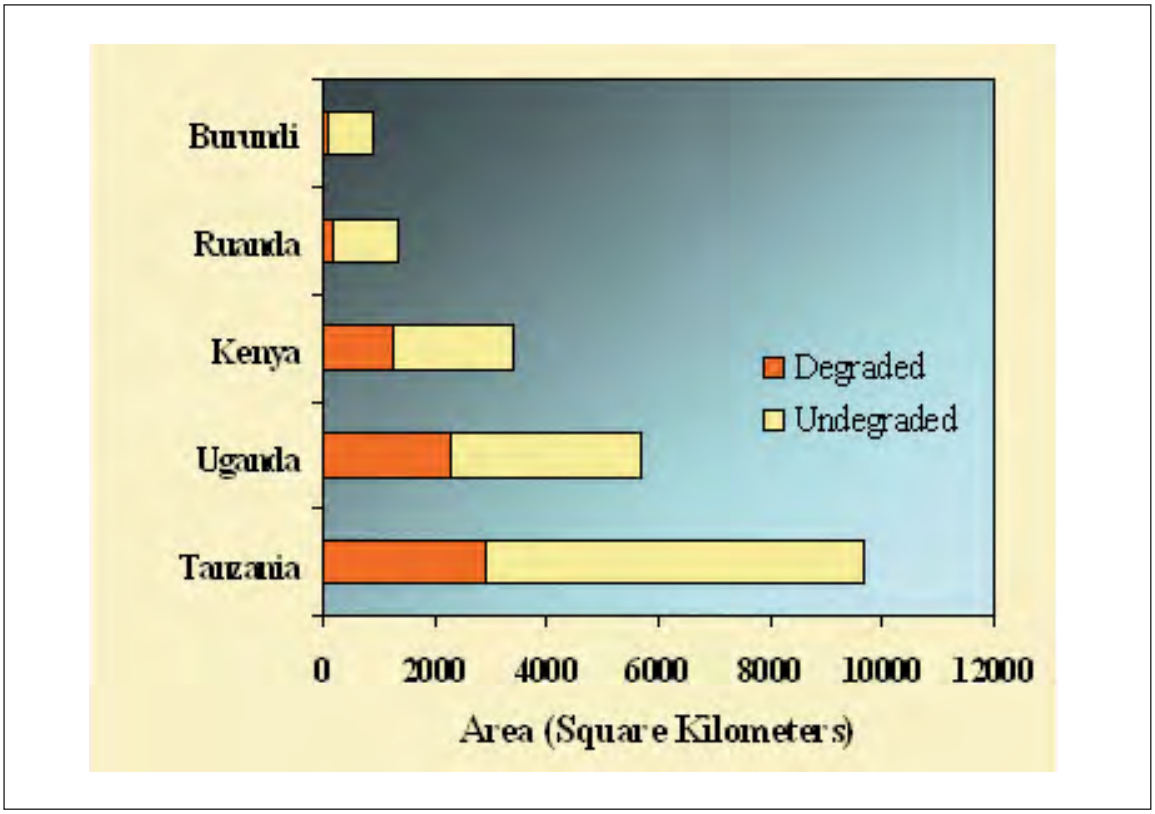


**Figure 3: Extent of land degradation in the Lake Victoria basin.**

Protecting the land quality for the benefit of people is a major challenge in the basin. Emphasis on agricultural sustainability arises out of increasing awareness about the finite nature of the basin's arable land resources, the widespread problem of land degradation, the rapidly deteriorating quality of the environment and the need to preserve soil and water resources for long-term use rather than for short-term gain. The current population pressure on forests, swamps, rangelands and marginal agricultural lands leads to inappropriate farming practices, forest removal, and overgrazing that, in extreme cases, leaves a barren environment that yields unwanted sediment and damaging stream flow to downstream communities.

