

Land Management Systems and Their Environmental Impacts in the Usangu Plains, Tanzania

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Abstract

This paper examines how land management systems have evolved as a result of different migrant groups moving into the Usangu Plains. Several factors have caused these migrations including climate, famines, search for arable and grazing lands, gainful employment, drought and dryland degradation. Findings from the study indicate that migrations into the study area have been more pronounced particularly beginning in the 1970s. This has involved both pastoralists and crop cultivators. The movement of people from different agro-ecological environments into the Usangu Plains has had some effects on the livelihoods of the people and the environment in the area. One of the impacts has been increased pressure on land that has led to decreased fallow periods and consequent decline of soil fertility, and changed land management systems that included introduction of new crops into the area, and intensified irrigation agriculture. Another implication on the environment is that the heavy in-migration of livestock and people into the area, combined with the extension of irrigation areas has created a shortage of grazing land. The consequent grazing in farmlands result in trampling that leads to soil compaction, thus limiting groundwater recharge. Thus it may be of interest to undertake more detailed studies on the effects of environmental changes particularly as they affect agriculture and people's livelihoods.

Introduction

This paper examines how land management systems have evolved as a result of different migrant groups moving into the Usangu Plains. It further looks at the extent to which the resultant management systems are complying with the local ecological conditions in the area. Land management systems in Tanzania have been undergoing some dynamism since fairly early in history. One of the driving forces has, in some places, been rural-rural population mobility (Mbonile & Mwamfupe, 1997), where as people move into new areas they tend to influence the native management systems, which consequently have several impacts on the environment. Several factors have caused these migrations including, among others, climate, security, famine relief, gainful employment and

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seasonal labour in high potential districts. Large movements of people have also been triggered by drought and dryland degradation. These are referred to in literature as 'environmental refugees' (Timberlake, 1988). In Tanzania these movements have involved both crop cultivators and pastoralists, and one of the places where there has been a big influx of in-migrating people is the Usangu Plains.

The rising population and deterioration of land quality in the pastoralist and agro-pastoralist areas of central and northern Tanzania have increasingly forced them to migrate and invade other areas in search for both pastures for livestock and good arable land (Kangalawe & Liwenga, 2005). The Masai, Barabaigs, Kwavi and Sukuma are among the pastoral groups that have been migrating southward into Iringa and Mbeya Regions, as well as into other regions in the south-central Tanzania. However, a significant proportion of these pastoralists and agro-pastoralists are mostly found in the Usangu Plains of Mbeya Region. In addition to the pastoralist and agro-pastoralist groups, today the Usangu Plains also receive Nyakyusa migrants from Rungwe District, the Kinga and Wanji from Makete District of Iringa Region (Figure 1), who are predominantly crop cultivators.

