Uganda Journal of Agricultural Sciences, 1994, 2:81-90
ISSN 1026-0919

Intergrated management of land resources in eastern Africa: A review

T. Hawando
United Nations Environment Programme
Nairobi, Kenya

Abstract

An overall assessment of current resources in eastern Africa indicates that land degradation has reached a serious stage. This is reflected in the fast declining agricultural productivity, increasing hectarage of agricultural land yearly going out of crop production due to soil degradation and siltation of dams and productive river valleys, and expansion of cultivation into adjacent forest and pasture lands. Most of the countries in the region do not yet have integrated land resource management policies and legislations that may lead to sustainable development and increased productivity of land resources that is compatible with sound environment management at regional, national and local levels. The World soils policy and National soil policies formulated by UNEP which are very closely linked with World Conservation Strategy and Agenda 21, have laid the basis for the formulation of land use policies, legislation and plan at all levels. To formulate meaningful land use plan at regional and local levels, the acquisition of land resource data base is essential. Intergrated management of land resources should be considered as an inportant step leading to sustainable development resources at all levels. The proposals for improved and strengthened planning, management and evaluation systems of land resources which include developing land resource data base, adopting appropriate farming systems for different agro-ecological zones, technology development and transfer, sustainable managment of plant nutrition and balancing ecological values and food production are some of the major steps recommended as an intergral part of the land resources management.

Key words: Environmental management, optimal land use, soil degradation, UNEP

Introduction

The ability of land to produce is constrained and the limits to production are set by climate, soil, land form conditions, use and the management applied to the land. Therefore, knowledge of land resources endowment and its potentail is an essential prerequisite to planning for optimal land use and subsequent sound agricultural and economic development that is sustainable in the long term.

Formulation of land use types and their ecological requirements need compilation of national land resources and a land use database; assessments of land productivity potentials; and development planning, population carrying capacities and input requirements to address policy issues.

The 1983, UNEP's environmental management guidelines for the formulation of national soils policy clearly state that there are three issues to be kept in mind when considering national soils policy. These are that soil (a) is a finite resource and it comes first because is the basis of man's existence; (b) soil can be lost or damaged by careless use thereby-reducing its long-term productivity; and (c) soil can be improved through proper land use and management practices. Governments need to recognise the fact that as the population increases, soil is being utilized with increasing intensity thus threatening its productivity.

Principles of World soils policy. The basic principles of the World soils policy formulated by UNEP (1983), are summarized as follows: In recognition of the fact that soil is a limited resource and that continuously increasing demands are being placed on this resource to feed, clothe, house, and provide energy for growing population while at the same time maintaining an acceptable ecological balance, the nations of the world agree to use their soils-on the basis of sound principles of resource management, to enhance soil productivity, to prevent soil erosion and degradation and to reduce the loss of good farm land to non-farm purposes.

National soil policy. As a follow up to the World soils policy, a national soils policy was prepared in such a way that it allows and stimulates maximum utilization of soil on a sustained basis without lowering its productivity, and without causing direct damage to the environment. The implementation of the policy should be taken into account when any aspect of national development is being considered. In broad terms, National soils policies should: (a) assess quality and quantity of land resource and its susceptability to degradation; (b) apply scientific knowledge, proven management techniques, and productive agricultural systems to improve soil productivity and that it is used sustainably; (c) enlarge the

area and improve the quality of available agricultural land wherever feasible through irrigation, flood control and reclamation; (d) slow down the loss of productive agricultural and forest land to other purposes; (e) monitor changes in soil quality and quantity and the way land is used; and (f) bring to the attention of all concerned the dangers and adverse consequences of soil degradation, and the need for conservation and appropriate legislation.

Relationship of soils policy with World Conservation Strategy and Agenda 21. National soils policy is closely linked with the World Conservation Strategy (WCS), through a number of priority issues identified in WCS including: (a) reduction in agricultural, grazing and forestry lands; (b) land degradation and soil erosion catchments; and (c) desertification, deforestation and lack of conservation-based rural development. All these priority issues are related to national soil policies.

National soils policy is also closely linked with Chapters 10, 11, 12, 13 and 14 Agenda 21 of UNCED (1992). These chapters deal with an integrated approach to the planning and management of land resources (Chapter 10), combating deforestation (Chapter 11), managing fragile ecosystems, combating desertification and drought (Chapter 12) sustainable mountain development - (Chapter 13) and promoting sustainable agriculture and rural development (Chapter 14).

Overall assessment of current land resources situation

The degradation of natural resources is the most serious environmental problem in developing countries (erosion, loss of soil fertility, deforestation and loss of vegetation, the depletion of genetic pool, a drop and/or rise in groundwater level, pollution of surface water and salinization of the soil). The productive capacities of many natural ecosystems and much of the agricultural land has been and continues to be seriously undermined by poor land use management practices which is a major cause of degradation. Five to seven million hectares are lost and go out of production annually through soil degradation. Thus one third of the world's arable land will be lost by the year 2000 (UNEP, 1983).

The developing countries are confronted with a number of factors which make it difficult to find and apply easy solutions. These factors are: (a) poverty which is both a cause and consequence of environmental problems (poor fights for survival and in the process accelerate land degradation); (b) rapid rate of population growth (a demand for more food which calls for cultivation of more land than before, undernourished people in developing countries were 360 million in 1969/71 and 435 million in 1974/76, a 20% increase in just five years) (FAO, 1981); (c) socio-economic and cultural problems (land use, land tenure, illiteracy and other cultural problems); (d) current transitional state of environmental management; and (e) macro-economic situation - most developing countries depend on agricultural and other commodities (i.e agriculture, forestry, fisheries and mining) which are coupled with international trade imbalance and debts. The problem of degradation of natural resources is thus, likely to remain the crucial environmental issue for some time to come.

