SOME ENVIRONMENTAL CAUSES OF FOOD INSECURITY IN SEMI-ARID TANZANIA

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Abstract

The potential for the production of crops and livestock in the semi-arid areas of Tanzania ranges from medium for the former to high for the latter under conservation farming. It is contended that contemporary land husbandry practices have triggered land degradation and hence threatened food security. Results have shown that traditional land use practices coupled with some latent factors have resulted in chronic and seasonal food shortage. A holistic approach to assessing and combating environmental degradation and food insecurity in semi-arid areas has been proposed.

Introduction

Man's economic activities on the earth's surface are the major force behind environmental degradation. In the semi-arid areas of Igunga and Shinyanga districts, most of the inhabitants grow crops and keep livestock and hence they are predominantly agropastoralists. Their production systems are predominantly based on a low level indigenous technology. These agropastoralists are living in a marginal ecosystem where a degraded environment contributes substantially to their poverty, food shortage and malnutrition. Their continued struggle for survival further destroys their fragile environment. It is also envisaged that land degradation results in declining land productivity and low food crop yields. It follows logically that a low crop yield is one of the major factors causing food insecurity especially in poor rural communities.

The continual degradation of the land which eventually leads to desert-like conditions is usually addressed as a technical problem by distinguished scholars such as Stallings (1957), Morgan (1986), and Hudson (1981) who propagate terracing, tree planting and similar conservation techniques. The problems of land degradation and indeed food insecurity in Developing Countries are more socio-economic than technical (Blaikie 1985). In essence the solution could be sought in the ways the land users tend to their crops, livestock and land itself as well as economic policies in place.

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The term food security may be referred to as the goal of increasing food for all segments of society (Mandivamba and Eicher, 1987). It could be achieved when all household members have access to food of an adequate nutritional quality over the short and long run. The concept of food security gives equal weight to the demand aspects as on the production or supply oriented aspects of improvements to per capita food consumption. It is determined by what the society is able to produce, import , process, store and prepare for meals.

The primary objectives of this study are two fold. Firstly, to capture peoples' perception of the problem of environmental degradation and food insecurity. This is built on the premise that the rural people are the victims of as well as agents for alleviating their problems. Secondly, to establish a base on which a holistic assessment of land degradation and food insecurity and strategies to combat them should be pegged.

Methodology

The study was predominantly based on empirical data collected through questionnaire. The objectives of the survey, time and financial resources influenced greatly the design of the respective research instrument which focused on land utilisation type characterisation (FAO 1983). Due to the difficulty of predicting farmers' and pastoralists' responses, questionnaire items were mostly open-ended. Food security assessment was carried out by using the 'Bag Model' (Shirika la Chakula na Lishe, Tanzania 1988).

A simple random sampling method was employed in the selection of households to be interviewed in each village. The sample size constituted 56 households for Busongo, 50 for Mwamashele located in Shinyanga region and 62 for Makomero located in Tabora region. A total of 168 heads of households were interviewed.

To complement the questionnaire derived data, village meetings were held with a view to discovering the existence or otherwise of popular awareness of the degradation and food insecurity problems. Some data were also gathered through consultation with District and Regional officials whose activities have a direct bearing on the environment and development. Furthermore, available literature both published and unpublished contributed to a better understanding of the research problem.

A reconnaissance land survey of the land units was also carried out. The main activities included the compilation of an inventory of biotic resources based on randomly located sites along traverses running from interfluves to valley bottoms.

Environmental Resources: An Overview

Shinyanga and Igunga districts are found in Shinyanga and Tabora regions respectively in central western Tanzania to the south of Lake Victoria. The surveyed villages namely Busongo and Mwamashele are located in southeast Shinyanga while Makomero village is found in eastern Igunga (Figure 1). In terms of coordinates, the three villages lie between 33°40' and 33°50' East of Greenwich and between 3°40' and 5°40' South of the Equator.

A reconnaissance survey of the environmental resources of the area has been reported among others by Wangell, et al. (1969) and Hankins, et al. (1971).