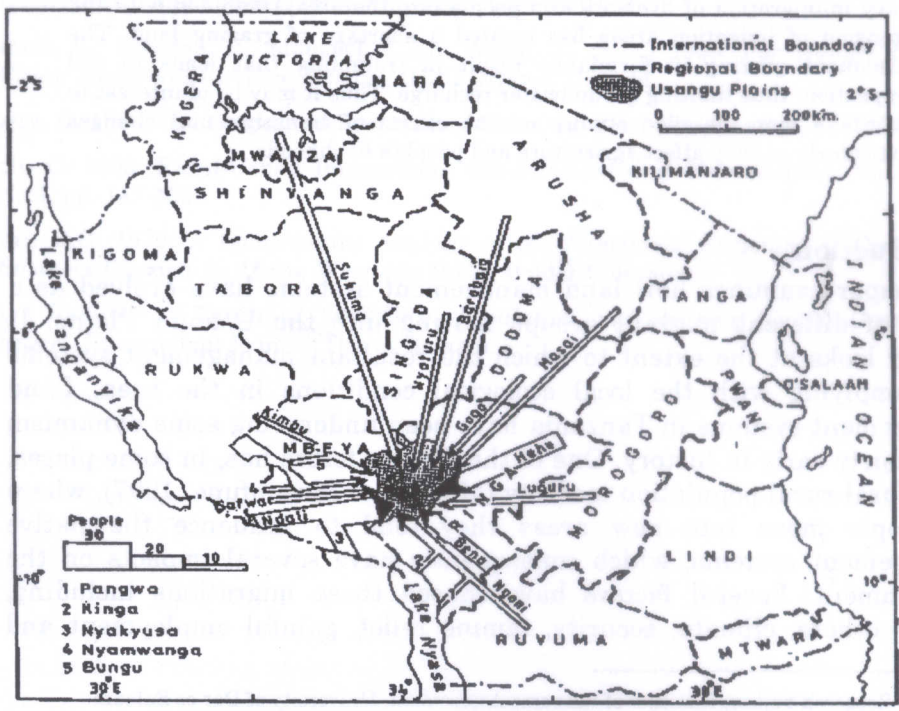


Figure 1: Ethnic migration flow into the Usangu Plains

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The migration of these groups can be traced from the early 1950s. However, the migration of crop cultivators, just like the livestock keepers have become more pronounced beginning the late 1970s. In early times people were reluctant to move into the Usangu Plains due to fear of malaria. Even those who happened to go there it was on seasonal basis, only during paddy cultivation season.

Currently the Usangu Plains are undergoing lots of dynamism of land-use and settlement brought about by new ethnic groups, infrastructural development (e.g. roads, railway line, large-scale irrigation schemes, schools and wildlife). It is estimated that between 50% and 60% of population growth from 1967 to 1976 was a result of in-migration (Hazlewood and Livingstone, 1978). Until 1972 the population of Usangu was composed mainly of Sangu, Nyakyusa, Hehe and Bena, who accounted for about 44%, 17%, 12% and 7% of the total population respectively (McCall, 1982). As such the ways of land management in the plains have also evolved.

One of the significant changes in the farming system of the Usangu Plains was rice becoming an important food and cash crop, its cultivation expanding more into the hinterlands, away from the road network. Settlement patterns are almost following the same dynamics. This once sparsely populated area is gradually becoming overpopulated.

Migrations into the Usangu Plains have involved migrants from areas that are ecologically different from these plains. Moving from zones facing acute shortage of land, and with plenty of rainfall almost throughout the year, migrants from Makete and Rungwe Districts have found themselves into a place where rainfall is seasonal and supporting different combinations of crops. The pastoral and agro-pastoral groups on their part have migrated from semi-arid areas of northern and central Tanzania where crop cultivation is only a marginal economic activity besides livestock keeping. However, the extent to which these migrants have adapted themselves to the new environmental conditions remained unknown. Furthermore, little had been known on whether there have been significant changes in the way these migrants manage their land and the consequent impact of the new land management systems on the environment.

The main objective of the study was to investigate and document how the different migrant groups into the Usangu Plain are managing their land, and the extent to which these management systems are complying with the local ecological conditions in the area. The specific objectives were to: (i) examine how the people (both crop cultivators and livestock keepers) manage their land; (ii) examine to what extent the new land management

systems are adapted/adapting to the local conditions in the area, and what environmental implications these systems have; (iii) determine the land-use conflicts that are likely to arise due to the influx of people into the Usangu Plains; and (iv) examine whether there have been changes in the economic activities both by the indigenous people and the in-migrants.

Methodological Approach

A combination of data collection methods was used to meet the study objectives. Secondary data was collected through a review of various documents available in Mbeya Region, Usangu Plains and libraries in Dar es Salaam. This enabled the study team to identify knowledge gaps. Primary data was collected by using different approaches, including:

- (i) Participatory assessments, mainly using Participatory Rural Appraisal (PRA) techniques. Participatory methods were used particularly to obtain qualitative data because the understanding of the local land management practices and their impacts on the environment require the involvement of and dialogue with the people who have developed and used such practices. These methods allow capturing of local peoples' experiences, knowledge, and skills prevailing in their surrounding environment (Chambers, 1991, 1992; McCracken et al., 1988; Pratt & Loizos, 1992).
- (ii) Formal and informal interviews with key informants from all major ethnic groups in the Usangu Plains (i.e. the Nyakyusa, Hehe, Bena, Wanji/Kinga, Barabaig/Maasai, Sangu and officials from National Agricultural Food Company - NAFCO).
- (iii) Field observations.
- (iv) Household interviews, where a structured questionnaire was administered to heads of households. The questionnaire was designed to solicit such information as socio-economic characteristics of the respondents, farm characteristics, information relating to livestock keeping and the management of cultivation and grazing lands. Other information collected included availability of grazing and cultivation land, as well as environmental concerns.