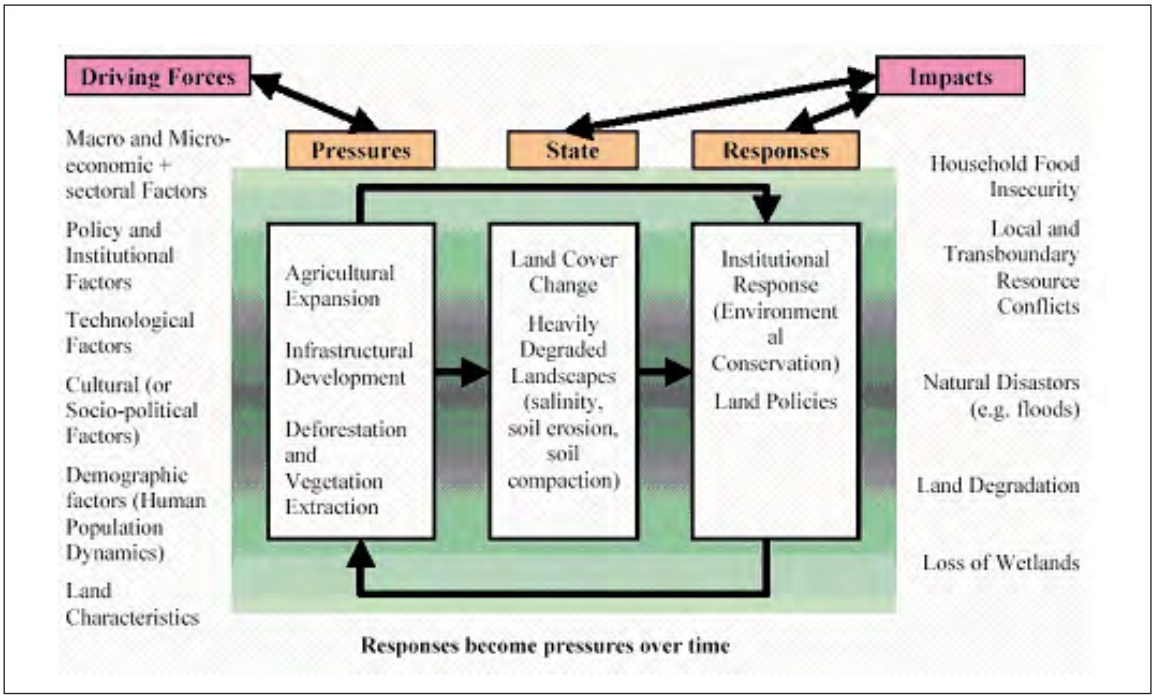


**Figure 4: DPSIR framework for assessing land degradation in Lake Victoria basin.**

The dilemma in sustainable land management in the basin is that land use changes needed to promote the survival of society over the long-term are at crossroads with what is essential to the survival of the population over the short-term. Presently the ecosystem and the people are vulnerable to the impacts of land degradation. This state is recognizable by several indicators. Severely degraded landscapes dot the basin with infrastructure such as homesteads and roads as well as arable cropland threatened with destruction (Plate 2). The forces of land degradation contribute differently to the problem as shown in Figure 5. Soil erosion (mainly by water) is widespread and lead to a pernicious form of land degradation in many parts of the region.

Soil salinization also poses a major problem in irrigated as well as rain-fed agriculture. Erosion and subsequent sedimentation of rivers and water bodies cause serious pollution concerns for the lake. Sources of pollution are nutrient runoff from agricultural land, urban and industrial waste and biomass burning (ICRAF 2000). From satellite imagery, it can be easily seen that the polluted Nyando river causes a large sediment plume in the lake (Plate 2).

