

Environmental Impact of Agriculture in Tanzania: Policies for Sustainable Development

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Introduction

Increasing environmental degradation in various forms, including deforestation, overgrazing, loss of soil fertility, soil erosion, water and air pollution has of late been of concern worldwide. This concern has given rise to a number of international fora such as the 1972 Stockholm Conference, the Bruntland and the South Commissions, and the Earth Summit held in Rio de Janeiro in June 1992. The main objective of these actions has been to bring to the attention of the international community the deterioration of the environment, and the need to exploit natural resources while also ensuring that future generations will be able to support their lives from the same resources, i.e exploitation in a sustainable way.

Tanzania's agricultural sector is the mainstay of the economy and its increased production and productivity is, and will be, vital for the economy in the foreseeable future. However, care must be taken to ensure that its contribution to the economy is sustainable by preserving the environment on which the sector depends.

Since Tanzania's economy is dominated by agriculture, it is through agriculture that most of the degradation of the environment is likely to occur and thereby threaten the sector and to make it unsustainable in the long run, which entails economic regression in the sector, leading to a decline in the living standards of the people. There is inadequate attention paid to environmental conservation. Legislation and land tenure systems, do not adequately address the enhancement of sustainable use of natural resources.

Appropriate national and sectoral policies are required to mitigate degradation and let depletion of the natural resource base on which agriculture and other economic activities depend. This paper attempts to highlight some of the important policies needed. Section 2 defines the existing agricultural environment while section 3 explores the patterns of agricultural resource use and impacts on the environment. Section 4 suggests policies on institutional

and on administrative frameworks for environmental conservation. Recommendations are given in section five.

Background

The Agricultural Environment

The country is ecologically very diverse and can be classified into seven agro-ecological zones.¹ Only 5% of the agricultural land is cultivated, although about 20% has a high probability of 750mm. of rainfall and has potentially productive soils.

Soils

Soils are another determinant of the type of crops that can be grown. Tanzanian soils show a wide diversity. A simplified classification of these soils is as follows:

- (a) Volcanic soils which are found mainly in Arusha, Kilimanjaro and the South Western Highlands. These soils are of high agricultural potential;
- (b) Light sandy soils these are found mainly in the coastal areas;
- (c) Soils of granite origin these occur in the mid-west especially in Mwanza, Tabora. They tend to be poor and acidic;
- (d) Red soils are found in the central plateau;
- (e) Iron stone soils - these are found in the far West including Kagera, Kigoma and Sumbawanga. They are inherently poor and acidic, but can be very productive through mulching and manuring; and
- (f) The *mbuga* black cotton soils which occur in many parts of the country.

Vegetation

Vegetation in Tanzania follows the rainfall pattern. Humid highland areas are covered by forests, while savannah woodlands with varying density of trees and grass occupy the semi-humid and semi-arid areas. The humid areas are mostly highland areas, which cover about 18.5% of the country area. They include North-Western and Eastern, Southern and South Western highlands. The less humid and semi-arid areas cover the central part of the country.

The Socio-Economic Environment

Population

Based on the 1988 census, Tanzania's population is estimated to be about 26 million, with a growth rate of 2.8%. Overall, the population density is low, averaging about 19 persons per square kilometer. However, wide variations in density exist between areas of greatest agricultural potential and those of low potential. For example, Ukerewe Island, Kilimanjaro, Mwanza and Dar-es-Salaam have densities of over 200 persons per square km, while Lindi, Rukwa, Ruvuma and Tabora regions are sparsely populated. Some of the latter areas have unreliable rainfall and infertile soils.

Nationally, there is no serious pressure on land, the pressure is local and regional. Areas of highest agricultural potential, e.g. volcanic, colluvial and alluvial soils are densely populated. This is evidenced in Kilimanjaro Region and other areas where saturation levels have been reached and migration into other regions and urban centres has occurred.

Other areas with sparse population, but good rainfall and good soils, include the Usangu Plains of Mbeya and the Kilombero Valley. These areas have increasingly attracted pastoralists and agriculturalists from other areas of the country, resulting in land use and ownership conflicts between the newcomers and the indigenous people.³

Economy

The Tanzanian economy is largely dependent on agriculture. Agriculture accounts for some 90% of direct or indirect employment, about 50% of GDP, and more than 75% of foreign exchange earnings.⁴ Food crop production accounts for 55% of the value added at current prices.

The livestock sector accounts for 30% of the contribution of agriculture to GDP with traditional cash crops (coffee, cotton, cashew, sugar, pyrethrum, tea, tobacco sisal) contributing another 8%. Fishing and hunting contribute 6% and forestry 1% of agriculture value added.⁵

Resource Use, Policies and Impact on Environment

Land Use Pattern

Tanzania has a total land area of 94.3 million hectares. A large share of the land is reserved with national parks occupying 4.2 million ha.; game reserves 7.7 million ha.; and forest reserves 10.1 million ha. The area under crops is estimated at 5.1 million ha.⁶

Table 1: *Land Use in Mainland Tanzania*

Pasture	63%	Arable	6%
Forest	10%	Parks	4%
Game	8%	Cropped	3%
Water	6%		

Source: Agricultural Sector Memorandum

The country's agricultural potential varies, ranging from semi-arid to highly productive land under rain-fed agriculture. Much of the most productive land is, however, now settled, and as the population pressure continues to rise people are settling, grazing and cultivating more intensively on the marginal areas. Nearly half of the country is occupied by forest and woodland which are estimated to cover 44 million hectares.