Geology and Geomorphic Resources:

Geologically, these areas are underlain by calcareous lacustrine deposits and some sodium rich sediments. These Pleistocene to recent lake and river deposits overlie Pre-Cambrian granitic crystalline rocks and form the soil parent materials. The terrain is a monotonously flat plain with a few limestone hills. The villages are characterised by a predominantly flat landscape with occasional depressions and dissected by seasonal rivers. In general they stand at an altitude of between 1000 and 1200 m. above mean sea level.

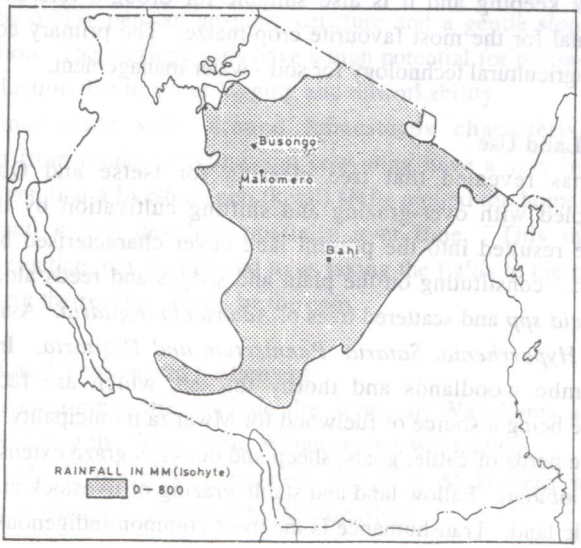

Figure 1 Location of study areas.

Climatic Resources

Located in the semi-arid zone, the villages are characterised by scanty and highly unreliable rainfall. The rainy season occurs between November/December and April/May. The mean annual rainfall ranges between 400 and 800 mm (Fig. 1). Hazardous drought spells, however, are not uncommon in this area during the rainy season. The resultant moisture stress causes crop failure. Prolonged drought also occurs and has a negative impact on pasture and crops resulting in livestock deaths and famine. The last two years have been bad years characterised by food shortage in the area. It should be emphasised, however, that drought is but a precursor of land degradation and food insecurity. There is a small difference between the mean maximum and mean minimum temperatures given the relative continental location of the area. Whereas the high mean maximum of 32°C is recorded in October just before the onset of the rains, the low mean minimum of 19°C is for April during the heavy cloud and high rain. There is, however, a marked diurnal temperature variation especially during the dry season.

Potential evaporation is highest in October (244 mm) and falls rapidly in February (158 mm) yet exceeds actual evaporation all the year round. The average annual soil water growing period (GP) therefore may be referred to as short, averaging to less than 90 days and characterised by unreliable onset.

Generally the area has a high potential for livestock production but a low one for livestock keeping and it is also suitable for drought tolerant crops but extremely marginal for the most favourite crop-maize. The primary constraint is, therefore, a low agricultural technology for soil - water management.

Vegetation and Land Use

History has revealed that tree clearing for tsetse and Queleaquelea eradication coupled with over-grazing and shifting cultivation by the Sukuma community have resulted into the present land cover characterised by degraded bushed grassland constituting on the plain and sedges and reeds along the river courses, the *Acacia spp* and scattered trees of *Adansonia digitaria.* Available grass species include *Hyparrhenia, Sataria, Pannisetum and Digitaria.* In some area there are miombo woodlands and thorny thickets which are facing a high deforestation rate being a source of fuelwood for Mwanza municipality.

Free range herds of cattle, goats, sheep and donkeys graze extensively on the open grassland (*mbuga).* Fallow land and stable grazing of livestock are a common practice on arable land. Transhumance is the most common indigenous technology used to combat rangeland degradation in the study are whilst pasture reserves known as *ngitiri* are not rare.

Farming is another landuse of major economic importance. The main crops grown include cotton, sunflower, sorghum, millet, maize and groundnuts. Other crops are sweet potatoes, pigeon peas, cassava and bambala nuts. Besides cotton and maize which are under intermediate agricultural technology the rest of the crops are cultivated by employing traditional methods (Rugumamu, 1991).