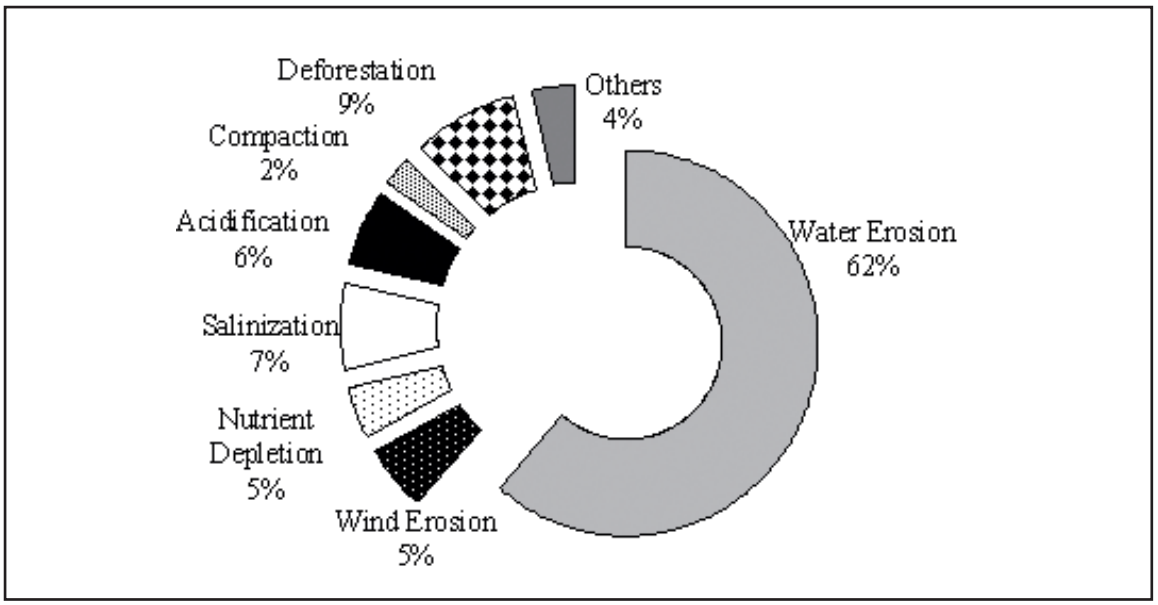


**Figure 5: Relative contributions of various degradation factors.**

The area around the shores of Winam Gulf is very dry, but it has good potential for irrigated cotton and sugarcane production. The production of rice in the plains at Ahero and West Kano Irrigation Schemes has collapsed owing largely to socio-political conflicts over the land resources and poor maintenance of irrigation infrastructure. Because of land scarcity, some wetlands are cleared for agriculture. During the rainy seasons, however, agriculture is greatly hampered by flooding. The flat terrain has not been effectively protected by dykes erected along the main rivers (Nyando and Awach). The population density is high with about 250 people/km². Marginal grounds and rangelands are therefore used as a result of the high population pressure further worsening the land degradation status as consequence of overgrazing (Plates 3 and 4). The settlements vary from linear trade towns along major roads to scattered homesteads within the flood plain. The settlement patterns of the homesteads and other socio-cultural practices have hampered sustainable management and conservation of the land resources in the area (Ochola and others 2000).

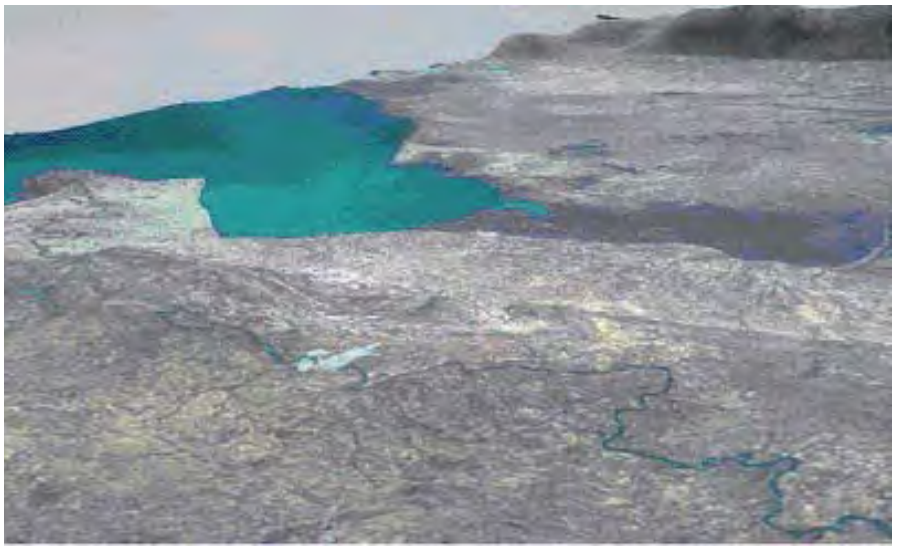

**Plate 2: Satellite imagery of sediment plume of River Nyando.**

*Source: van der Kwast (2002).*

**Plate 3: Degraded land with receding gullies threatening a homestead.**

*Source: van der Kwast (2002).*

The proportion of the population with access to arable land in the region averaged around 35 per cent over the period 1990-1999 (FAOSTAT 2004) although per capita land holding has been steadily declining in the past thee decades to the current average of about 0.75 ha. There has been progress in land use reforms within the Lake Victoria basin countries, which is expected to create an enabling environment to mitigate against the adverse effects of malign land use practices on land and water resources in the basin. Stakeholder engagement, including community responsiveness to land degradation is being addressed in the new land policies under redrafting in Kenya and other East African countries. Land resource conservation and rehabilitation or reclamation and related technologies should form an integral part of sustainable agricultural development.