Concept and definition of land degradation. The International Convention to Combat Desertification (ICCD) defines "Land" as the terrestrial bio-productive system that comprises soil, vegetation, other biota, and the ecological and hydrological processes that operate within the system and "Land degradation" as reduction or loss, of the biological or economic productivity resulting from mismanagement of land resources or from a process or combination of degradation processes. These processes arise from human activities and habitation patterns. Land degradation implies a regression from a higher to a lower state, a deterioration in land productive capability. It is not a continuous process and land degradation occurs under all climates (UNEP/ISRIC, 1990)

The world map on global assessment of human induced soil degradation (GLASOD) has put two categories of soil displacement; by erosion (water and wind), and *in situ* changes by physical and chemical processes (Alderman, 1988; Aldeman et al., 1990). GLASOD forms the basis of UNEPs most recent detailed global degradation (UNEP/ISRIC, 1990) and desertification (UNEP, 1992) assessment (Table 1).

Main types of land degradation identified by GLASOD are:

a) Water erosion (loss of top soil and terrain deformation)
b) Wind erosion (loss of top soil, over blowing and terrain deformation).
d) Chemical deterioration (loss of nutrients, salinity, pollution, etc)
d) Physical deterioration (compaction, water logging, subsidence).
e) Stable terrain (under natural condition stabilized by human intervention).

The 1992 dry land human induced degradation assessment gives a figure of 1036 million ha which is 20% of the world's total dry land area. The extent and seriousness of land degradation in humid areas requires detailed assessment for planning, management and rehabilitation of degraded land in all climates. The

Table 1. GLASOD data on causes of soil degradation through human activities in million hectares in selected regions of the world

Degradation causes	World	Africa	Asia	Latin America	Europe
Deforestation	579	67	298	100	84
Over grazing	679	243	197	68	50
Agricultural method	552	121	204	64	64
Over exploitation	133	63	46	12	1
Bio-industrial activity	23	+	1	-	21

relationships between natural environmental variability and human induced degradation also need further investigation. These studies need take into consideration social, economic policy and environmental factors at regional, national and local levels.

Over exploitation of the resources undermines not only the productive capacity but also the regulatory and informative function of the environment with waste products likewise leads to reduced productive capacity. In most cases the production systems in developing countries are not sustainable. This is apparent in the complete disappearance or decline of vegetation, loss of productive land and falling productivity on the land that remains.

Factors controlling land use to a very large extent are social, political and economic. Pure technical approach to land development, the use and conservation of land resources, is unlikely to succeed. The primary responsibility for a more balanced and harmonious approach lies at the political, policy making, higher administrative and planning levels.

Some basic information on land, human and livestock resources of ten countries in Eastern Africa is given in Table 2. The arable land in the region is estimated to be 3,862 million km² of which 594,000 km² is put under cultivation. The area under forests is estimated to be 1,342 million km² of which 7,000 km² of forest is cleared annually. The sharp increase in human and livestock population in eastern Africa without corresponding land resource productivity increase, is a matter of concern. The data from GLASOD indicates that the major causes of land degradation in Africa are overgrazing, poor land use, deforestation and over-exploitation in that order of importance (Table 1). So this is an issue of concern for the planners, politicians and public alike.

It is estimated that 68.5% of eastern Africa falls under semi-arid and arid classification (Table 2). Land resource potential data indicates that in Sub-Saharan Africa, 37.3% falls under low potential low rainfall zone, 26.4% falls under low potential humid tropics and 36.3% falls under high potential good rainfall zone. Priority emphasis should be given to develop high potential areas and take appropriate measures to develop the potential of both problematic humid and dry lands. Erosion is one of the major problems in Africa especially or specifically in highly eroded Ethiopian and Eritrean highlands.

It is very interesting to observe that population density and major forest areas are concentrated in high rainfall areas, highlands and in the alluvial soils of River Nile in Sudan.

Qualities and limitation of land resources

Land quantities and characteristics are properties of the land units. Land unit is an area as much as possible, a homogenous piece of land mapped with specific characteristics employed as a basis for land evaluation. Land quality is a property of land which acts in a distinct manner to influence the suitability of land use for specific use (e.g moisture availability) whereas land characteristic is an attribute of the land which can be measured/estimated

Table 2. Some basic information on land, human and livestock resources of ten countries in eastern Africa

	Land area, 1000 km²				Human population in millions				Livestock in millions				Dry/Humid in thousand km²	
	Total	Arable cultivated	Grazing	Forest	1977	1984	1991	2025	Cattle	Sheep and goats	Camels	Equine	Arid-semi -arid	Humid
Burundi	28.5	21.1	4.6	0.4	-	4.7	6.0	1.4	0.76	1.0	-	-	-	28.5
Djibouti	22.0	0.004	2.0	0.06	-	-	0.7	1.4	-	-	-	-	22.0	-
Eritrea	122.0	2.59	87.3	13.0	1.8	2.5	3.2	7.0	1.2	2.2	0.1	0.083	97.6	24.6
Ethiopia	1130.0	177.41	550.0	260.0	28.6	42.2	53.2	130.0	22.8	14.4	2.8	3.1	632.8	497.2
Kenya	582.8	88.5	261.9	24.0	-	17.2	25.0	73.0	11.5	9.1	-	-	440.0	129.14
Rwanda	25.9	16.4	4.0	2.0	-	6.4	7.1	17.0	0.65	1.2	-	-	-	25.9
Somalia	638.0	52.0	288.5	85.9	4.0	5.1	6.5	13.0	4.8	30.8	4.1	-	604.0	34.0
Sudan	2506.0	1364	108.1	1027.9	477.0	16.1	22.4	26.0	60.0	17.3	29.8	2.5	-	1906.0	599.0
Tanzania	945.0	570.0	78.0	530.8	173.0	-	22.2	25.2	59.0	12.5	9.4	-	-	567.0	378.0
Uganda	235.77	180.0	50.0	78.00	60.0	11.6	14.8	17.0	48.0	4.5	3.2	-	-	25.7	210.0
Total	6268.9	3862.5	594.09	2832.44	1342.4	-	-	169.9	422.4	76.77	101.1	9.5	3.183	4295.1	1926.34
% of Total	100%	60%	9.4%	45.18%	21.4%								68.5%	30.7%	

Sources: Country reports on National Plan of Action to Combat Desertification
Renewable resource trend in East Africa. Clark University, 1984
World Development Report WB 1991,1992 and 1993
Population densities in Eastern Africa in 1991 was 43.8 persons per km² and in 2025, it was calculated to be 67.4 persons per Km ² of arable land

and can be used for distinguishing between land units of differing suitabilities for use, and it describes land qualities in terms of range of a given property. For example, moisture availability can be described in terms of amount of rainfall distribution, available soil water level or ground water.