Land Tenure and Land Use Policies

(a) Land Tenure

Land tenure in Tanzania is still largely influenced by customary tenure system, where land is communally owned and user rights are administered through the clan. Transfers to outsiders are rare. By law, land is ultimately the property of the government. Land markets are not recognised. However, land acquisitions by sale are widespread as was found out in the Cornell/ERB's survey: "Poverty Profile".

(b) Land Legislation

The key land legislation in Tanzania is the Land Tenure Ordinance No.3/1923 (Land Ordinance Chapter 113) enacted under British Administration in 1923. This Act declared all land as public, whether occupied or unoccupied. Land could, however, be given under freehold rights provided initially to settlers and to large commercial agricultural undertakings. The other land was publicly held for use under a "right of occupancy" by indigenous Tanzanians, defined in 1928 to include the "title of a native community lawfully using or occupying land in accordance with the customary law". To date, the Ordinance has failed to protect the principle of native lands by the government for the benefits of immigrants or other interests.

After independence, all freehold lands were converted to government leaseholds under the Freehold Titles (Conversion) and Government Leases Act. The non-freehold land has continued to be regulated by the traditional tenure systems.

(c) Villagization

Of the changes in land tenure brought by the Arusha Declaration of 1967, villagization has been the most important. Land use in the reorganized villages is a mix between individual tenure (new, undeveloped plot) and communal plot "block farms". Not only did this "Operation Sogezza" severely disrupt agricultural production, but it also contributed to land degradation. Massive shifting of people was not necessarily accompanied by studies of the agricultural potential of new areas or their sustainability (Kikula, 1996: Forthcoming).

The Village Act of 1975 gave the power of land allocation to District Development Directors and called for the establishment of village boundaries and village registration. Later the Local Government (District Authorities) Act 1982, consolidated the Village Act of 1975, by giving the power of allocation of land for communal or individual use to village councils. Under this arrangement, there was no guarantee of rights over land ownership and ownership could be terminated at the will of the state. Security of tenure was, therefore, non-existent.

The agricultural and livestock policies of 1983 attempted to address the problem of tenure insecurity within the framework of village based tenure. In practice this meant that part of the land allocated to villages could be sub-leased to individuals, enterprises or institutions for shorter periods of between 33 and 99 years. However, such leases can not be sold.

There are several shortcomings in the existing land policy and legislation.⁷ These are:

- (a) The inadequate resources at the Ministry of Lands, Housing and Urban Development to survey village land in order to give them titles as required by the government.
- (b) The creation of new villages and the movement of population under the villagization programmes had social and production effects whose impacts are still unquantifiable. The process of demarcation of land is not popular and is in some places being resisted;
- (c) There are difficulties in defining and demarcating the area over which each village shall exercise control. Priorities in determining which villages to title first are unspecified;
- (d) The nature of the village title and its effect on the derived titles and traditional user rights of residents is unclear, quite apart from the uncertainty created;
- (e) The effect of village-based titling on the "rights" of non-residents such as nomadic grazing groups, who, prior to titling used such village resources as grazing areas or trees on a predictable basis, is unclear;
- (f) The management of "common natural resources" such as grazing areas, trees, lakes, rivers, is unclear;
- (g) The degree of village control of transfers of land, and its powers of allocation across individuals or enterprises, is unclear;
- (h) The relationship between village authorities and government agencies and institutions (including the hierarchy of local government elected bodies - district and regional), and their ability and authority to decide on tenure issues is unclear; and
- (i) Resolution of intra- and inter-village conflicts and the national authorities (for example, powers of acquisition for "public purposes"), is unclear.

The decision to go ahead with the titling of land to villages in Tanzania (as a first phase towards an eventual individualization of title) is based on the belief that such "title" would improve security of tenure and that this improvement would bring with it increased investment in land and management, resulting in intensification and improved yields and rural incomes. Land security in Tanzania is, however, far from secure. Some studies have suggested that security of tenure through titling is less important in enhancing productivity and land management in traditional societies.⁸ The success of agriculture functioning under customary tenure systems, it is argued, is "built on the

solidarity of small-scale social entities.” These entities may cease to function if national institutions or national and international mobility of labour destroy their legitimacy, or if loyalties to lineage and communal groups become weak.⁹

The above observations suggest that the customary land tenure, which still dominates rural land ownership in Tanzania inspite of villagization, should be recognised and allowed to evolve without interference. Government intervention would be needed to confirm individual rights in areas where these are already well developed, or to permit the introduction of commercialized, intensive agriculture in regions where the tenure systems appropriate to this type of land management have not yet evolved. Such selective government intervention should be sanctioned under an umbrella land tenure legislation, which establishes basic principles and procedures. The assumptions on which the proposals are made are that:

- (i) In rural Tanzania, land use and land tenure systems are established at the local village level. This is where land management is implemented and rules are enforced.
- (ii) Although the extent to which villagization has affected specific areas is unclear, the evidence from the Cornell/ERB survey suggests that traditional systems have survived. These are usually more effective than formal-legal systems.
- (iii) Villagers are generally aware of their land boundaries.
- (iv) Within villages and depending, in part, on their proximity to urban areas and communications networks, land transactions (purchase or rental) take place with prices reflecting location and land quality.
- (v) Population increase and government policies favouring agriculture have resulted in the extension of cultivation to lands of lower agricultural potential and to the reduction of areas available for pastoralists and trans-humans.
- (vi) Present uncertainties with regard to rights to land combined with the power of government to acquire land at inadequate compensation levels does not encourage either agricultural innovation, or development. More importantly, there is little incentive to improve land management and conservation.