**Plate 4: Overgrazing in Kano plains.**

## LAND COVER AND LAND COVER CHANGE (LUCC)

Land cover in the basin area (Figure 6) exhibits both highly spatial and temporal variation. The pattern depends on lithology, geology, topography, the corresponding soil moisture and season of the year as well as human activities.

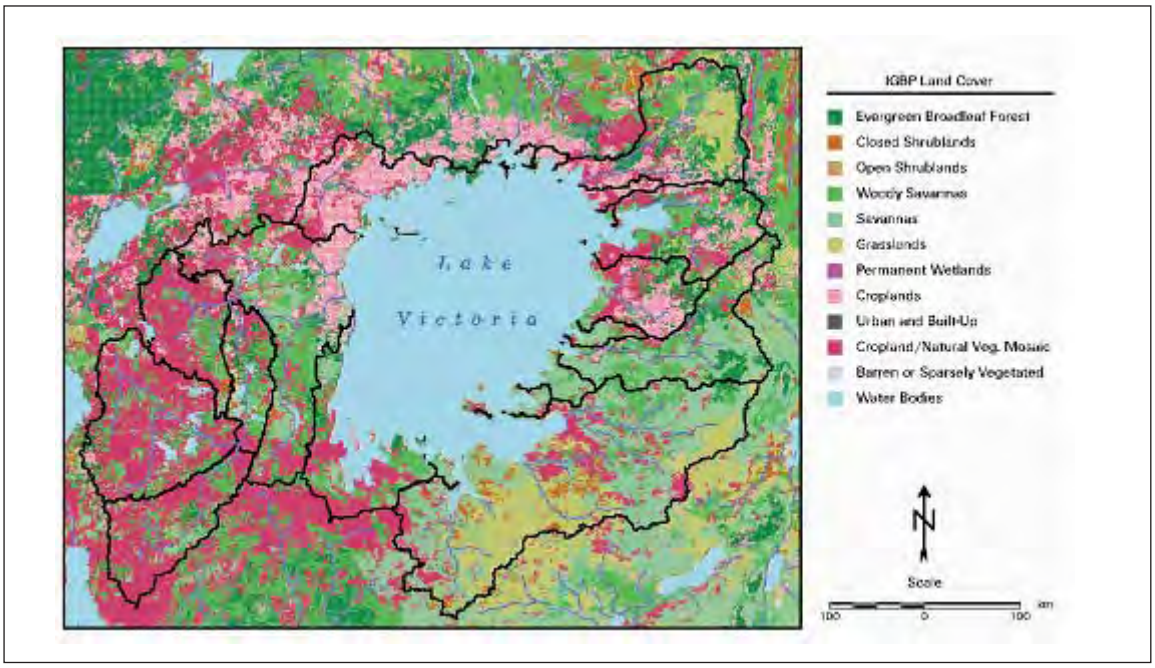


**Figure 6: Land cover map of Lake Victoria basin.**

In general, uncovering the possible underlying human and biophysical driving forces of land-use/cover change in the region is a formidable task. An analysis of the occurrence of these underlying driving forces and direct causes of LUCC as well as land degradation and their inter-linkages show that identifiable regional and transboundary variations of synergetic cause/driver combinations are significant in the basin. Economic factors, institutions, national policies and remote influences are prominent in the basin. Sub-basin specific patterns of causation can be identified in addition to the more “robust“, proximate and underlying causes. The results have implications for modelling the LUCC process, for policy intervention, and future scenario setting aimed at identifying causality behind land-use and land-cover change in the basin.

### *Driving forces of land-use change*

Undoubtedly, population growth together with the modernization-driven income growth, urbanization, and lifestyle changes will continue to shape the patterns of land use and to drive the changes in land use in the coming two or three decades as they did in the past two decades. Scenarios for each of the major driving forces have been developed and organized to show incremental effects starting from the base year 2004. Poverty, in association with unsustainable livelihoods such as sand harvesting (Plate 5), put undue pressure on natural resources. This accentuates the vicious cycle of high population growth rate, poverty and environmental degradation. The environmental impacts of disasters like flooding in Budalangi Division of Busia and Kano Plains in Nyando District of Kenya are enormous. Transboundary and regional initiatives for the conservation of shared resources straddling international borders need to be pursued.