FAO Soils Bulletin Number 52 of 1983 lists about 24 land qualities which affect suitability under rainfed condition, while FAO Soil Bulletin Number 55 and 58 recommended land qualities for irrigated lands and qualities for grazing land, respectively, as tabulated below(Table 3). The bases for land use suitability evaluation should be based upon land qualities because of the following advantages: (a) land qualities are directly related to the specific requirement of land use; this enables development of simulation models to explain land/land use relationships; (b) land qualities take account of interactions as between environmental factors; and (c) the total number of land qualities is considerably less than the land characteristics.

These land qualities affect crop production mainly related to management, conservation and environmental requirements. By no means all of these qualities will be relevant for assessing suitability for a given crop or range of crops in a particular region. Often three or four land qualities account for most of the variations in output. The qualities used in an evaluation are selected with reference to both the land uses considered and the nature of the land units in the study area. A land quality is significant for suitability assessment if: (a) the quality has a known effect upon the crop or kind of land use under consideration; (b) critical values of the quality adversely or favourably affecting the crop or use occur in the study area; (c) there is some practical means of collecting information for its measurements or estimation. The selection procedure is to list all the land qualities and check them against corresponding use requirements. Each land quality is then assessed according to its effects upon the use of the land, occurrence of critical values within the study area and practicability of obtaining information.

After determining which land qualities are relevant to the evaluation, then the following alternative forms of diagnostic factors are employed to measure and estimate the land qualities. These are: (a) estimation on the basis

Table 3. Land qualities for land use suitability classification

Bulletin No. 52 Agricultural land	Bulletin No. 55 Irrigated Agricultural land	Bulletin No. 55 Grazing and Pasture lands
1. Radiation regime	Growing period	Radiation
2. Temperature regime	Radiation	Temperature
3. Oxygen Availability	Temperature	Moisture
4. Nutrient Availability	Aeration	Nutrient availability
5. Nutrient retention capacity	Water quantity	Rooting conditions
6. Rooting condition	Nutrients	Sodicity/Salinity
7. Conditions affecting germination	Water quality	Soil toxicity
8. Air humidity affecting growth	Salinity	Fire hazard
9. Conditions for ripening	Sodicity	Flood hazard
10. Flood hazard	pH, trace elements	Frost hazard
11. Climatic hazards	Pest, diseases	Genetic potential of vegetation
12. Excess of salts	Flood, storm	Control undesirable plant spp.
13.Soil Toxicities	Location	Potential, mechanisation
14. Pests and diseases	Water management	Potential management units
15. Soil workability	Pre-harvest management	Erosion hazard
16. Potential for mechanisation degradation	Harvest and post harvest	Tolerance to vegetation
17.Condition for land preparation	Mechanisation	Drinking water
18. Conditions for storage and processing	Land clearing	Biological hazards
19. Conditions affecting time of production	Flood protection	Climatic limitations
20. Access within production unit	Drainage	
21. Size and potential management units	Land grading	Condition of way and silage
22. Location	Soil amendments	Ease of fencing
23. Erosion hazard	Environment hazard leaching	Location
24. Soil degradation hazard	Long term salinity erosion effect	

of single land characteristics (e.g use of past records of flood); (b) estimation from the most limiting of the group of land characteristics (e.g limiting nutrient); (c) estimation from empirical combination of land characteristics (e.g rooting zone, soil depth structure, etc); and (d) estimation by modelling, comparing land characteristics with requirements of the relevant land utilisation types (e.g soil moisture availability, land use systems).

The practicabilities and costs of obtaining information are important considerations. It is important to select the most suitable quality provided it is feasible and yields the desired data.

Review of land use policies

The policy options for government for controlling land degradation include: Economic incentive in the form of charges of pollution taxes, subsidiaries in the form of concessions finance and income tax on investment putting sustainable land resource management application of essential controlling regulations, provision for distribution of information, review of property rights and review of other essential government policies that have direct or indirect effect on land resource management. From the outset it can be clearly stated that no country in eastern Africa has an integrated land resource management policy and legislation. A common feature of existing land-use legislation in many countries is that it is sectoral in character, dealing with specific aspects of land management such as soil conservation, land development, flood control, etc.

Land-use legislation is the means through which an agreed soils policy can be implemented. The land-use legislation is judged by the efficiency it acts to implement the national soils policy, by the extent to which it is understood and accepted by the people it affects, by the nature of the incentives or penalties imposed and by the efficiency of the state implementing the legislation. Satisfactory land-use legislation at the national level depends very much on local needs in terms of physical environment, social and economic conditions. In general, adequate legislation will include: (a) a clear statement of policies and purposes to explain the need for the anticipated benefits from the legislation; (b) the establishment of priorities and guidelines in relation to agriculture, urban development, industrial development, etc, aimed at preventing conflicting policies and uses, especially where agricultural production is the issue; (c) the power to declare protected zones; (d) the creation of institutions at the required level; (e) careful co-ordination and appropriate interconnection between different legal enactments directly or indirectly affecting land and soil; and (f) adequate powers of implementation and enforcements (UNEP, 1983).

National land use policy/soils policy. The broad objectives of a national soils policy should assess available land resources, improve the productivity of the soils, enlarge the areas and improve its productivity, slow down expansion of cultivated land, monitor changes in soil prospective and in land use and bring awareness of dangers of soil degradation (UNEP, 1983). The national soil policy has three elements: technical, institutional and legal aspects. Legislation relating to land and its use must obviously vary considerably from region to region, country to country, from one agro-ecological zone to another, and according to environmental, economic and social factors (UNEP, 1983). A sound land use policy should be management oriented and based on practical incentives for regional use and protection of land resources, the prevention of damage on the land and the promotion of environmentally sound policy and planning for the sustainable development of land resources.

Two broad legislative approaches for integrated management of land resources could take into consideration: (a) a strict liability approach whereby any damage to land or any damage beyond a prescribed level is rendered unlawful per se (e.g in U.S.A, soil volume eroded is set as a basis), or (b) a four staged approach where the first stage involves land suitability classification which broadly divides the common uses to which it is best suited. The second stage involves land use planning which identifies areas having common land characteristics or problems and which establishes guide lines as the basis for land resource management. The third stage involves land management systems application and resource management principle within a given area to a particular land unit. The fourth stage is the enforcement of the policy and legislation defined, characterised and set under stage one above.