Soils

The Sukuma people who form the majority in the villages have a working knowledge of the soils they use and a means of recognising and distinguishing them (Milne, 1947). The area is characterised by undulating soilscapes and three major soil types arise out of that spatial variation (Rugumamu, 1991). These are: (a) model polypedon of the flat interfluve tentatively correlated to Cambisols and Solanchacks, (b) model polypedon on the gentle slope (1.5°-2°) down the catena tentatively correlated to Planosols, Gleysols and Solonchaks and (c) the lowest member of the catena on the flatlands which could be tentatively correlated to Vertisols and Fluvisols (FAO-UNESCO 1974). Besides these, man-made soils form around the homestead and are characterised by accumulation of cow dung and domestic garbage resulting in an anthropic epipedon.

The interfluve soils have a moderately high potential for crop production under good management practices, the midslope soils have a low potential as reflected by mediocre stands of bulbrush millet and sorghum and constrained as to their depth by a clay pan, an unstable structure and a gentle slope making them prone to erosion. The toeslope soils have a high potential for pasture and a low one for crop production due to water logging and unworkability.

The man-made soils around homesteads characterised by humus accumulation from domestic refuse and cow-dung have a very high agricultural potential. Given that a livestock pen (kraal) shifts around the homestead, a zone of highly productive soil develops spatially over time. This indigenous land amelioration practice may be referred to as taking the fields to the manure when as matter of course the reverse should be the case.

Population Land Tenure and Settlement

The main communities include the dominant Wasukuma and other small societies constituting the Wanyaturu, Wataturu and Wachagga.

From Table 1, the least populated village is Makomero while the most populated one is Busongo, followed by Mwamashele.

Table 1 Population of studied villages

Village	No of Households	Population
Busongo	287	1,468
Mwamashele	249	1,236
Makomero	160	680

Source: Village records.

The sample household size shown in Table 2, reflects the population characteristics in Table 1, with Busongo having the largest household and Makomero the smallest.

Table 2 Sample household size

Village	Mean	Range
Busongo	6	3-10
Mwamashele	5	3-9
Makomero	3	1-8

Although in Tanzania all land belongs to the State, traditional systems of land ownership are still in practice in these villages (The Agricultural Policy 1983). Land ownership is either by village government allocation, inheritance, purchase or rent (Rugumamu 1991). Grazing land that belongs to village government is communally owned and used. Traditional grazing reserves are also found in these villages and are known as *ngitiri*.

It is important to point out that Makomero has been recently inhabited by the Wasukuma and Wanyaturu thus reflecting the small household size. Some household members however have yet to join the core families and also culturally the purely pastoral communities tend to have small families. In Busongo and Mwamashele, however, households which are agropastoral are larger than the purely peasant ones. These are old village settlements dating back to the pre 1974 Ujamaa Villages. The concentration of large numbers of people in a prescribed land area appears to have contributed to the land resource overutilization and subsequent degradation as population grew through the 1980s to the present. In all

cases, however, it has been discovered that agropastoral families are richer and command more power than purely peasant and pastoral ones.

Within the potentialities of the above ecological setting however, the Sukuma agropastoralists have evolved land use types that have so far supported their livelihood as a community and at the same time contributed to national development. The production of maize and beef cattle for the local market and cotton and hides and skins for export is a testimony of the Sukuma traditional agricultural technology. It is in this environmental setting that analysis of the cultural aspects of land use that contribute to land degradation and form the core of the problem of food insecurity obtained in these rural communities is made.

Agricultural Land Use Practices and Environmental Degradation

The ingenuity and diligence with which man manages the land resources determine which crops to be grown where and when, the type of livestock to be kept, the required inputs and expected production in a spatio-temporal perspective (Figure 2). In the study area, Rugumamu (1991) identified five land use types namely (i) smallholder rainfed farming with intermediate technology based on cotton; (ii) smallholder rainfed farming with intermediate technology based on maize; (iii) smallholder rainfed farming with improved indigenous technology based on intercropped cereals; (iv) smallholder livestock keeping with improved indigenous technology based on free range livestock associated with crops; and (v) small scale range reclamation based on biological and mechanical soil conservation carried out by the Government of Tanzania. An understanding of land tenure system and land use practices, therefore, is pivotal in evaluating peoples' perception of the land degradation hazards and is a key to decision making regarding the intensity of land use and the maintenance and or improvement of the land resources' productivity by the land developer - the agropastoralist.