One shortcoming of the current land tenure policies and legislation has been the virtual exclusion of pastoralist's and agro-pastoralist's rights to grazing lands and water rights in the arid and semi-arid areas. This exclusion has contributed towards the current land use conflicts between agriculturalists expanding into traditional grazing lands and pastoralists.

Crop Agriculture

The potential cultivable land for agricultural production is estimated at 40 million hectares of which only 6.5 million hectares are cultivated. This is only 13% of the cultivable land.

Characteristics of Smallholder Agriculture

Small family farms form the core of the agricultural economy, occupying about 90% of cultivated area. The contribution to food production by this category amounts to 92% of the area cropped. With regard to permanent crops, small-holders are responsible for 75% of the area under cultivation. With 79% under cultivation or fallow, small farmers make more intensive use of

Table 2: *Land Under Farms*

	Land Under Small Farms		Land Under Large Farms		Land Under All Farms	
Temporary crops	2,515	55%	218	16%	2,733	46%
Permanent crops	340	7%	102	8%	442	7%
Mixed Temporary & Permanent crops	227	5%			227	4%
Sub-Total (Cropped Area)	3,082		302		3,402	
Fallow (Up to 5 years)	552	12%	159	12%	711	12%
Pastures	120	3%	399	30%	519	9%
Forest	450	18%	147	11%	597	10%
Other	387	8%	298	23%	685	12%
TOTAL	4,591	100%	1,323	100%	5,914	100%

Sources: Agricultural Sample Survey 1987/88, Bureau of Statistics, October 1990; and Survey of Large Scale Farming Report, Tanzania Mainland 1987/88; Bureau of Statistics, December 1990.

their land than the large farmers who cultivate and fallow only 36% (see Table 2). The average size of a smallholder farm is small, ranging between 0.01-2.00 ha. About 93% of all smallholder cultivated area comprises of these farms. In addition, smallholder agriculture in Tanzania is characterized by the following main features:

(i) Inputs Availability and Improved Technology

In comparison with other parts of Eastern Africa, the use of inputs like fertilizers and improved seeds in Tanzania is more widespread.⁹ However, the adoption of improved technology by farmers, is still low. Ox-plough use in the 1-2 ha. farm size category is only 20%. Similarly, pesticide users constitute only about 20% of the farming community. High yielding and disease resistant varieties are still scarce, although the rate of adoption is increasing.¹⁰ Fertilizer use has doubled over the 15 year period from 1971/72 to 1986/87, going from 7 to 14% of all farmers.¹¹ This trend has continued, and by 1991 some 26% of all

farmers used fertilizer.¹² The increase was, however, registered by farmers in the 2-4 ha. farm size category, while there was a decline in the 0-0.5 farm size category. The rate of application is still low, about 21kg/ha in 1991.¹³

The constraints on the use of fertilizers relate to the availability and timeliness of supply, lack of credit to poor farmers, information on proper application and poor infrastructure which limits accessibility to rural areas. The majority of smallholder farmers are, therefore, forced to rely primarily on household labour and traditional farming techniques with the objective of meeting subsistence needs, with some cash through small surplus production of food and/or cash crops being a secondary objective.

The above constraints on input availability and distribution negatively affect productivity of labour and land. Yields per area are low. As land becomes ever more scarce, traditional fallowing systems are no longer feasible. The alternative to meeting the needs for more food and cash, partly due to population pressure and urbanization (estimated to be at a rate of 8.3% in Tanzania) has, to a large extent, depended on bringing more land under cultivation.

It has generally been observed that fertilizer over-use can cause environmental degradation, including contamination of underground water due to leaching. This is however, more common in large scale farming, particularly in areas under irrigation. These areas are usually associated with high intensity of inputs use, but are not widespread in Tanzania.

In Tanzania fertilizer is still subsidized, currently at 25%. Subsidy was to be phased out from the 1994/95 season. Even with subsidy, the use of fertilizers, as noted above, is still low in Tanzania. Subsidies however, have a potential of contributing to environmental degradation through over-use.

Because of low use of improved technology, agricultural growth is mostly low and follows population growth patterns. New under-utilized areas are assigned to new families, to immigrants and the area cultivated gradually expands, with the best areas being taken first and expansion extending into marginal areas, with the attendant degradation.

Deforestation is one outcome of this phenomenon. Consequences of destruction of forests and woodlands for the agricultural sector are felt at two levels. At a local level, rural communities feel the effect first through scarcity of firewood and other forest/woodlands products such as fodder and medicinal plants. As these communities experience the scarcity, they forage further afield, using roots and crop and thus adding to soil instability and fertility. Over a larger geographical region, deforestation has serious consequences for watershed management and causes increased flooding intensity.