In most countries of eastern Africa the existing legislation on natural resources is a "command and control" type emphasising prohibition and punishment of violation rather than "management oriented". The question of land tenure frequently arises in soil conservation projects. The conventional wisdom is that farmers will not invest in soil conservation and sustainable and resource management works unless they can expect to reap the rewards. This applies particularly to work with a long pay-back period, like terracing and tree planting. In Uganda the basic aspects of these policies and laws governing natural resources remained unchanged during and after the colonial era up to 1990. During the colonial era, natural resources remained as Crown property and the Land Reform Decree of 1975 was a substitute of "crown" by public, "Uganda for Britain" and the like. Resources like soil, vegetation, water, wildlife, etc have been administered on the basis of numerous laws and regulations often without gazetted and explained policy on soil management. This trend is similar in almost all the countries of eastern Africa. There is no integrated overall land resource management policy in all the countries of the region. In Kenya, there are more than 50 separate statutes which relate to the protection of the environment and the management of the natural resources. However, at the present time there is no comprehensive environmental policy or legislation to provide a coherent framework for the integrated management of land resources. In Ethiopia, Tanzania, Somalia, Sudan and Eritrea, there is no land management policy and legislation. There are sectoral decrees and legislations without any

clear policy for the overall management in an integrated manner.

Current situation with regard to planning and management of land resources

It is important to place land degradation problem in context with other environmental issues competing for public recognition and scarce resources at national and local levels. Soil is the fundamental resource on which primary production is dependent. It is the origin of a food chain that terminates with human consumption of rural products. There have been no serious suggestions that an alternative source of food supply is likely to render our continued requirement for soil less important. In view of the insignificant rate of soil formation and the scarcity of top soil due to the alarmingly high rate of soil erosion on highly populated highlands of eastern Africa, the land degradation problem can be realistically considered as an irreversible withdrawal from national's resource bank and its handling should be given top priority.

Cultivation. In 1980, only one-third of Africa's cultivable land surface (800 million ha) was put under cultivation. In the highlands of eastern Africa, with altitudes more than 1500 m.a.s.l., alarming rates of land degradation caused by erosion accompanied with serious reduction in productivity prompted the British colonial government to impose massive soil conservation schemes between 1900 and 1962. This activity was revived in 1974 by the government of Kenya assisted by SIDA.

The World Bank funded and FAO executed Ethiopian Highlands Reclamation Study (EHRS) which revealed that 27 million ha of land in Ethiopian highlands covering 44% of the country's total land area (1.13 million square kilometres) and the highlands of Eritrea, with 95% of the cultivated land and high forests occurring in this zone, is seriously being threatened by soil and biological degradation mainly caused by soil erosion. Of the 27 million ha, 14 million ha were badly eroded and were unlikely to support any cropping in the future (EHRS, 1984). In the 1970s and the 1980s, the Ethiopian Government with international assistance and mobilisation of all available human resources in the country carried out massive physical reclamation of eroded lands by constructing terraces, soil bunds and by afforestation. The salinization and water logging problems in vast irrigated lands of Sudan and North Eastern Rift Valley of Ethiopia is another serious problem affecting land productivity.

Increasing land productivity. The productivity of soil varies according to management practices. The crop yield statistics from Sudan shows that the main crop yield under irrigation management is 3 to 4 times higher than it is under rainfed condition (Table 4)

The comparative yield of sorghum on mechanised farms under rainfed conditions in Sudan is 5 times lower than in Australia. This shows that there is a large gap to increase sorghum yield in Sudan (Tables 4 and 5). Other studies of major cereal yields in Ethiopia under large scale state farms and farmers cooperative fields have shown that wheat and maize yields can easily be increased from 11 quintals ha^{-1} national average to 40 quintals ha^{-1} with proper land management practices.

Peoples participation in land resources planning and management

It is essential and important to encourage land users to participate in managing their land resources. Participation is the key to minimizing land degradation in developing countries particularly in regions with serious land degradation problems. The options one can use to encourage grassroots level community participation include developing sustainable land use practices for short term benefits to farmers (agro-forestry scheme, food for work programme, etc); organising land users associations, including self help groups, that will enable the community to pool knowledge, capital and labour on private and community projects and to achieve improvements at the farm and village level; organising demonstrations, technical advice and training and publicizing land productivity and conservation issues to alert the public to the problem of land degradation and ways in which to minimise the land deterioration processes.

The successful integrated land resource management in the Machakos District in Kenya is one good example where self-help groups pull in capital and expertise from national and international sources to supplement local self-

Table 5. Comparative sorghum and cotton yield for mechanized farms (mf) in Sudan and Australia (Homoudi, 1984)

Crops	Sudan Yield/Feddan	Australia Yield/Feddan^{-1}
Sorghum	0.35 tons	2.0 tons
Cotton	0.158 tons	0.32 tons

Table 4. Sudan - Yield of main crops

Management	Period	Mill Fedd	kg Fedd^{-1}
Rainfed a)	(a) 65/66-69/70	6.73	257 - 5 years average
	(b) 74/75	11.56	247
Irrigated	(a) 65/66-69/70	1.69	983 - 5 years average
	(b) 74/75	2.48	1276
Flooded	(a) 65/66-69/70	0.12	374 - 5 years average
	(b) 74/75	0.18	303

help through upward links to the political systems, the churches and other NGOs. The community was able to use improved systems which enabled better use of the resource base (use of marginal lands, breakdown of indigenous systems, reduction of fallow, etc). This should be seen with the basic processes of change which have been occurring in Machakos District: Intensification of production; changes in capital; labour ratios and shares of marketed production; new leadership patterns in the community; technical change; and rise in the level of knowledge. The non-integrated but massive physical reclamation of eroded lands in Ethiopian highlands (soil conservation and afforestation) involving the Ethiopian Peasant Association, local level farmers organisation through "food for work" programme is another example of peoples participation.