The two types of land tenure system strongly influence land management and conservation. Under the customary land tenure a farmer can in practice rent or loan part of his land or sell it to someone who is in need of more farmland. As for the communal form of land tenure, all land belongs to the village government. In this case members of the village usually organise themselves under their government and develop the land either communally (Ujamaa farms popularly known as - *Mfumaki*) or as a cooperative venture (village pasture reserves - *ngitiri.)* Communal land is continually being fragmented to cater for village youths who wish to establish their homesteads.

The land tenure systems allow for a free access to the use of the land. For farmers who wish to expand their arable land, the village government allocates them

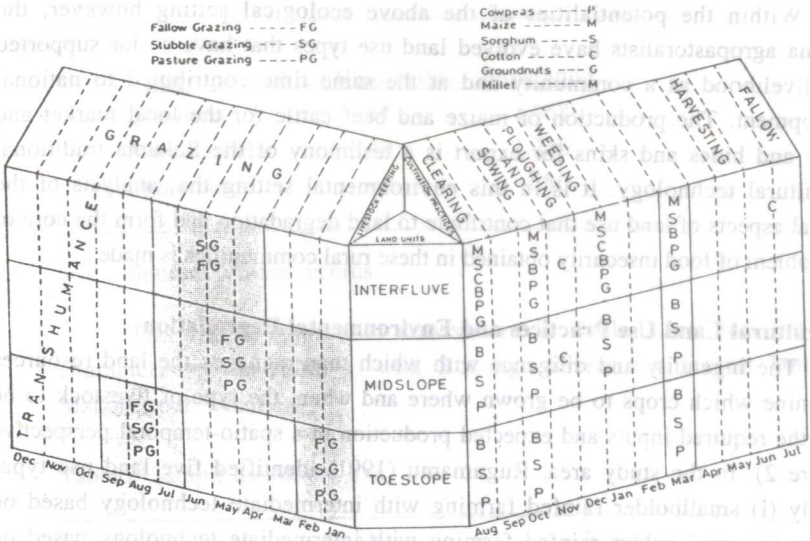

Figure 2 A spatio - temporal model of land use types.

extra land for as long as they may wish to continue using it (Table 3). It is indeed this practice that provides for short fallow of the private plot - an improvement of shifting cultivation (Rugumamu 1989). The practice has adverse effects on pastureland that is converted into arable land over and above a decline in soil productivity over time (Figure 2). The rate of population growth therefore has a great negative influence on future availability and access to land.

When communal land is finally abandoned primarily due to declining yields, this arable land is susceptible to water and wind-borne erosion and reverts to pastureland (Fig. 2). Sheet erosion, rills and gullies develop thus rendering the land unproductive. This development also has some off-site environmental impacts and indeed confirms the cause for the southward settlement trend by the majority of Wasukuma in the area (Collins 1968). The developed gullies tend to extend to neighbouring arable land, both upslope and downslope. Silting on the other hand takes place in adjacent lower members of the catena. In the final analysis the tenure system does not guarantee a sustainable utilisation of the land resource base.

The survey revealed that in Mwamashele village 24% of the respondents had acquired their farmland through purchase from landlords while in Busongo and Makomero it was 9% and 3% respectively (Table 3).

As for the inheritance mode of land acquisition, the sample showed that 16% inherited their farmland in Mwamashele village while 4% did so in Busongo village and none in Makomero village. From the table above it is observed that in all the studied villages the commonest way of obtaining land is by village government allocation. The observed trend may probably be a result of the villagization programme (Table 3).

Table 3 Land acquisition

Village	Mode of Acquisition (No of households)		
	Government	Purchase	Inheritance
Busongo	58 (100%)	6 (11%)	2 (4%)
Mwamashele	30 (60%)	12 (24%)	8 (16%)
Makomero	60 (97%)	2 (3%)	0

Currently, efforts by the Ministry of Lands Housing and Urban Development are underway to provide title deeds to village governments in Busongo and Mwamashele stating their legal rights and responsibilities on the land held. This exercise is aimed at implementing the 1983 Agricultural Policy which seeks to encourage people to invest in agriculture for a sustainable utilisation of the land resource as opposed to short term ownership that leads to soil mining. This will facilitate the acquisition of loans from banks for developing the agricultural industry. It is hoped that this positive move will instil into the agropastoralists some degree of confidence and responsibility which will encourage them to protect the land against degradation hazards.