**Plate 5: Sand harvesting along River Awach.**

## RESPONSES TO AND ALTERNATIVE OPTIONS FOR ACTION ON LAND DEGRADATION

The riparian states have individually enacted environmental laws consisting of legislation, standards, regulation, institutions and administration strategies governing activities on environmental management (LVEMP 2003). The countries are signatories to several multilateral environmental agreements (MEAs) that address several sectors of the environment including land. Some of the MEAs ratified include the Convention on Biodiversity (CBD), UN Convention to Combat Desertification (UNCCD), the UN Framework Convention on Climate Change (UNFCCC), the Montreal Protocol on Substances that Deplete the Ozone Layer, Rotterdam Convention on Prior Informed Consent (PIC), and the Stockholm Convention on Persistent Organic Pollutants (POPS). In order to benefit from the MEAs, the states are also domesticating the New Partnership for African Development (NEPAD) initiative on combating desertification through the respective National Environmental Management Authorities (NEMA).

In addition the following can form useful mitigation options:

- Review of the national and regional agricultural policy in relation, among others, to land tenure systems, sustainable land management and organization for regional economic integration;
- Implementation of policies that influence land tenure and property rights positively with due recognition of the minimum size of land-holding required to maintain production and check further fragmentation;
- Formulation, introduction and monitoring of policies, laws and regulations and incentives leading to sustainable agricultural and rural development and improved food security and to the development and transfer of appropriate farm technologies, including, where appropriate, low-input sustainable agricultural (LISA) systems and environmentally sensitive technologies;
- Development and facilitation of national and regional early warning systems through land degradation and land use change assessment and monitoring;
- Formulation and implementation of integrated agricultural projects that include other natural resource activities such as management of rangelands, forests, and wildlife, as appropriate, and;
- Promote social and economic research and policies that encourage sustainable agriculture development, particularly in fragile ecosystems and wetlands.

## SCENARIOS FOR THE FUTURE OF LAKE VICTORIA BASIN LAND RESOURCES

An analysis of future scenarios of the Lake Victoria land resources and land use change is an indispensable element of environmental management that focuses on long-term interactions between economic development and environment. Important factors influencing future land use and land cover may change considerably in the near future. This is particularly true for the environment and natural resources in the countries of the lake basin undergoing social and economic transition. The various scenarios permit the incorporation of several paths of future development in those sectors relevant to land-use change.

The futures featured in the land and land use scenarios are a direct and indirect result of current unsustainable exploitation of the land resources in the basin. The indicators of the various scenarios will be obvious: loss of biodiversity, worsening land cover change, vulnerability to natural disasters such as floods, shortage of arable land, degradation and loss of wetlands. As proxy to these, there will be witnessed poverty and environmental health deterioration. Few studies paint a sustaining future scenario. This would depend on resilient efforts to mainstream public participation in overall integrated land management endeavours and concerted stakeholder outreach focusing on sustainable land management and sustainable agricultural practices. The development of regional and local human development capacity with regard to general education and specifically dealing with environmental conservation may also lead to a realisation of this otherwise unattainable sustainable future. A clear shift towards socio-cultural practices that are in tune with this realisation will obviously be needed coupled with high-level inter-regional co-operation. There is also a need to put more emphasis and confidence on scientific and technological input to meet future land use needs in the region including available arable land.

### *Land availability in 2025*

Land availability forms a binding constraint to land-use requirements in general and for agricultural land uses in particular. Without additional available land, the only choice left for an economy is to increase land use intensity (land productivity) or to increase imports. The foreseen scenarios of land productivity improvement and land availability, demand a clear-cut trade-off between land productivity improvement and net import requirement. This sub-section discusses an estimation of the land availability for the basin in the major land-use sectors for the year 2025 based on current land use patterns.

Productive land is lost not only due to growing land requirements of cities, towns, villages, rural industries, and infrastructure, but also because of degradation caused by natural disasters, water and wind erosion, and other chemical and physical deterioration. To make up for these losses or to even extend the existing land base, farmland reclamation and land reinvigoration is emphasized in the basin's agricultural development. However, conversion of degraded land to productive farmland is very restricted and would require substantive investments. Due to increasing awareness of land scarcity in recent years, it is expected that great efforts will be made to increase land reclamation and to protect agricultural land. Hence, the assumption that degradation-induced total losses of cultivated land, grassland and forestland between 2004 and 2025 could be fully compensated by land reclamation and preservation. This assumption reflects also the policy orientation of the Lake Victoria basin states. Nevertheless, land conversion from agricultural uses to more profitable non-agricultural uses and to settlement and urban uses will certainly continue. The estimates of upper bounds of the land available in 2025 are as presented in Table 1, based on current trajectories of key driving forces like demography, technology, economy and environment.