In Ethiopia all urban and rural lands are owned by the government, so the beneficial effects of the massive structures, terracing, bunding, ponds, etc have not been sustained because the farmers did not have ownership rights on the land or the trees planted on the land and the reclamation work was top-down planned food for work programme. One important condition for people's participation is that actions should be based on bottom-up planning starting from initial stages of identifying problems up to implementation and evaluation of the impacts on the community and the environment.

Experience of major groups including NGO's in sustainable management of land resources in the region

There are some successful integrated rural development projects in eastern Africa where sustainable land resource management has been implemented over several years. Perhaps a model example can be land resource management in Machakos District, Kenya for the last 60 years (1930 - 1990). The World Bank environment study paper Number 5 (1994) conclusively reports that Machakos District, which is a drought prone area with a rainfall of 600-1000 mm yr^{-1}, has gone through a successful sustainable integrated land resource management scheme. Between 1930 and 1990 the population increased five times (from 0.27 to 1.382 million), livestock population increased two fold (from 0.249 to 0.478 million), cultivated land increased seven times (from 56 to 401 thousand ha) and 0.24 ha $head^{-1}$ in 1930 to 0.29 $head^{-1}$ in 1990. Agricultural productivity in maize increased 4.2 times (from 0.25 tons $head^{-1}$ to 1.0 tons $head^{-1}$) and output increased 10 times per square kilometre (from 10 to 100 tons km^{-2}. The World Bank study reported that overall agricultural production per capita is estimated to be three times in 1990 than what it was in 1930 actively managed by farmers and there is no fuel wood shortage as predicted prior to 1970 by various reports including that World Bank in 1967.

The World Bank study concludes that the agricultural growth which has occurred has not been accompanied by resource degradation. The study enumerates about 45 new technologies which have been adapted. These include terracing, increase in cash crops, ox drawn plough, early maturing varieties, use of crop residues for forage, use of animal manure, suitable crop system, improved livestock breed, etc.

The participation of local people, their willingness to change and adopt new technologies, government policies and assistance, the role of international agencies including that of NGO has been vital to the success.

Other integrated rural development schemes else where in the region have also contributed to sustainable land resource management. The SIDA programme in ARSI Rural Development Scheme in South East Ethiopia and the World Bank funded Wolliata Rural Development Scheme in Southern Ethiopia prior to the 1974 revolution can be pointed out as good experiences that have led to sustainable land resources management. During the last five to six years a Rwenzori Integrated Rural Development project in Kasese district in South Western Uganda funded by Norwegian Church Aid and implemented by South Rwenzori Diocese is a good example of integrated approach for sustainable land resource management where rural population, church and the government are involved at project levels.

The relative advantages and disadvantages of non-governmental organisations (NGOs) and community based organisations (CBOs) have been compared with bilateral and other medium size agencies and large multi-lateral institutions in several studies (Cassen 1986, Fowler and Harrison, 1987). Few selected points about NGOs and CBOs are that:

NGOs and CBOs are in close contact with beneficiaries, often acting virtually as additional extension staff. They therefore have a strong local involvement and are able to identify the felt needs and associate better with minorities as the landless and ethnic minorities;

They are better able to test, advise, develop and help implement local techniques because they have limited resources they have to focus on low cost ventures and are able to test innovations which could not be attempted on a bigger scale.

Being independent, they can also bypass bureaucratic problems and overcome problems of inter-departmental cooperation. Being small and inoffensive, their activities are unlikely to be seen as a threat by the establishment.

They tend to be cost effective, are strong on reaching the poorest in the community and have the appreciation of the need to involve in rural development schemes.

They are particularly able to operate projects which depend on large input from the farmers such as farmer centred research and the local adaptation of imported technology.

Local NGOs have a lot of undeveloped potential. International NGOs are able to mobilise and stimulate local NGOs where there is an effective consortium of international and national NGOs all working together. NGOs are ideally placed to be used as subcontractors by aid agencies and to carry out pilot schemes with a greater emphasis on long term efforts at local level.

Major issues and challenges to sustainable productivity

World Commission on Environment and Development (1987) in the book "Our Common Future", defines sustainable development as the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains two concepts: the concept of needs (essential needs for the poor) and the idea of limitation of the environment's ability to meet present and future needs. Tolba (1987) indicates that the concept of sustainable development in broad terms encompasses (a) help for the poor because they are left with no option other than to destroy their environment, (b) the idea of self-reliant (self propelling) development, (c) the idea of cost-effective development, (d) the issues of health, appropriate technologies, food self-reliance, clean water and shelter for all, and (e) the notion that people-centred initiative are needed. Human beings are resources in the concept of sustainability.

Sustainability in IRDP. In the mid-seventies there was a great vogue for integrated rural development projects (IRDP). These were the products of expanding aid budgets and of an intensified commitment to distributing the benefits of aid among rural population and low income groups in particular. The projects made bold effort to tackle rural poverty by addressing simultaneously the multiple obstacles in the way of rural development; they sent out to improve productive services, provide infrastructure and sometimes to provide health and education. They therefore, tended to be large, multi-sectoral, and administratively complex, (Cassen, 1986). Many IRDP projects failed because of insufficient knowledge on cropping systems, proposals not attracting farmers, under-assessment of costs and over optimistic yield assumptions, etc (FAO, 1987).

Sustainability in agriculture. To be sustainable, agriculture must meet the three essential goals of food security (sustainable balance between self-sufficiency and self-reliance), employment and income generation in rural areas particularly to eradicate poverty and natural resource conservation and environmental protections (FAO, 1992).

Spreading and maintaining sustainability. Sustainability institutional spread is when activities by one NGO, CBO or any implementing agency are taken up and adopted by the other NGOs or by incorporation into government organisations. There is also spontaneous or induced diffusion, when there is a non-institutional effect such as visits by farmers who take away the said idea which multiplies elsewhere. Few NGOs or governments pay adequate attention to this. The number of projects continued by counterparts in the absence of donor funds is very small. The reason for this lies in the failure of development agencies to treat communities and farmers as fully capable of achieving their own sustainable management of resources. Another issue in self-sustainability is encouraging the development of informal organisations as well as building up government agencies. English, et al (1994) indicate that major contributions on sustainability come from the development of grass root organisations, where project beneficiaries gradually assume increasing responsibilities for project activities during implementation and particularly following completion (Causley and Kumar, 1987). This study indicated that of 25 projects, assessed as successful at completion, 13 projects (50%) were found to have failed between 5 and 15 years after the end of the project, because of failure to build institutional capacity. Long term sustainability was not considered during the project, grass-root organisations were not developed, adequate plans to hand over were not carried out and/or no research base to maintain them for the future was put in place.