In Tanzania, the Sukumaland area has been systematically deforested since the 19th century for crop cultivation, and especially as a result of the expansion of cotton cultivation.¹⁴ Accelerated destruction of woodlands has resulted from cash crop farming. Tobacco farming in Tabora and pyrethrum farming in the Southern Highlands, which requires wood energy for curing, has decimated large tracts of woodlands. Removal of vegetative cover exposes the soil to direct sunlight, rainfall and wind. These are erosive agents which contribute to soil and land quality deterioration.

Improving farm inputs and their timeliness, credit availability and

information, improvement in marketing and transport infrastructure as well as research into better varieties will improve agriculture productivity.¹⁵

(ii) Agro-Chemicals

The agro-chemicals used in Tanzania include fungicides, insecticides and herbicides. They are confined mainly to cash crop growing, particularly for coffee and cotton. In 1987/88 season they accounted for 50% of procurement of farm inputs down from 83% in 1984/85. The fungicides, copper and sulphur, are used mainly in coffee and cashew farms respectively. Insecticides use in cotton exceeds that used in coffee growing. Herbicides are used mainly in coffee, tobacco, tea, horticulture and cereals. Of late the use of sulphur fungicides for cashew plants has increased steadily¹⁶ as have production levels.

Environmental impacts of chemical use in agriculture in Tanzania are yet to be documented. However, it is known that over-use will have negative effects. It leads to resistance, harmful residues in food crops and environmental pollution. Over-use of chemicals may decimate other forms of life like insects, thus disturbing the ecological equilibrium. Cotton and coffee growing areas would be most affected as they employ a lot of pesticides. Integrated pest management techniques which are environmentally friendly can limit cases of pest resistance to chemicals.

Large Scale Farming

Large scale farming is not widespread in Tanzania (about 10% of cultivated land). One example of large scale farming is the Hanang wheat project area in Karatu in Arusha, which was taken from pastoralists. This has squeezed the available pastoral lands for grazing, increasing land use conflicts with pastoralists, as well as increasing land degradation. As a result soil erosion in the area has increased. The experience of Hanang raises questions as to whether large-scale farming is sustainable on lands that are essentially marginal. Floods have also devastated many farms in Babati and the Basuto wheat complex in Hanang District.

Irrigation Agriculture

There are a few irrigated crop production schemes in the country. About 0.9 million hectares are irrigable, of which only 15% is under irrigation. As pointed out by Svendsen¹⁷ irrigated agriculture displays key features that characterize and cause serious problems to its sustainability.

The first is discontinuity of response to inputs as the water table rises to reach the crop root zone (waterlogging), which renders land unproductive for some years or requires expensive remedial measures, especially if the subsurface water is saline.

Secondly, there are externalities as a result of irrigation i.e. causing side effects at another area and at another point in time. One of the most important of these externalities is the effect of over-exploitation of a watershed above an irrigation or electricity reservoir on the reservoir itself, leading to increased siltation.

Other changes in soil parameters are alkalinity, permeability and general physical characteristics of the soil, which in effect reduce agricultural productivity. In addition, irrigation schemes may increase or introduce incidences of water borne diseases such as malaria, amoebiasis, cholera, bilharzia etc., which affect the health and productivity of the people. Svendsen suggests that the policies required to achieve sustainable use of irrigated agriculture will include a combination of:¹⁸

- physical improvements to existing systems;
- changes in management structure and practices; and
- economic incentives for a more rational use of the resources.

Some undesirable environmental impacts have been noted in Tanzania, although their magnitude and actual quantification are yet to be done. Population increase in irrigated areas aggravates pressure on available land and water resources. Such resources include fuel-wood, marginal lands brought into agriculture and building materials. The population of Mto wa Mbu Scheme for example, has increased from 1,200 to 7,000 between 1958 and 1978. Land use conflicts, have developed as a result of encroachment of pasture and game land at the Mto wa Mbu Irrigation Scheme.¹⁹ Free movement of animals has been blocked as well as increased incidents of poaching as more people settle adjacent to the game area.²⁰ In addition, crop agriculture has expanded into areas previously used as dry land pasture and as watering points by pastoralists.²¹

Furthermore, ecological imbalance can lead to investigation of vermin into the irrigated area. For example, the large rice schemes at Dakawa have attracted *Quelea Quelea* birds into the area, a feature which was unknown when people used to cultivate small plots.²²

Destruction of catchment areas and siltation are common environmental side effects associated with irrigation schemes in Tanzania. Recently concern has been expressed over the destruction of the Ruaha catchment area and siltation of Mtera Dam as a result of uncontrolled agricultural activities in Ruaha catchment area and the irrigation schemes in the Usangu Plains.

An important policy measure that can be effected in order to reduce over-irrigation, is appropriate pricing of water. This measure, apart from improving cost recovery from expensive schemes and thereby providing resources for further investment in the sector, will improve water conservation. Other incentives could be designed with the aim of encouraging water conservation.