Regarding the size of farmlands, the main aim was to find out how much arable land the sample farmers have access to ploughing, in any one year. Table 4, shows that the distribution of farm sizes in the sample vary greatly.

The range of farm sizes at household level varies significantly from a minimum of 0.25 hectares in Makomero to a maximum of 56 hectares in the same village. In the whole sample, Makomero, has the smallest farm size probably because pure pastoral communities predominate and also the largest farm size due to immigrant Sukuma people seeking for virgin land for extensive cultivation.

Table 4 Farm sizes in the studied villages

Village	size (hectares)	
	Mean	range
Busongo	3.5	1.5 - 14.0
Mwamashele	2.8	2.1 - 10.5
Makomero	4.5	0.25 - 56.0

Source: Village records.

At household level total cultivable land is an aggregation of small plots of the order of 0.25 ha. or less. Although land fragmentation at low level technology concentrates degradation processes in small plots, the practice tends to spread these processes over wider areas dotted with such plots resulting in lower yields over time. The recent southward movement of the Wasukuma (as indicated before), may explain in part the availability of larger farmlands in Makomero compared to the northern villages. Another indicator of availability of arable land in this village is the existence of miombo woodland and bushland that are also sources of fuelwood for Igunga township as well as Mwanza municipality.

The survey has revealed that environmental degradation in the form of accelerated soil erosion ensued with the colonisation of land for crop and livestock production. Between 1960s and 1970s there was very scanty evidence of soil erosion. It was reported that from the late seventies to the present, the soil erosion problem has become severe (Kumbukumbu ya Warsha ya Kitaifa ya Upandaji Miti, 1984). The field survey has shown that there were several depressions and riverines where water for domestic and livestock uses could be obtained way back in the early nineteen seventies. Today, however, those water sources have either dried up or the water table has fallen beyond accessible exploitation using the indigenous technology.

Almost all the respondents reported that the evidence of soil erosion on the farm land is loss of top soil known as sheet erosion. Some farmers, however, do not take cognisance of the problem, and subsequently do nothing to control it.

Tie-ridges are common in most cotton and maize plots. Farmers in the survey area argue that they have to put up, the ridges only when the soils are too shallow for the crops. It may be argued that the management of soil and surface runoff is secondary in the study area.

Only a few farmers, 11.9% of the respondents fallowed part of their arable land. This could be due to the small plots they own. The only fallow period, therefore, is between harvesting and ploughing which allows no land recovery.

The problem of environmental degradation could also be directly attributed to poor extension services. Results of the survey have revealed that both agricultural and forestry extension staff rarely visit the farmers (Table 5).

.Just over a half of the respondents (56%) in the case villages reported that extension staff visited them once in a year. About 20% of the respondents said that they had never seen an extension officer in their farms. Judging from site observations these agropastoralists do not get adequate advice on land, crop, livestock and pasture husbandry. In essence the extension service should adopt a new technology package to convey to the land users and by the same token be prepared to learn from the peoples' rich experience as this is essentially a two way process. A change in the way the message is delivered could significantly get it across more effectively. The above cultural aspects built-in the crop and land husbandry systems are a pointer to induced low productivity and poor yields.

Table 5 : Number of visits by extension staff in a year

Village	Frequency in a year (%)			
	Once	Twice	Thrice	Never
Busongo	62.5	4.2	5.1	28.2
Mwamashele	59.0	20.0	2.0	19.0
Makomero	56.5	15.4	28.1	

Livestock Keeping and Environmental Degradation

In semi-arid environments all over the world, livestock production has been proved to be one of the most suitable land uses (Raikes 1981). Busongo, Mwamashele and Makomelo villages are no exception. The main system of livestock and pasture management is transhumance. The grazing resources include the degraded rangelands, bushlands, and woodlands, as well as fallow and crop residues within and outside the village boundaries (Figure 2). The Sukuma people as already noted, traditionally enclose pasture reserve which are jealously guarded against trespass.