**Table 1: Land Availability (Km²) in 2025[13]**

| Country | Agricultural Land | Other Crops | Forestland Grassland | Built-up Land | Other |
|---|---|---|---|---|---|
| Kenya | 316 | 61 | 204 | 255 | 184 |
| Uganda | 527 | 68 | 340 | 425 | 340 |
| Tanzania | 898 | 203 | 580 | 725 | 493 |
| Rwanda | 127 | 29 | 82 | 102 | 69 |
| Burundi | 84 | 19 | 54 | 68 | 46 |
| **Lake Victoria basin** | **1953** | **380** | **1260** | **1575** | **1132** |

The range of scenarios, which can be developed to quantify how population growth, changes in lifestyles, levels of urbanization and migration, and per capita income growth during the next two decades might affect the demand for different types of land in the region, reflect the effect of future land use change drivers. All the land use types face shortages for the most-aggregate scenarios. If the traditional policy of grain and food self-sufficiency were maintained intact, to keep the farmland requirement feasible, an annual growth rate of land productivity of about 4.5 percent would be required (Swallow and others 2002). It is widely believed that due to prevailing inefficiencies and structural problems, land productivity in the basin's agricultural sector may not have ample room to significantly increase above current levels without having to rely on future technologies. Further productivity growth is also required to compensate for loss and degradation of current cropland. The region requires concepts for infrastructure development that minimize land requirements, especially in the rapidly growing hinterland highlands and urban centres.

There is bound to be witnessed an increasing land stress level that will continue to strain regional food and economic security. If the governments of Kenya, Uganda and Tanzania as well as other Great Lakes states re-orient their land use policies towards efficient use of land and water resources, then food security attainment can be realised by 2025. According to Edwards and others (1996), the key roles that governments play in realising this include:

- Facilitating and institutionalising a policy regime that enhances realisation of full value and benefits of land owner's land use decisions, and;
- Encouraging advances in land use knowledge accumulation and dissemination through research and transfer of land and environmentally sound technology. Such knowledge may include temporal and spatial trends in land quality, agro-ecosystems health as affected by agricultural and other anthropogenic activities.

Other policies must target the eradication of cross-boundary and inter-sectoral land use conflicts. There is need also to couple integrated land and water management with effective population growth strategy and other health and environmental management strategies. Specifically, an integrated land use policy must consider regulated land and water resource exploitation, focused reforms in agricultural incentives and economic diversification away from dominant land-intensive agriculture. These policies would relate to the difficulties of the traditional rain-fed agriculture, uncontrolled urban expansion and the increasing land fragmentation under the existing socio-cultural set-up. Land tenure reforms must enlist the broadest possible participation to be of value to this mitigation process. If not carefully carried out, land tenure reforms may themselves create uncertainty and conflict over land use. The implementation of these rational policies would largely be dependent upon legal, institutional and political will as enabling factors. It is possible to utilise the region's water and land resources on basin and catchment basis rather than on administrative areas. This would demand a review of existing legislation on exploitation of transboundary land and water resources. Economic tools or approaches should be employed in the allocation of land and water resources to competing uses through prudent land use planning.

13 The projections are based on the Stockholm Environment Institute's (SEI) Polestar System with the 2002 baseline data and using "business-as-usual" assumptions.

### *Strategic implications*

In the Lake Victoria basin, there exists a strong link between the environmental and the land use agendas. Indeed, neither the environmental nor the land use pressures in the region can be addressed in mutual isolation. Large numbers of rural people are already changing production techniques away from traditional low-input systems in order to survive. But that change is increasingly taking the undesirable path, away from intergenerational equity. Ample evidence indicates that at present, the path of sustainable land management, that focuses on the reduction of land degradation through strategies for the protection of land quality, including conservation investments and improved environmentally sound land use practices, is largely ignored.