Pastoral Agriculture

The system of pastoralism, which includes trans-humans and agro-pastoralists, has evolved over many years into an equilibrium that is efficient in providing a way of storing sporadic grass and rain in usable form throughout the year. As a system it is adaptable for coping with drought. But the increased population of man and cattle has made it harder for semi-arid grazing land to recover from the effects of recurring droughts. Ownership of large numbers of cattle is

a source of wealth - "banks on hooves". More lands have been taken up for agriculture, thus squeezing the rangelands, because rangelands usually are marginal lands, characterized by low quality, productivity and high production risks. Changes in farming systems on such land, such as mono-cropping or yield enhancing activities like heavy mechanization, may render them even more vulnerable, unless properly adapted.

In Tanzania, time series data on land use for agriculture and livestock is not available. Land taken from pastoralists for agricultural purposes is exemplified by the Hanang wheat farms in Arusha. About 26 million hectares are currently under grazing. Most of the grazing lands in Tanzania are part of extensive rangelands found in the semi-arid areas of less than 750 mm of rainfall such as Dodoma, Shinyanga, Singida and Arusha. The rangelands support more than 13 million cattle, 10 million sheep and goats. More than 90% of feed requirements come from these rangelands which are exploited under traditional systems of land ownership.²³

The carrying capacity of livestock has been "conservatively" estimated to be 20 million units.²⁴ However due to diseases, tsetse fly infestation, disparities in the distribution of infrastructure, failure of destocking policies and the nomadic behaviour of pastoralists, nearly 60% of livestock is concentrated in only 10% of the land.²⁵ "The pursuance of uncoordinated and conflicting objectives on the use of land also limits the more even distribution of livestock. For example, the establishment of forest reserves has resulted in a loss of dry season grazing".²⁶

In Sukumaland, where there is already a danger of desertification, tsetse fly control efforts have, in the past, relied on destruction of large tracts of woodlands. This procedure, which started in the 1920s, has left, large tracts of land bare. Aided by overgrazing in the area, the practise has resulted into soil erosion, siltation of water reservoirs, increased frequency of floods and reduced soil fertility. This environmental degradation may increase the incidence of crop failure and famine in the area.

Summary of Environmental Impacts of Agriculture

(a) Soil Erosion

Soil erosion is probably the worst environmental hazard from agriculture. It occurs as a result of the exposure of the soils to erosive agents, which in turn causes land degradation in almost all regions of Tanzania mainland. It is a serious problem in both plains and sloping lands of maize/beans farming systems where there is no tree cover. In pastoral and agro-pastoral systems, overgrazing contributes to soil erosion through removal of grass from overgrazed lands. Among the most affected regions are: Arusha, Dodoma, Kilimanjaro, Shinyanga, Singida, Tabora, Mwanza, Mbeya and Iringa regions.

Some of these areas are the same ones where both crop and livestock farming is carried out most intensively to support the population as well as production of export crops. Bad land use practices also fail to protect land adequately from the erosive effects of water and wind. Such practices include:

- (i) Hillside cultivation without terraces or other remedial measures.

- (ii) Lack of crop rotation, such as cereal/legumes rotation to replenish soil nutrients and organic matter which improve the physical characteristics of soils and making them resistant to erosive agents, e.g. water holding capacity.
- (iii) Burning or removal of crop residues is a common practice in many regions. This practice robs soil of organic matter - the building block of fertile and stable soils. Burning of crop wastes also hardens the upper soil layer. As a result, soil cannot absorb water and runoff is accelerated.
- (iv) Non use of organic manure like compost and animal manure, even by farmers keeping cattle. Some farmers claim increased growth of weeds as a result of manure application. But organic manure increases organic matter in the soil and improves soil stability.
- (v) Pastoralist and agro-pastoralist overstocking contributes to overgrazing, migration in search of pasture. Similarly, water and land for cultivation has accelerated land degradation not only in traditional rangelands, but also in the new settled areas. Migration from the north and central parts to the Southern Highlands has degraded the environment in those areas.

The effects of soil erosion include siltation of rivers and dams like Mtera; loss of fertile top soil in agricultural lands like Isimani in Iringa; loss of water holding capacity and, therefore, increased runoff and frequency of floods like the Moshi floods of 1990.

(b) Deforestation

Deforestation resulting from agriculture occurs mainly due to farmland expansion, and the requirements for fuel wood and charcoal for agricultural produce processing including such activities as cooking, tobacco and pyrethrum curing as well as building material for resettlement. As mentioned earlier, these activities expose soils to harsh climatic condition. In addition, water catchment areas are destroyed, and streams feeding to rivers dry up, thereby reducing the volume of water flow downstream with further repercussions on hydro-electricity and water for irrigation and other purposes. Other forest products may also be lost through deforestation such as medicinal plants, honey etc.

(c) Land Use Conflicts

Conflicts among users of land has principally been between pastoralist and crop farmers, especially in Arusha region and Usangu plains. It is evident that the four activities related to agriculture i.e. cropping, irrigation, pastoral and forests systems have inter-linkages. Changes in one area are, therefore, likely to have repercussions in many others. If agricultural activities are to be sustained

there is urgent need for government policy to address the issue with a view to mitigating the degradation.