Indigenous livestock and land husbandry practices dominate the livestock economy in the area surveyed (Rugumamu, 1991). It should be noted, however, that the natural mechanisms for pasture protection and destocking such as tsetse

flies and lack of water are gradually decreasing in effectiveness due to improved veterinary services. Furthermore, the *ngitiri* system is also becoming less important as the range deterioration worsens parallel with livestock population rise. Currently, pasture is reserved for the lactating, calves and oxen . The situation becomes more complex when the owners of large herds of cattle take a lion's share of the common range resource without any reclamation efforts. This leads to the incapability of the ecosystem to sustain the present livestock population on indigenous technology within the village land resource base.

In response to increased pressure of the livestock population on land, these agropastoralists have embarked on a transhumance management system whereby herds of cattle are being driven away from the village, district and even region to the neighbouring republics in the south for greener pastures (Rugumamu 1989). It is important to point out that cultural aspects inherent in the livestock and land management systems underlie the problem of land degradation and food insecurity.

With the early signs of desertification causing concern not only to the agropastoralists but also to both the Government of Tanzania and the international community, a number of projects have been initiated. For Shinyanga districts, the Norwegian assisted Shinyanga Soil Conservation and Agroforestry project (SHISCAP) has already gained roots in Busongo village. The focus is on reclaiming degraded pastureland through soil erosion control structures and tree planting. The herders however, are yet to be effectively involved in rehabilitating their land!

In the other surveyed areas the afforestation campaign which requires every household to plant trees around the homestead is gaining momentum. The main constraint is that prolonged periods of drought have resulted in the wilting and subsequent death of seedlings. Furthermore village bushlands are being enclosed and protected against all types of use in order to facilitate bush regeneration. The project is gaining success through the deployment of peoples' militia (Sungusungu).

A long term solution to the deforestation process resulting from crop and pasture land demands and fuelwood needs however, has to be sought. Given that the rural poor cannot readily switch to alternative energy sources, there is need to develop a more efficient use of the available wood and cow-dung resources. An introduction of energy saving charcoal stoves and biogas technology along with the afforestation campaign may yield fast and lasting results in combating devegetation, soil erosion and declining yields..

The contemporary agropastoral and forestry technology employed in exploiting the land resources is defined to upsetting the ecological balance completely. For every measure to increase agricultural, pasture or forest output,

special consideration must always be given to the impact it creates upon the general ecological balance and quality of life of the agropastoralists.

Relation Between Environmental Change Food Production and Food Insecurity

As already noted the food security equation places emphasis on the demand aspect as it does on the supply side. An assessment of the relationship between the degradation of the land resource base and food insecurity was conducted by using the 'Bag Model' (Shirika la Chakula na Lishe, 1988). It is assumed that one bag of cereals weighs approximately 90 kilograms. It is further assumed that an individual household is a nucleus for the planning of production and consumption at village level. Basically, it is the household that is responsible for the assessment of the food situation and making decisions on the amount of land to be cultivated, the types of crops to be grown and when to start planting, harvesting, processing and storing and even the actual preparation of meals to be consumed.

The key variables in this crude method include estimation of cultivated, land yield and production (Table 6). The household food requirement has been estimated by the Tanzania Food and Nutrition Centre (Shirika la Chakula na Lishe 1988 p.43). In the study area the estimated food demand in the sample households is shown in Table 6. (Here, legumes constitute pulses and groundnuts).

Table 6: Food Requirement in Sample Households

Village	No of people per household	Cereals (bags/year)	Legumes (bags/year)
Makomelo	3	9	1.5
Busongo	6	18	3.5
Mwamashele	5	15	2.5

By way of comparison, yields of maize and millet in the study areas are higher than the regional averages for 1986-87 (KILIMO 1988) and 1988-89 (FAO-KILIMO 1989). This may be attributed to a small sample size studied in the reconnaissance survey. The crude results however point to the production potential of the land and the productivity of labour.

By matching the household food demand with the production , it is evident that the villages studied have a food surplus with respect to carbohydrate rich foods (Table 6 and 7). The protein rich foods (amino-acids) however, show an appreciable deficit (Table 6 and 7). The so called food crops, however, have been sold for cash

in order to meet emergence basic needs. This has been more common for maize in situations where cooperative societies fail to pay farmers in cash on selling cotton. The tendency has a very severe negative impact on resource poor households (those who do not own livestock). This state of affairs is an indicator of a malnourished society.