In the region, for the land use agenda to serve its own needs and those of the environment, it must be focused on sustainable intensification in order to close the huge gap between current and potential land productivity. The more fragile land resources in the widespread rangelands that have been rendered unproductive by incremental degradation over the years can be reinvigorated. Although rapid increase in land productivity in these areas is likely to remain difficult, soil conservation, alternative income sources (to reduce stress on land), and modest sustainable increases in productivity based on controlled use of external inputs are key. Sustainable agriculture and rural development policy and programs have an important role to play in helping land users along the path of change that leads to sustainable land management. Box 5 illustrates some approaches to this end. Some of these approaches would include:

- ❑ Promoting sustainable land management as the central theme in land use policies. This should not be done isolation from other sustainable development themes relating to agriculture, trade, investment, research and development, infrastructure and finance. The high economic and social endowment value of land resources and services, and the high costs of unsustainable land use must be emphasized.
- ❑ Encouraging the formulation and implementation of integrated multi-sectoral land use policies at the local, national and sub-regional levels, involving all stakeholders at all stages.
- ❑ Carrying out more intensive research on the socio-economic causes of land degradation and the interactions within and among environmental and sustainability issues in order to define the priority issues and suggest ways of addressing the main driving forces.
- ❑ Improving the coordination between land and environmental audit at all spatial scales for effective sustainability monitoring and evaluation.
- ❑ Assessing the impact of various sustainability pathways.
- ❑ Establishing multi-agency, multi-stakeholder task forces to develop proposals for strengthening regional, local and transboundary coordination and governance structures to protect the land and water resources.

## OPPORTUNITIES FOR IMPROVED LAND USE

### *Integrated water resources management*

Any attempts to improve the management of land, wetlands and the inherent water resources in the basin must consider the land-water interactions and the conflicts resulting from decisions made by policy makers, administrators and local land users. There is need to adopt a participatory approach to land and water resources management, thus broadening considerably the scope of the interventions, putting people in the centre of the land management process in order to ensure sustainability. Integrated water resources management (IWRM) regimes for the basin must address the impact of the land conservation practices on the lake and hinterland freshwater resources and reservoirs. There should be local and transboundary water management through low-cost drainage, flood reclamation and water conservation in the basin and its sub-catchments.

Integrated water resources management strategies would open opportunities for addressing primary social and economic courses, including poverty alleviation and a way out of the subsistence farming trap and related environmental degradation in the basin (Odada and others 2004). The water and land

conservation issues are closely related to rural poverty and vulnerability of inhabitants of the basin. Efficient water use and irrigation applied to reclaimed high capability land also would free more water for use in adjacent areas with land but no water. Within the basin, small-scale irrigation based on water harvesting, small reservoirs and shallow groundwater (often highly under-utilized) founded on community work and labour-intensive approaches, has considerable potential.

### *Management of wetland resources*

Wetlands occupy 40.8% of the basin (Gichuki 2003) and belong to the most productive systems in the region and are vital to the local and regional socio-economic development and biodiversity. The success of sustainable management of Lake Victoria basin wetlands must be judged from many different angles, such as stakeholder well-being, government agency satisfaction, and agro-ecosystem integrity. To achieve these outcomes, it will be prudent to refine the key strategies of wise wetland utilization (Gawler 2000). Evidence from the basin indicate that like in other parts of Africa, the sustainable use of wetlands is often endangered when government development and natural resource management policies are insensitive to the wetlands and to the communities who use them (Gichuki 1992; Gichuki 2003). To be appropriate, these policies must address the physical, anthropogenic and ecological threats to wetlands through co-management. There should also be appropriate changes in land tenure, resource access, property rights, and the recognition of co-management regimes in national and local policies, legislation, and development plans and initiatives. Other features of such policies should include:

- Encouraging partnerships between the local people and other stakeholders in participatory monitoring and evaluation of the social, economic, ecological, and biophysical characteristics of the wetlands, and scaling these up towards the community-wide and national land use objectives;
- Ensuring win-win trade-offs and scenarios in which socio-economic development goes hand in hand with wetland resource conservation; and
- Incorporation of indigenous environmental knowledge and technologies in wetlands co-management systems.

The main local level indicators that should be used to measure involvement of indigenous people in the sustainable management of wetlands are highlighted in the Ramsar Convention on Wetlands (1999).

### *Sustainable agriculture and rural development*

Concerted efforts should be made to promote integrated approaches to the planning and management of land resources. This would encompass the development of locally and regionally accepted land quality indicators and appropriate monitoring systems for regular assessment of land conditions, land use and land cover change. Land use monitoring can provide the information required for sound decision-making for the sustainable land management and also to better understand the processes and trends in land degradation, enabling more timely and effective prevention, control and restoration. Land reform must be used as an important tool for poverty alleviation and increasing food security in these areas. The institutionalisation of secure land and water rights will greatly increase the vested interest of smallholders in improving land resources management and investing in land conservation as well as other land improvements.