Some Conservation Efforts in Crop Agriculture

(a) Government Efforts

Soil degradation has been one of the most visible of the land degradation effects of agriculture in Tanzania. Soil conservation has, therefore, received attention by the government as well and some non-governmental organizations. The increasing population pressure has also put more pressure on the government to act in order to sustain the productivity of the land. Some of the soil conservation activities in agriculture include:

- (i) Training and extension services offered to farmers by district/regional land use extension teams. Demonstration on how to develop erosion control structures using simple tools like line levels is made to the villagers by the experts. Better land cultivation practices such as crop rotation, terracing etc. are also taught. This has been strengthened by the introduction of the NALERP project supported by the World Bank. Adoption rates are however below expectations.
- (ii) Promotion of agro-forestry practices in rural areas to encourage mixing of trees and crops for food and fuel wood supply. Insufficient supply of seedlings and improper choice of species are the main drawbacks in the villages.
- (iii) Soil surveys and land use planning control is an important conservation measure. Yet only a few areas have received this service.
- (iv) Enforcement of by-laws does discourage post-harvest farm grazing and steep slope cultivation. Poor and/or non enforcement of these by-laws and other legislation have however left most of these lands open to degradation. There is also political interference with the enforcement of laws and by-laws.
- (v) Promotion of fertilizer and manure application on farms to raise crop yield reduces shifting cultivation. The problem here has been the delayed and/or poor distribution of fertilizers in the regions.

There are a number of activities in the agricultural sector that can help to control soil erosion but implementing these activities has not been easy and the achievement has been minimal. Good results are usually realized in donor aided integrated projects because of availability of inputs, finance and technical advice.

(b) Soil Conservation Activities by NGO's, Institutions, and Individuals

In Tanzania environmental degradation is of concern not only to the government but also to other bodies. Some individuals, NGOs and private companies have and are directly or indirectly involved in conservation activities. They include Catholic and Lutheran churches, Mwanza Flora Conservation, Bonite Bottlers Limited (IPP), Tanzania Tree Planting Foundation (Handeni), TESO, Malihai Clubs of Tanzania (Arusha), and Sikh Sawmill Company Ltd. (TWICO).

(c) Population Resettlement

Various reasons have been advanced to justify population resettlement in Tanzania. The main reason has been to reduce stress on land such as Mbulu,²⁷ Kilimanjaro etc. However, while this improves resource utilization, degradation will also take place in new areas as people migrate into such areas with their livestock. Resettlement was done out of purely political reasons, as was the case with the villagization programme.²⁸ The concentration of people (and their livestock) increased pressure on the new lands.

Conservation Measures in Pastoral Agriculture

As a way of reducing environmental degradation by pastoral agriculture, some of the activities undertaken by the government include the following:

- (i) Formulation of livestock marketing policy that encourages culling of livestock by villages. The aim is to design an effective marketing system which will assist in alleviating the overstocking problem. However, there is an apparent shortage of markets in some areas, due mainly to their inaccessibility.
- (ii) De-stocking campaigns are part of the extension programmes. Ten percent de-stocking rate appears to be a yardstick although the response and results are generally poor. The policy does not state who is to enforce the de-stocking effort.
- (iii) Measures to improve and develop rangelands to counteract severe overgrazing, emphasizing on well planned water points distribution, tsetse control and reseedling or oversowing to rehabilitate denuded areas. Today these efforts are almost in a standstill due to financial constraints.
- (iv) Pasture seed production research and pasture development activities have been instituted to supplement the over-utilized rangelands. Seed production project, under TALIRO are implemented at some stations like Kongwa and Tengeru, while pasture production is one of the activities of some parastatals like DAFCO, NARCO, and NAFCO. However, seed production has never satisfied demand. Pasture research is conducted at Sokoine University of Agriculture (SUA),

UAC and by TALIRO centres. Some of these parastatals are - however - to be phased out following reforms.

- (v) Directives to shift livestock from over-stocked zones to under-stocked ones are aimed at avoiding localized land degradation. However, the idea is not effective in the case of Shinyanga and Mbeya due to poor organisation, planning, follow-up and poor inter-sectoral co-operation. This shift also assumes that there will be no conflicts on land use between indigenous land users and the newcomers.
- (vi) Improvement of livestock and management strategies such as promoting cross breeding and zero grazing, aim at changing people's attitudes of keeping low quality herds of cattle. The acceptance of projects like HIP is a case in point. Poor supply of heifers has been the main snag.
- (vii) Grass planting to stabilize soils is a direct effort to control soil erosion. Sod forming grass species like star grass has been used to stabilize water dams in some areas e.g. Kiteto District.
- (viii) Attempts to establish ranching associations in order to rationalize range use and development have failed in the past. There is need to involve the local communities.
- (ix) Most of the conservation programmes and activities leading to soil erosion control in the livestock sector are unfortunately concentrated in government institutions and large private farms. The programmes have limited access to the traditional livestock sector which constitutes the main group directly contributing to overgrazing. Consequently most measures under this sector have proved ineffective. They remain good plans, on paper, without any positive impact on soil conservation.

Some Lessons From Past and On-going Conservation Attempts

The Principal reason for failure of conservation schemes is their non acceptance by the peasants. The following observations on on-going soil conservation and related programmes refer to:

- (i) Conservation schemes that are complicated, requiring a lot of technical staff attention and continuing maintenance, fail after a few years.
- (ii) Techniques which are already familiar have greater chances of acceptance; ridging (*matuta*) is an example in Sukumaland.
- (iii) Laborious conservation schemes e.g bench terracing are sometimes

resisted by people, especially if the labour is required at critical times of the year like during cultivating and weeding season. However, terracing is sometimes quickly accepted in areas with shortage of land and steep slopes e.g Chome ward under TIP in Same District.