Table 7 Sample household food production

Village/Crop	Maize			Millet			Sweet potatoes			Legume		
	Fs	Y	P	Fs	Y	P	Fs	Y	P	Fs	Y	P
Makomelo	1.1	1.9	2.1	2.4	1.2	2.9	1.0	1.0	1.0	1.2	0.8	1.0
Busongo	0.9	1.6	1.4	1.8	1.3	2.3	0.8	1.1	0.9	0.8	0.7	0.6
Mwamashele	0.8	1.5	1.2	1.1	1.2	1.3	0.9	1.1	1.0	0.6	0.7	1.5

Fs - Farm size (ha)
Y - Yield (tons/ha)
P - Production (tons).

It was not easy to get a correct response regarding the number of people in the household who suffer from food deficiency disease. A casual observation however, revealed that some children under five suffered from Kwashiorkor and eye problems. One respondent, for instance, disowned his problem child saying that it belonged to his daughter who lived in town. This is a reflection of peoples' unwillingness to discuss issues that relate to their social status.

It was found out from official sources that care for the under five's is very minimal especially when left home to be cared by their elders as mothers go out for farming or merry-making (Ngoma) activities. Such casual feeding habits often result in malnutrition even when food is abundant at household level. Several children therefore are victims of ignorance caused malnutrition. This is indeed a cultural problem that calls for a revolution.

The bag model's weakness is that it neither considers other sources of household food supplies such as those from relatives, financial remittances by kinsfolk in towns nor does it say anything on other farm enterprises such as livestock products which are important in determining household socio-economic sustainability. It should be noted that dependable cash income may allow a given household to subsist through parts of the food deficit season. One prolonged spell of about two consecutive years, however may spell a disaster to the community.

Furthermore, food self-sufficiency has greatly been altered by increasing commoditisation of food crops. It is not automatic to estimate yield of food crops as basically directly used by the household due to the conversion. It is not surprising to note therefore that this trend has negatively influenced the cultivation and indeed the production of cotton in the study area.

With reference to people's perception of food shortage, it was revealed that 98.5% of the respondents admitted the existence of food shortage during ascertain period in a year. It was noted that protein - rich foods are not accessible between February and May and carbohydrate -rich foods are scarce between December and March. Whilst vitamins are in short supply between July and December. Investigation further showed that most households (75%) reported that time in a year. Hence seasonal hunger before the next harvest is widespread. It is unfortunate that the people repeatedly suffer from food shortages especially when most work is being done in the fields.

Generally, it was discovered that beef is too expensive for a common man in Busongo and Mwamashele villages and less so in Makomelo village where most pastoralists live. The fact that meat shops open intermittently the study area is of a low level beef consumption. It was noted that one normally slaughters his cow when it is either in poor health or he is badly in need of hard cash.

Respondents in the survey reported that the main causes of food shortage in order of significance were drought, low yield, small acreage ploughed, pests, infertile soils and floods (Table 8). It was observed that most serious cause of food shortage and indeed famine is an occasional prolonged drought similar to that which occurred in 1990 and 1991. People in the study villages are prone to periodic food shortages. famine similar to other one reported above afflicted these people in 1973, 1980, 1981, 1982 and 1984. This could be referred to as chronic hunger.

Table 8 Causes of food Shortage

Causes	% Respondents per village		
	Busongo	Makomelo	Mwamashele
drought	100	100	100
low yields	51.8	25.8	40.0
small acreage	23.2	12.9	2.0
pests	14.0	11.2	12.0
infertile soils	7.1	11.2	8.0
floods	5.4	4.8	4.0

During this time the Government intervened by giving food aid to the seriously affected household in the study area. Certainly, food aid is not a sustainable solution of food insecurity. Information from district officials, however, has revealed a post-harvest food loss of the order of 30%. This was attributed in part to prolonged traditional ceremonies and a low level food storage technology.

Peoples' Adjustments to Food Shortage

In response to the aforesaid vagaries of nature, people have developed strategies to combat the problem of food insecurity. Almost all people keeping livestock in the study area resort to selling their stock to avert famine (Table 9). Because drought also affects pasturelands negatively it has a perverse effect on the quality of the animals which fetch a low price on the market. It is worth noting here that natural calamities contribute greatly to destocking and subsequently to the restoration of a dynamic equilibrium between livestock population, feed and the ecosystem. However, these calamities are also at times important factors that mitigate against destocking in this fragile environment when herders believe that the greater the numbers, the more they can efficiently spread risk brought by the calamities. This is the crux of the problems of overstocking, overgrazing and decline of land productivity and food insecurity.