An integrated approach of land resource planning

Land is a finite physical resource defined in terms of topography and spatial nature and includes natural resources; the soils, minerals, water and biota (Agenda 21, chapter 2, UNCED, 1992). These natural resource components are recognized in ecosystems which provide a variety of services essential to the maintenance of the integrity of life-support systems and the productive capacity of the environment. Land resources are used in ways that take advantage of all these characteristics.

Land resources are used for a variety of purposes which interact and may compete with one another. Therefore, it is desirable to plan and manage all uses in an integrated manner. Integration should take place at two levels: that is all environmental, social and economic factors including their impacts on environment and natural resources on one hand, and all environmental and resources components together on the other hand (air, water biota, land, geological and natural resources). Integrative considerations facilitates appropriate choices and trade-offs, thus maximizing sustainable productivity and use of land resource.

The broad objective is to facilitate allocation of land to uses that provide the greatest sustainable benefits and to promote the transition to a sustainable and integrated management of land resources at local, national and regional levels.

As clearly indicated in Chapter 10 of Agenda 21, the specific tasks include:

a)**Management-related activities.** This include developing supportive policies and policy instruments, strengthening planning and management systems, promoting application of appropriate tools for planning and management, raising awareness, promoting public participation in land resource planning.

b)**Data and information.** This includes strengthening information systems, through observation and assessment of systems at global, regional and local levels, strengthening co-ordination between existing sector and data system and national capacity, and providing land resource information to public.

c)**International and regional co-ordination and co-operation.** This includes establishing regional machinery to study and design regional policies to support programmes for land use and physical planning, promoting development of land use, designing information systems and promoting training and exchange of information, means of implementation through financing and cost evaluation depending on the strategies of specific governments, scientific and technological means that is assessing land potential capability factors and testing research findings through pilot projects.

d)**Human resource development.** This includes enhancing education training at appropriate levels in co-operation with government and local authority and capacity building. These include strengthening technology capacity and strengthening institutions at appropriate level and with international organization support.

Conclusions

a)The assessment of current land resources situation in nine countries of eastern Africa (Burundi, Djibouti, Eritrea, Kenya, Rwanda, Sudan, Tanzania and Uganda) indicates that human and livestock population is concentrated in humid and sub-humid areas and in fertile river valleys. These rainfed regions are subjected to tremendous population pressure and concentrated economic activities to the extent that the rate of land degradation has reached alarming levels. The major factors contributing to land degradation in eastern Africa are overgrazing, deforestation, poor land-use and absence of policy measures and legislation leading to appropriate land resource management systems at regional, national and local levels.

b)To tackle the land resources degradation, United Nations Environment Programme formulated the World Soils Policy which laid down basic principles that led to the environment guidelines for the formulation of national soil policies (UNEP, 1983). Both the World Soils Policy and the National Soils Policies have very close relationship with World Conservation Strategy and relevant chapters of Agenda 21 (Chapters 10, 11, 12, 13 and 14) dealing with integrated management of land resources for sustainable development and increased productivity (UNCED, 1992).

c)Review of land use policies in the countries in the region indicates that existing policies and legislations are "command and control" type and are unco-ordinated sectoral oriented. These are no integrated land resources management policies and legislations in most countries of the region.

d)The absence of basic natural resource data-base is the major draw-back to the formulation of any meaningful land use plan at national and local levels in eastern Africa.

e) Past experience in the region show the importance of people's participation in land resources planning and management, the role of community based organizations (CBOs), NGOs, and other international agencies in contributing to sustainable development in rural land resource management through adopting and introducing appropriate farming systems suitable to the local environment.

f) Integrated management of land resources should be considered as an important step leading to sustainable development of agriculture and other land resources at regional, national and local levels.

Recommended proposals for improved and strengthened planning, management and evaluation systems of land resources

One of the 13 principles of the World Soil Charter states that "It is a major responsibility that land use programmes include measures aimed at achieving the best possible use of the land, ensuring long-term maintenance and improvement of its productivity, and avoiding the loss of productive soil. The land users themselves should be involved, thereby ensuring that all resources available are utilized in the most rational way".

Development of land resource database for decision making. Knowledge of land resource endowment at local, national and regional levels and its potential is an essential prerequisite to planning for optimal land use and subsequent sound agricultural and economic development that is sustainable in the long term. The formulation of land use types and their ecological requirements need compilation of data based on: physical endowments (land, population, soil, water, climate, genetic resources, etc); social and economic parameters; policies, legislation, institutions and human resources; and land use systems and agro-ecological zones.

Suggested farming systems for different agro-ecological zones and viable land uses. A farming system that is suitable to each specific agro-ecological zone should evolve as a result of interaction of indigenous/traditional farming systems with new and improved appropriate technologies acceptable by the local community. There is intensive, extensive and integrated farming systems which farms can adopt in their locality according to the characteristics of each agro-ecological zone. The reported integrated rural development scheme of Machakos, Kenya, which has shown a sustained and increased productivity (1930-1990) without causing land degradation provides a good example of district level land resource management system. This is an encouraging sign in the region of eastern Africa.

Technical development and technology transfer. It is important to keep abreast of technical developments which enhance improved developments and increased resource productivity which is sustainable in the long term. Such appropriate technologies in terms of improved crop varieties, livestock, farming systems, infrastructure, product distribution and marketing schemes that are suitable in one agro-ecological zone can be transferred to similar zones elsewhere in the region.

Sustainable management of plant nutrition.
One of the major problem areas in land degradation is the loss of nutrients through erosion, crop removal, leaching and burning crop residue. The sustainable management of plant nutrition includes reducing soil erosion, applying manure and crop residue to the land, crop rotation and agro-forestry practices and applying commercial fertilizers whenever necessary.

Ecological values vs the need for food and other produce. It is important whenever possible to try to obtain the balance between the ecological values if the agro-ecological zone and the need for food, fibre and shelter production. Each specific locality is suitable for given set of land use schemes without damaging the ecological values of the areas. The food, fibre and shelter production systems in any one areas should plan and implement practices to increase productivity without any due sacrifices to the ecological system. Sustainable land productivity should be attained without any cost to sound environment management. In other words in fragile regions, conservation based development may be a sustainable way out.