- (iv) Measures that require centrally imposed regulations and fines fail. They are considered unfair and, therefore, not adequately enforceable suggesting that regulations and enforcement should be more locally based.
- (v) Intra-societal controls are more effective. The HASHI project in Meatu District has won the people's support. Incentives like supply of porridge, food on work sites and study tours have had encouraging results. However, it is questionable if such centres are sustainable in the absence of donor funding.

Towards Environmental Conservation: Policy and Institutional Arrangements

Economics has traditionally treated environmental and social concerns as externalities. However, ecological degradation now threatens to undermine economic development, necessitating a change in the tools of decision making to internalize environmental concerns in economic projects and activities. For sustainable development, the future must be compensated for environmental losses by equivalent assets. Markets are the best channel through which this compensation can be effected.

The majority of rural Tanzanians are poor peasants. Since large scale farms are a small proportion of total agricultural output, it is the peasants who contribute, or may contribute to environmental degradation. Over-exploitation and irreversible degradation of their natural resource base is often a result of inadequate policy and the institutional environment in which the rural households operate. Peasants are, however, rational in their decision making and act on economic and social incentives in a predictable way, provided information and market infrastructure is adequate.

Tools that can be used to effectively correct for environmental neglect are mainly economic, but social and legal policies are important to ensure their success.

Economic, Social, Legal, Policies and Instruments

Several policy instruments to prevent or correct environmental damage resulting from agricultural activity can be designed. In this section, we attempt to survey some of such policies and instruments.

Economic Policies

There are four groups of economic policies that have an effect on sustainable agriculture. First, are the macro-economic policies which determine broad

parameters such as exchange rate, monetary and fiscal policies. Second, there are the micro-economic policies which affect agricultural activity directly, such as input and output prices, or user charges for services provided by the public sector. Third, there are the legal and social practices that determine the functioning of markets, such as natural resource products which can be bought and sold; and how property rights are defined. Fourth, there are policies directly designed to control resources degradation and reduce pollution which may be enacted through a range of environmental instruments.

(a) Macro-Economic Policies

The IMF/World Bank induced reforms almost always include, among others, exchange rate, monetary and fiscal policies, which may have an adverse effect on natural resource use. Exchange rate devaluation, for example, is often associated with increased export of traded crops. However, the increase in production may be positive or negative on resource conservation criteria depending on the type of crop and method of cultivation. Perennial crop production increases - e.g. coffee - have soil conserving characteristics, while annual crop increases - e.g. tobacco - increase deforestation. Increased pesticide use is detrimental to the environment.

The extent of the damage to the environment brought about by such policies is difficult to quantify. Macro-economic policies are, however, designed mainly for economic stabilization and long term growth. Any environmental hazard brought about by the policies must, therefore, be countered by other instruments e.g. pricing policy.

(b) Micro-Economic Policies

Economic policy instruments can dramatically lower the cost of achieving environmental goals by allowing producers and consumers to decide how best to meet them at least cost. More importantly, broad market based incentives can bring about adjustments needed to deal with complex, long lived, dispersed environmental problems associated with various consumption and production patterns.

Price policy instruments provide powerful and continuous incentives for the development and adoption of resource-saving and waste-reducing products and processes. Rapid, environmentally favourable technological improvement, which is essential if living standards for all are to improve, can best be stimulated by market based - mechanisms, reflecting full costs, including the costs of environmental protection - is the appropriate starting point.

Input and output price policies, and resource user charges may be employed here. Examples include irrigation water, fertilizer and agro-chemical user charges through price policies. The revenues obtained may be directed towards reforestation (in the case of deforestation as a result of tobacco) and other mitigating activities with no extra cost to public finance. Price signals may also be used focussing on small rather than large scale irrigation projects. In agriculture, such revenues will be important in funding livestock and crop research for high yielding and disease resistant genotypes. The latter will greatly contribute towards increasing the productivity of land and labour, reducing

the need to bring new marginal lands into production. User charges may also be imposed on rangeland use to act as incentive against overgrazing.

Environmental Instruments

These are specifically designed to deal with environmental degradation and pollution and may include regulatory, economic and persuasive measures.

(a) Regulatory Instruments

These are instruments applied and enforced, and they carry penalties for non-compliance. These may include laws preventing farming in certain areas or banning the planting of certain crops on steep sloping lands; stipulating the maximum number of livestock to be kept in certain areas to prevent overgrazing etc.

While such regulatory measures are in use in Tanzania, implementation is generally weak due to lack of information and corruption. The problem is that they depend heavily on an efficient and effective legal and institutional framework, and thus underscores their importance.

(b) Economic Instruments

Charges imposed should reflect the additional price the pollutant must pay to have access to resource use. This activity raises revenue and also serves as an incentive for alternative non-polluting processes. The revenue may also be used for research and subsidies for alternative non-polluting processes. They are administered in the form of taxes and input/output subsidies with the aim of correcting environmental damage.

Subsidies on fertilizer and agro-chemicals that have been in place in Tanzania are due for scraping. Although no reports of environmental damage have been indicated so far, chemicals have a high potential for damaging the environment. Subsidy on chemical implies a subsidy for environmental destruction.