A random sample was selected, and all the time attempts were made to draw a sample that represented the various groups (crop cultivators, both indigenous and in-migrants, pastoralists, and large scale farmers). The choice of villages for primary data collection was based on the zonation of the Usangu Plains. These plains consist of three main agro-economic zones: the Northern zone, which occupies about half of the total area which has a low agro-economic potential and sparse population; the Central Grazing Zone around the Great Ruaha River; and two Cultivation Zones along the northeast to south and south-western edge of the plains.

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One village was selected from each of the three zones to be included in the survey. From the northern zone Msangaji village was picked to represent an area with sparse population and low rainfall. Mahanjo village in Madibira Ward (see Figure 2) was picked to represent an intermediate area between the Northern Zone and the Central Grazing Zone. In the Cultivation Zone two villages (Uturo and Simike) were selected. Particular emphasis was placed on picking Simike village, which is inhabited mostly by in-migrant crop cultivators from Makete and Rungwe districts, unlike other villages that have been settled mostly by in-migrant pastoralists.

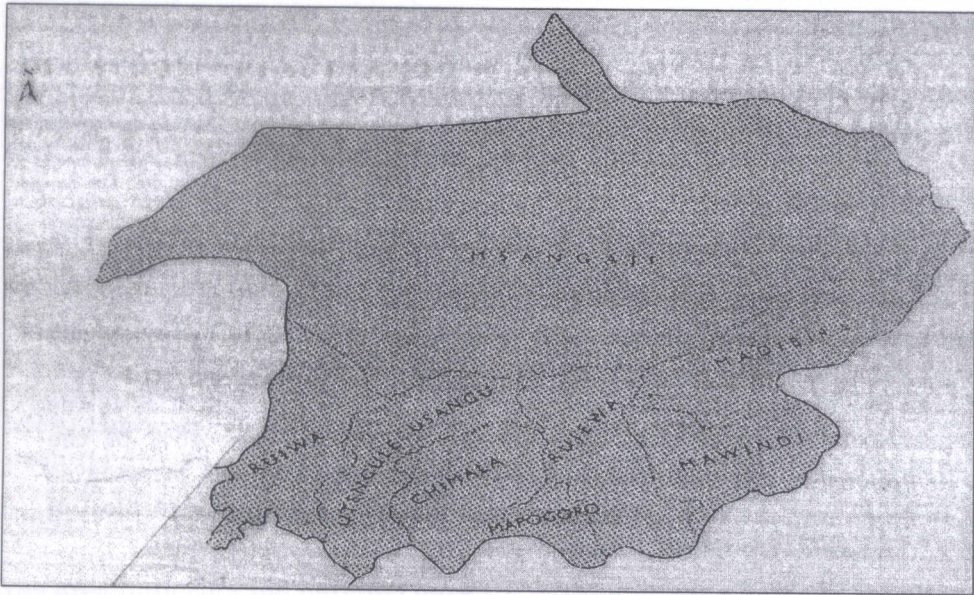


Figure 2: The Usangu Plains showing administrative subdivisions – wards

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The movement of people from different agro-ecological environments into the Usangu Plains has had some effects in the general life of the people in the area. One of the implications has been on the management of land resources, and on the environment. The effects of migrations on the environment are perhaps most profound because those in-migrants establishing settlements in the Usangu Plains, for example, have originated from different agro-ecological environments and may have to adopt new land management practices which comply with the local environmental conditions. Before the influx of people into the Usangu Plains, the Sangu had developed land management systems that reflected

the environmental conditions of the area. For example, with plenty of land around most people practiced fallow cultivation as a method of maintaining soil fertility. But, as large groups of people began to move into the plains land became scarce forcing both the indigenous people (Sangu) and the in-migrant groups to modify the land management systems. However, the precise nature of the implications on land management in this area is not well understood. Thus, this study is an attempt to provide an understanding of the impact of migrations on land-use types and land management system of the Usangu Plains.

Land-use types

Three major land-use types can be identified in the study area. These are crop farming (both large scale and small scale farming), livestock keeping, and wildlife.

1. Arable land-use

Crop cultivation is the major land-use type in the Usangu Plains, and agricultural production is dominated by small-scale farming. This is done both under irrigation and rain-fed cultivation. The average farm size varies between 0.5 to 2.0 hectares. A wide range of crops is grown in the Plains. These include rice, maize, beans, groundnuts, cassava, millet, sorghum, bananas, sugarcane, sweet potatoes and vegetables. Rice is the main cash and food crop in the Usangu Plains. About 45% of the households interviewed during this study are engaged in rice farming as their predominant crop. Due to low and sometimes unreliable rainfall in the area rice is grown under irrigation.