Agricultural land vs urbanisation. It is very unfortunate that in several urban centres, particularly in developing countries, prime agricultural land is used up for industrial, residence, or market centres. This is especially true where unplanned satellite towns around big cities are coming up and a very good farm land is used up. It is important that governments make detailed land uses of areas around big cities and categorize the land resources accordingly. In addition, home gardens in the cities and towns should be encouraged to produce vegetables and fruits for home consumption. In fact there is no reason why a certain proportion of trees in city parks, along the roads, compounds of buildings and individual homes cannot be replaced by fruit trees. This serves both purposes, greening the city and at the same time increasing food production.

References

Aldeman, L. R. (Editor), 1988. Guidelines for general assessment of the status of human-induced soil degradation. Working paper and preprint 88/4. Wageningen, ISRIC.

Alderman, L.R., Hakkeling, R.T.A. and Sombroek, W.Q., 1990. World Map of the status of human-induced soil degradation. An explanatory note. Wagenigen: ISRIC/ UNEP.

Alderman, L.R., Engelen, V.W.P., Van. Pulles, J.H.M., 1991. *The Extent of Human Induced Soil Degradation.* Wageningen; ISRIC.

Casley, D.J. and Kumar, K., 1987. *Project Monitoring and Evaluation in Agriculture.* WB Washington D.C.

Cassen, R., 1986. *Does Aid Work?* Oxford University Press, Oxford.

EHRS, 1984. *Ethiopian Highlands Reclamation Study.* FAO/EHRS. Addis Ababa.

English, J., Tiffen Mary and Mortimore, M., 1994. Land resource management in Machakos District, Kenya (1930-1990). World Bank environment paper No. 5. W.B., Washington, D.C.

FAO, 1983. Guide Lines: Land evaluation for rainfed agriculture: *FAO Soils Bulletin* No.50, 1983. Rome.

FAO, 1993. *Agro-ecological Assessments for National Planning: The example of Kenya.*

FAO. 1989. Soil conservation for small farmers in the humid tropics. *FAO Soils Bulletin No. 60,* 1969. Rome.

FAO, 1991. A study of the reasons for successes or failure of soil conservation projects *FAO Soils Bulletin No. 64,* 1991. Rome.

FAO, 1987. Review of field programmes 1986-87. *Report C/87/4.* Rome.

FAO, 1992. Sustainable development and the environment. *FAO Policies and Actions.* Stockholm 1972 - Rio 1992. FAO, Rome.

Fowler, A. and Harrison, 1988. NGO's in Africa. Achieving comparative advantage in relief and micro-development. Discussion paper 249, Institute of Development Studies Brighton, UK.

Harrison, P., 1987. *The Greening Africa: Break through in the Battle for Land and Food.* Paladin Grafton Books, London.

Hamoudi, A.B., 1984. *Soil Degradation Resulting from Mechanised Agriculture in Rainfed Areas.*

SIDA, 1992. *The Revival of Soil Conservation in Kenya, Report No. 1.* Regional soil conservation unit/SIDA. 30pp.

SIDA, 1993. *Management of Natural Resources and Environment in Uganda.* Policy and Legislation landmarks, 1890-1990. Regional soil conservation unit/SIDA. 100 pp.

Tolba, M.K.., 1987. *Sustainable Development - Constraints and Opportunities.* Butterworths. London.

UNCED, 1992. Agenda 21 - Chapter 10. UN Conference on Environment and Development. *Rio-Declaration,* 38 chapters.

UNEP, 1983. Formulation of National Soil policies. Prepared in consultation with FAO, UNESCO, ISSS and the UN specialised agencies. *UNEP Environmental Management Guidelines, No. 7.* Nairobi, 32pp.

UNEP, 1984. *General Assessment of Progress in the Implementation of the Plan of Action to Combat Desertification, 1978-84.* Nairobi. UNEP.

UNEP, 1992. World atlas of desertification. London, Edward Arnold.

UNEP/ISRIC, 1990. World map on status of human-induced soil degradation, Nairobi, UNEP.

WCED - The World Commission on Environment and Development, 1987. *Our Common Future.* Oxford University Press. The Bundtland Report.

Guide for Authors

1.Types of contribution. This could be: (i) original full papers (regular papers), (ii) invited review articles, (iii) short communications, and (iv) views and ideas.
Original papers should report the results of original research. The material should not have been previously published elsewhere, except in a preliminary form. Reviews should cover a part of the subject of active current interest.

A short communication is a concise, but complete, description of a limited investigation, which will not be included in a later paper. Short Communications should be as completely documented, both by reference to the literature and description of the experimental procedures employed, as a regular paper.

The section views and ideas offers comment or useful critique on material published in the journal or on relevant issues. Contributions to this section should not occupy more than 2 printed pages.

2.**Submission of manuscripts**
The article should be original and not being considered for publication elsewhere. Hard-copies are sufficient for the initial submission of manuscripts. However, for the processing of accepted papers, electronic versions(diskettes) are preferred. After final acceptance, your diskette plus two, final and exactly matching printed versions should be submitted together. Label the disk with the name of the computer and wordprocessor package used, your name, and the name of the file on the diskette.

4.**Preparation of manuscripts**
a) Manuscripts should be written in English;
b) Submit the original and two copies of your manuscript. Enclose the original illustrations and two sets of photocopies (three prints of any photographs);
c) Manuscripts should be typed on one side of the paper with double spacing throughout. Every page of the manuscript, including the title page, references, tables, etc. should be numbered;
d) Manuscripts in general should be organized in the following order: Title (should be clear, descriptive and not too long); Name(s) of author(s); Complete postal address(es) of affiliations; Abstract; Key words (indexing terms); Introduction, Material studied, area descriptions, methods, techniques; Results; Discussion; Conclusion; Acknowledgements and any additional information concerning research grants, etc; References; Tables; Figures; Legends.
e) In typing the manuscript, titles and subtitles should not be run within the text. They should be typed on a separate line, without indentation. Use lower-case lettertype.
f) SI units should be used.