A positive subsidy will be on alternative tools e.g. subsidy on electric cookers which is an incentive for using electricity instead of fuel wood; free tree seedlings for afforestation, etc. However, the success here will depend on the ability of the government to raise enough revenue for the subsidies, although this can be offset by revenue obtained from penalties or taxes imposed on polluting activities.

(c) Persuasive Measures

Education and awareness programmes play an important role in conservation. Pressure can be applied directly or indirectly to ensure voluntary agreements between resource users, farmers and government on environmental issues, e.g. they can be used to support persuasive measures.

Government extension activities form part of persuasive activity. In agriculture this may promote agro-forestry for fodder and fuel-wood while reducing soil erosion by improving soil cover and tree barriers of rain run-offs. In livestock, sterilization, culling and persuasion to increase market offtake are some of the measures.

Social Policies and Legislation

The function of the law is to provide a framework within which problems of sustainability of resource use and development are addressed. Therefore, where appropriate, regulations should be used to set standards for desirable agricultural and other economic practices and in order to minimize their negative effects. This will include procedures which promote local (government, villages, etc.) regulation and resources management. These include:

- land tenure issues and security.
- legal standards for Environmental Impact Assessment (EIA).

This may be made a mandatory exercise for all envisaged projects and programmes, which require internalization of environmental costs of projects, projects and plans before they are considered for financing or implementation. Legal intervention may also be required to halt any activity which violates a set standard of environmental degradation.

The above instruments and policies assume an economy run by private enterprise. Markets are important for marketeers and, therefore, the government must also develop infrastructure like roads to improve accessibility.

Institutional and Administrative Arrangements

Provided they are properly designed and implemented the above mentioned policies and instruments are adequate for addressing environmental issues, since they employ market incentives. They require that the central government avoids centralization of all aspects of economic activity. People must be involved at the grassroot level, and must also be given authority of control and management over their resources with advice, such as "extension for environment" services from the government.

Currently, there is no comprehensive, well coordinated and coherent environmental policy. There are, however, a number of sectoral environmental policies. Policy formulation and implementation has remained the responsibility of line ministries and departments. This not only creates problems associated with conflicting interests of the various departments, but also makes coordination and implementation difficult because of the struggle for turfs and status.

For example, the agriculture and livestock policies of 1983 which stressed increased production, entail in part expansion and encroachment into, and hence destruction of, forests and woodlands while the forestry and wildlife policies aim at conserving forests and wildlife. Furthermore, the policies' advocacy of forest clearing and woodlands as a tsetse control measure for human and livestock wellbeing runs contrary to the forestry policy.

Environmental issues cut across all sectors of the economy, in that utilization of resources can cause adverse effects both in and outside it. Therefore, any efforts towards mitigating these internal and external effects need to be inter-disciplinary or holistic in approach. For that matter, there

must be an institutional framework which is able to provide authority across government departments, ministries and private players in order for policies and regulations to be effective. The question then arises: who should set these policies, or rather who should recommend the setting of policies and regulations to be put in place, as well as to monitor the environment?

Realizing the gravity of environmental degradation and its negative effects on the sustainability of the economy, the government has attempted to take some mitigation measures. In addition to line ministries and departments, some institutions which specifically aim at protecting the environment through monitoring, managing and conserving have been created. Some of these include the National Environmental Management Council (NEMC) created in 1986; and the National Land Use Planning Commission (NLUPC). But the problem with all these institutions is that there are no clearly defined boundaries of action for each. Overlap of activities is common. There may, therefore, be a need to have a body whose authority cuts across all sections of government. Such a body should monitor and set policies that aim at regulating economic activities to take environmental concerns on board.

Whether setting of overall environmental policies should be done at ministerial level or at the executive level of government is open to debate. However, it must be pointed out here that a ministry may find it difficult to co-ordinate other ministries. Consequently, it may require that environmental policies and implementation of such policies be done at a level well above that of the ministries. Such a level could well be in the President's Office or an independent environmental body directly under the executive arm of government. Such an organ could be empowered to make policy to resolve conflicts and provide co-ordination.

In addition to having a coordinating body, it will be important to have a committee to advise the executive body. This should be composed of individuals with technical expertise, non-governmental organizations both local and international and universities.

Conclusion and Recommendations

This paper has focused on the importance of agriculture in the economy and the importance of improving production and productivity to support it. The paper has also highlighted some areas where environmental degradation has occurred as a result of agricultural activities. These include soil erosion and loss of soil fertility, deforestation, siltation of reservoirs and dams, land use conflicts, desertification, encroachment into reserved areas such as forests and wildlife areas, and destruction of water catchment areas and overgrazing. Degradation of the environment threatens sustainability of agriculture and, therefore, the viability of the economy.

Measures towards mitigation of these effects can be employed mainly through economic, social and legal policies and regulations. These measures need to be holistic in nature and should take account of the externalities. Research into better cultivation methods and livestock breeds (high yielding, disease resistant) and extension services should be strengthened.

An authoritative institutional framework able to prevail across all levels of the government is required to set and monitor policies. Such a framework will need to be higher up in the government hierarchy, probably at the executive level - the Presidents Office.

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