The application of appropriate technologies to the available land and water can help farmers and policy makers face the myriad significant agro-environmental challenges threatening sustainable agriculture and rural development (SARD) in the basin. Within the overall context of contributing to the achievement of sustainable development in the economies of Lake Victoria basin states, environmentally sustainable systems of agricultural production demand a reduction in environmental damage from farming activities, as well as conserving natural resources, especially land and water, and contributing to the provision of environmental benefits, such as landscapes, bio-diversity, flood control, and land conservation. The demand for sufficient, safe and secure supplies of food and fibre must be met in economically efficient and least environmentally and socio-economically distorting ways by ensuring intergenerational land use equity.

The allocation of land resources to competing land uses must take into account the inherent uncertainties

of the future availability of resources while improving livelihoods of the people in cost-effective ways. This will be achieved through identification of indicators and signals upon which land users, policy makers and other stakeholders can base their decisions. These indicators must relate to 'land resource productivity', 'eco-efficiency', 'green accounting' as well as 'socio-economic parity'. Such indicators may include:

- Adoption of rates of sustainable land management;
- Change in indigenous on- and off-farm biodiversity;
- Change in soil, water and land quality and integrity;
- Local level participation in decision-making, assessment, planning, implementation, and evaluation of integrated and sustainable land management activities;
- Reduced erosion rates and sediment delivery;
- Reduced phosphorous runoff from agricultural land, and;
- Sequestration of above and below ground carbon.

The SARD reforms should target the livestock sector to reduce grazing pressure. Agricultural policy reforms must also contribute to slowing down or halting of the rampant conversion of environmentally fragile rangelands or ecologically valuable land to agricultural or other land uses. They should target significant areas of wetland, forests and natural grassland for preservation through reforms in land user rights. Changes in land use must be encouraged by land use diversion schemes, which provide, over time, incentives to remove the most environmentally sensitive or ecologically valuable land from production to improve land quality through integrated agro-ecosystems management. This must be in the context of appropriate property rights enshrined in the overall land tenure structure.

### *Sustainable land use technology transfer*

The Poverty reduction strategies of the East African states must address land use issues to avoid increasing vulnerability of the population. For instance, Kenya's PRSP Action Plan of September 2002, the current Government's Economic Recovery Plan 2003-2007 and the agricultural revitalization strategy have all identified multi-sectoral approaches to natural resource management as a priority for development. Emphasis has been placed on creating a more demand driven and pluralistic extension system through the implementation of the National Agricultural and Livestock Extension Program (NALEP). The reorientation towards more participatory and demand-driven technology transfer approaches are to be developed and institutionalised through linkages with research bodies like the Kenya Agricultural Research Institute (KARI), Kenya Marine and Fisheries research Institute (KEMFRI) and Kenya Forestry Research Institute (KEFRI) as well as other Non-Governmental Organisations.

The facilitation of research, information, advice, technology transfer and training to farmers should focus on the "public good" aspects of farming practices (ICRAF 2000). Historically, research and development activities have been aimed at developing technologies which, by maximising private profits, have contributed to a large increase in agricultural productivity and output, but which have not always been sustainable. In the past, farmers have often adopted technologies without taking into account the associated environmental costs and benefits. The value of indigenous technical knowledge (ITK) should be considered. The challenge is to identify the best set and combination of scientific and indigenous technologies that work in specific basin circumstances, and define and provide the right incentives and frameworks for their adoption and continued participatory monitoring and evaluation. Rigorous participatory *ex-ante* and *ex-post* assessments and appraisals can help ensure greater follow-through in tracking the adoption of technologies for sustainable farming systems, and in the accountability of research efforts and policies for technology dissemination and adoption.

### *Early warning and assessment for land degradation and natural disasters*

A land degradation early warning system (LDEWS) for Lake Victoria basin would provide data, information, and analyses to decision makers so they can evaluate and anticipate the need for pre-emptive interventions. A major goal of such a system would be to provide timely access to satellite data/ products in order to identify potential or actual problems related to land degradation or natural disasters that may jeopardize the availability or productivity of a given land unit. A programme to create a network of all relevant collaborating early warning partners with improved access to relevant satellite data at key designated periods within the various land use echelons should be institutionalized. Specifically, the programme should (1) provide access to relevant satellite data, (2) collect, archive, manage, and distribute other early warning-related spatial and temporal data, (3) develop web-enabled versions of databases, (4) provide remote sensing and GIS services and analyses, (5) develop and evaluate GIS-environment models for land use/cover change, flood risk monitoring, and land degradation assessment, and, (6) evaluate, recommend and develop new data sources and land quality analysis techniques.

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