Table 9: People's response to food shortage

Village	Percentage		
	Sell livestock	Sell labour	Sell cotton
Busongo	65.5	12.2	22.8
Mwamashele	80.0	15.7	30.4
Makomelo	92.5	8.2	21.4

Some households which do not own cattle, goats or sheep sell their labour and or cotton in response to normal food shortage. In Makomero village, the collection of Gum-arabica for sale is an important source of cash income during the dry season. It is worth emphasising that the problem of food shortage is part and parcel of most people's way of life in the study area. Due to spatial variation of rainfall, inhabitants in the study area resort to seeking for food in neighbouring villages. In such circumstances they may either get food as donation from relatives or may sell their labour.

The second side of the food security equation constitutes marketing and distribution (Lofchie 1978, and Mujwahuzi 1981). It is very essential to establish efficient administrative capacity to balance deficit with surplus. Whereas it is fairly easy for the pastoralists to move their stock to greener pastures, the peasants are, between harvests, left to the mercy of businessmen who hike food prices so much so that the rural poor cannot afford it, save for the government 'handouts' (free food rations) during prolonged droughts. It is at this juncture that one may question the validity of each rural community to produce all the food it needs in view of the varying local ecological potential as well as the ever changing food consumption habits.

Conclusion and Recommendations

The preceding discussion underscores the poverty, land degradation and food insecurity cycle. The main actor - the poor agropastoralist cultivates the land and keeps cattle. Other than a casual application of animal manure on the cotton crop and vegetables as well as ploughing and transport, it is obvious that the two activities are not organically linked. As a consequence, soil degradation is proceeding at an alarming rate and poverty and food insecurity are prevalent.

The current land tenure system whereby the land user is not accountable for the degradation of the communally owned land is a social malady. HASHI, for instance, should not be a land reclaiming agent but rather be an advisory board on sustainable rural land use systems.

The future of the agricultural industry in this fragile semi-arid ecosystem lies in the revolutionization of the technology of soil resources utilisation. From Gover's (1978) optimistic report on the history of agriculture in Europe, the quotation below is a case in point:

> *"Yields in Europe were low until a couple of centuries ago and soils tended to deteriorate to reach low equilibrium levels under cultivation. As agricultural technology improved and new sources of energy were tapped to provide fresh input to agriculture, cultivation begun to improve fertility and now production from well farmed land is greater than from virgin soil".*

It is, therefore, obvious that the quality of soil resource is a reflection of the level of scientific and technological development of the human resource. A detailed and standardised soil resource inventory is a prerequisite for determining

appropriate conservation activities and in monitoring our natural resource base (Rugumamu 1987).

To attain a dynamic socio-economic ecological balance and equilibrium between livestock population and feed supply as well as between cultivation and grazing within the village setting should be secured. Hence, poor land management resulting from poverty and ignorance should be fought by the government from all fronts. This calls for legislation of livestock movements and cultivation and herding practices and tenure systems.

A technology such as 'agro-silvi-pastoral land use' at farm and community level would most probably raise the productivity of both land and labour. This approach should take advantage of the declining 'ngitiri' system in gaining acceptance and popularity amongst the agropastoralists.

Given that industrial fertilisers are not within reach of most agropastoralists, the growing of leguminous crops such as *leucaena-spp.* which can fix nitrogen in the soil, provide animal feed and woodfuel and also by effectively applying animal manure on farms and by efficiently employing animal power on farm and non-farm operations, development for the rural poor could be achieved. In essence, comprehensive study of the agropastoraralist's day-to-day practices and resources conservation land management problems should enable us to develop agro -technological packages which could improve the agricultural industry in the short term with a long term goal of sustainability of the ecosystem. It is within this context that guidelines for semi-arid land usage development schemes should be formulated. Research into household food self-reliance should therefore be based on matching the qualities of the land with the requirements of the food and export crops and pasture as well as assessing the social cultural values of the people. Let the 21st century see rural communities undertaking economic activities that suit most their environment in totality.

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