Maize is another dominant crop for most smallholder farmers. This is grown as a staple food crop in the wetter areas of the plains. About 40% of the households have maize as their predominant crop. Maize is grown in mixtures with other crops, most often with beans, and sometimes intercropped with sunflowers. In addition to small-scale farming, there are large scale farms (Mbarali, Kimani and Kapunga) which specialise mainly in rice production. These are state farms established under the National Agriculture and Food Corporation (NAFCO). In these schemes irrigation is the main feature of rice production.

2. Livestock Keeping

This is an important sector in the economy of the Usangu Plains. Like crop cultivation, livestock grazing is done both by individual herders as well as on ranches. A ranch (for cattle) is being run by National Ranch Corporation in Ruiwa. Historically the Sangu have been keeping livestock

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in these plains since their early times. Recently, however, this sector has gained more significance due to the increase in the number of livestock resulting from the movement of other pastoral and agro-pastoral groups into the Usangu Plains. These pastoral groups include mainly the Barabaig, Maasai, and Sukuma.

Within the Usangu Plains, livestock is more concentrated in Utengule, Msangaji, and Rujewa wards. Despite the fact that the actual numbers of livestock heads in the Usangu Plains is rather uncertain, the number has been growing tremendously, and more than doubled from 420,856 in 1984 to 1,032,810 in 1994 (Mbonile et al., 1997). Traditionally, cattle among the Sangu have been used as draught animals, as well as to provide food (milk and meat). In recent years however, and especially with an increase of the number of in-migrant pastoralists, cattle have continued to play a cultural role as a status symbol, in addition to being used as draught animals.

3. Wildlife

The Usangu Plains borders the Ruaha National Park to the northwest. In recent years there has been a growing concern over increased pastoral activities, which are encroaching on land set aside for wildlife. The areas bordering the Ruaha National Park in the north were considered safe from encroachment by pastoral activities due to presence of tsetse flies in the area. However, in recent years as more and more pastoral and agro-pastoral groups are flocking into the areas, bushes are increasingly being cleared for settlement. In another study on the Usangu Plains, Charnley (1994) noted that livestock have caused excessive competition for resources, and have contributed to the decline of wildlife populations in the area buffering the national park.

Land Management Systems

1. Management of Arable Land

Migration process has been an important force in bringing about social change in rural areas, especially in the transformation of peasant agriculture (Chilivumbo, 1985). In the case of Usangu Plains the first agricultural revolution began in the 1950s when rice cultivation was re-introduced by the Baluchi immigrants. These immigrants hired local labourers who were non-Sangu such as the Bena and Hehe. This process, combined with the initiative by local farmers to develop irrigation doubled the production of rice and this crop became the major food and cash crop. As such paddy cultivation became one of the major determinants of migration into the Usangu Plains. Again, the establishment of state farms in the Usangu Plains made the area produce more than 20% to 25% of rice, which is consumed in Tanzania (Charnley, 1994).

Besides paddy, the migrants have introduced several crop varieties and livestock from their places of origin. In places where more Nyakyusa and Ndali have settled such as Simike village, it is very common to find crops like bananas being grown. The type of bananas grown includes those that are used as fruit such as *kambani* and those used for cooking—such as *matoki* and *harare*. The banana groves are usually grown near the homestead where yields are slightly poor, and along river courses and irrigation channels where the yields are much higher. Also, besides consumption, they are sold locally for cash. Another fruit introduced from Rungwe District is the avocado. In recent years this fruit has been more widespread in the Plains, and form one of the major fruits being sold in the local market. The Nyakyusa households from Kyela District have introduced palm oil and cocoa trees into the area, though they are grown at a small scale.

The migrants from Makete District, such as the Kinga and Wanji, have introduced bamboo trees that are used for tapping a local beer, known as *ulanzi*. The households with these bamboos indicate that it is one of the big sources of income especially during the rainy season. However, because of the irrigation potential in the plains, they may get *ulanzi* throughout the year. Again the in-migrants have introduced more intensive market gardening where they grow vegetables such as onions, cabbages, carrots, and Chinese spinach. These vegetables have a good market both locally and nationally. Like rice, the vegetables are sold in the urban centres and along the Tanzania-Zambia Railway and the Dar es Salaam-Tunduma Highway.