5. Abstract. The abstract should be clear, descriptive and not longer than 200 words.

6. Tables. Place each table on a separate page and lebel them clearly with a number and title; double-space all material; omit vertical lines. Units of measure should be metric, with two places of decimals. Base-dates for index numbers, geographical area covered and sources be clearly stated. Statistical differences, letters for the 5% (<0.05) and 1% (<0.01) significance levels should be indicated. Avoid footnotes. Authors are fully responsible for the accuracy of the data and for checking their proofs, but whenever they feel that the referee would have difficulty in testing the derivation of their statistics, they should provide supplementary notes on the method used, which will not be published.

7. Figures and illustrations. Figures should be clearly drawn, with clearly marked axes and must be numbered. Lettering on the figures must be sharp and dark enough to withstand reduction. Figures must be cited in the text, submitted on separate sheets and accompanied by the basic statistics required for their preparation, when appropriate. In short, send the illustration (say bar graph) with the tables from which the graph was derived. The editors may prefer your graph presented as a pie chart or as a table. Illustrations should be in black and white, if colour is (absolutely) necessary, indicate in the covering letter.

8.**References**
a)All publications cited in the text should be presented in a list of references following the text of the manuscript. Carefully check the manuscript to ensure that the spelling of author's names and dates are exactly the same in the text as in the reference list.
b) In the text refer to the author's name (without initial) and year of publication. Examples: Mukiibi: "(1982) has shown that ...." "This is in agreement with results obtained later (Bekunda, 1990)".
c) If reference is made in the text to a publication written by more than two authors the name of the first author should be used followed by "et al.". This indication, however, should never be used in the list of references. In this list, mention the names of first author and co-authors.
d) Chronologically arrange references cited together in the text. Arrange the list of references alphabetically on authors' names, and chronologically per author. If an author's name in the list is also mentioned with co-authors the following order should be used: publications of the single author, arranged according to publication dates - publications of the same author with one co-author - publications of the author with more than one co-author. Publications by the same author(s) in the same year should be listed as 1974a, 1974b, etc.
e) Arrange your references as shown:
(i) For books, write as:
Gaugh, Jr., H.G., 1992. *Statistical Analysis of Regional Yield Trials*. Elsevier, Amsterdam, 278 pp.
Stover, R.H. and Simmonds, N.W., 1987. *Bananas*. Tropical Agriculture Series. Longman, Singapore, 468 pp.
(ii) For periodicals.
Bekunda, M.A., Smethurst, P.J., Khanna, P.K. and Willet, J.R., 1990. Effects of post-harvest residue management on labile soil phosphorus in a *Pinus radiator* Plantation, *Forest Ecology and Management*, 38:13-25.
(iii) For edited symposia, special issues, books, etc. published in a periodical, write as:
Swift, M.J., Bohren, L., Izac, A.M. and Woomer, P.L., 1994 Biological management of tropical soil: Intergrating process research and farm practice. In: P.L. Woomer and M.J. Swift (Editors), *The Biological Management of Tropical Soil Fertility*. John Wiley, Chickester, UK, pp. 209-227.
f) Titles of periodicals in the list of references should be in full.
g) Work accepted for publication but not yet published should be referred to as "in press".
h) References concerning unpublished data and "personal communications" should not be cited in the reference list but may be mentioned in the text.

Guide for Authors Continued

9. Formulae

a) Leave ample space around the formulae.

b) Subscripts and superscripts should be clear.

c) Clearly show the difference between letters and figures that resemble, e.g. zero (0) and letter O, and one (1) and the letter l.

d) Give the meaning of all symbols immediately after the equation in which they are first used.

e) Equations should be numbered serially at the right-hand side in parentheses. In general only equations explicitly denoted by exp.

f) The use of fractional powers instead of root signs is recommended. Also powers of e are often more conveniently denoted by exp.

g) Levels of statistical significance which can be mentioned without further explanation are *p<0.05, **p<0.001 and ***p<0.001.

h) In chemical formulae, valence of ions should be given as e.g. Mg^{2+} and SO_4^{2-}, not as Mg^{--} or SO_4^{--}.

i) Isotope numbers should precede the symbols, e.g. ^{14}C.

j) The repeated writing of chemical formulea in the text is to be avoided where reasonably possible; instead, the name of the compound should be given in full. Exceptions may be made in the case of a very long name occurring very frequently or in the case of a compound being described as the end product of a gravimetric determination (e.g. phosphate as $P_2 O_5$.

k) Use e.g. kg ha^{-1} instead of kg/ha, etc.

10. Nomenclature

a) With the exception of common domestic animals, identify all biotica (crops, plants, insects, birds, mammals, etc.) by their scientific names when the English term is first used.

b) All biocides and other organic compounds must be identified by their Geneva names when first used in the text. Active ingredients of all formulations should be likewise identified.

c) For chemical nomenclature, the conventions of the International Union of Pure and Applied Chemistry and the official recommendations of the IUPAC-IUB Combined Commission on Biochemical Nomenclature should be followed.

11. Offprints

Could be ordered in an off print order form.

Order Form

Uganda Journal of Agricultural Sciences (UJAS)

Subscription Information for 1 Year

	Local	Africa	Elsewhere
Institutions	$ 40	$ 80	$ 120
Individuals	$ 20	$ 40	$ 60

If you wish to be a subscriber please fill in the required information and return to the address below:

Full name: Prof./Dr/Mr/Ms.....

Designation.....

Organisation/Institution.....

Address.....

.....

Country.....Post/Zip code.....

E-mail.....

Tel:.....

Fax:.....

Signature.....Date.....

NB: Prices in Uganda Shillings are determined by the Dollar exchange rate at that particular time,

All payments should be by draft cheques payable to "Uganda Journal of Agricultural Sciences (UJAS)", National Agricultural Research Organisation (NARO), P. O. Box 295, Entebbe, Uganda or sent by telegraphic transfer to ***"UJAS, Acc. No.0119431-001, Nile Bank Ltd , Main Branch, Plot No 22 Jinja Road, Kampala, Uganda.***

Uganda Journal of Agricultural Sciences

A Multi-Disciplinary Journal Devoted to the Study and Promotion of Agriculture and Natural Resources, Livestock, and Fisheries Development

(Volume 2 Issue 2)

CONTENTS