Apart from the introduction of new crops by in-migrants in the Usangu Plains, there is another notable feature in the way the land is managed. The concentration of in-migrants (both pastoral groups and crop cultivators) in some localities (such as villages in Madibira ward) has caused serious land shortage problems in the concentrated area. One of the most direct effects of this land shortage is the reduction of fallow periods. Fallowing has always been used to maintain soil fertility. In normal practice farmers would use a plot for about three to four years, and once the productivity begins to fall the plot would be abandoned and a new one brought under use. In this way, land was left to rest and regain fertility. After a certain period—say five to six years, depending on the availability of farming land—a farmer would return to the same plot and cultivate it for another three to four years until such a time when productivity begins to fall.

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The length of any one cycle of land-use (for cultivation) differs spatially, largely due to population density. The cycle is shorter in areas with a dense population but longer in areas with sparse population. In many places, where population has increased rapidly, this system has been abandoned due to shortages of land. Instead, farms are cultivated continuously. To maintain or increase productivity in the cultivated fields farmers are forced to use of fertilisers. However, few farmers have tended to expand cultivated fields into marginal lands. Concerning the use of fertilisers, most farmers feel that they cannot afford to buy fertilisers because of prohibitive prices; hence the net effect has been a fall in production. At the same time—and until this time—there is a belief among most farmers that their soils would be spoilt once they apply chemical fertilisers. This belief contributes to the dislike of fertilizers, and is one of the reasons for the farmers' reluctance to apply chemical fertilisers.

The dislike of fertilizers among local farmers with the assertion that inorganic fertilizers destroy the soils is in agreement with studies reported for other semi-arid parts of Tanzania, such as the Sukumaland (Budelman, 1996; Meertens et al., 1999), and the Kondoa Irangi Hills (Kangalawe, 2001), in Iramba District (Kangalawe et al., 2004), and several other parts of the world—e.g., in Ethiopia (Eyasu, 1998). In literature, the dislike is attributed to low economic recovery of fertilizer costs under such dryland situation, and particularly where the soils are sandy (Young, 1976). The use of inorganic fertilisers in sandy soils may not be sustainable to subsistence farmers due to the high cost of fertilisers, and the generally low nutrient recovery from fertilisers when applied in such sandy soils with low cation exchange rate (CEC) and organic matter (Budelman & Van der Pol, 1992).

Table 1 presents the local perceptions regarding availability of land for various uses. Nearly two-thirds (65%) of the respondents in the study villages reported that land under crop cultivation was decreasing due to increase in the population pressure in the area. Only 25% reported that land under cultivation had remained the same. The remaining 10% of the respondents reported that land under cultivation had increased. The latter category appears to be a concern of the more wealthy farmers who are capable of buying out land from other farmers, or expanding in other areas. Overall, the total area under cultivation in the Usangu Plains has been on the increase. This may have resulted from the increase in the number of crop cultivators and not necessarily an increase in the amount of land per capita.

A similar trend is observed for the grazing land. Again, over two-thirds of the respondents reported that grazing land has been decreasing, and another 20% thought this land was increasing. The remaining 13% had the view that land under this use had remained the same (Table 1).

Table 1: Trends in the availability of land for various Uses in the Usangu Plains (%)

| Trends in land-use | Crop cultivation | Grazing land | Fallow land |
|--------------------|------------------|--------------|-------------|
| Decreasing | 65 | 67 | 88 |
| Remained the same | 25 | 13 | 10 |
| Increased | 10 | 20 | 2 |

Perhaps the most dramatic trend is noted in the land under fallow. The majority of the respondents (88%) reported that land under fallow was decreasing, and only 10% thought this land had remained the same. The remaining 2% of the people said land under fallow was increasing (Table 1). The latter may largely be attributed to shortage of labour, where a household cannot cultivate all the fields it owns in any one season, thereby some of the plots remaining under fallow (cf. Kangalawe, 2001).

Due to the expansion of large-scale farming (by NAFCO and private farmers) smallholder farmers are increasingly being squeezed and pushed into marginal lands. This has also contributed to the abandonment of their traditional systems of maintaining soil fertility—fallow rotation. Thus, the continuous ploughing of the land has increasingly reduced soil fertility.

2. Management of Grazing Land

Traditionally, the indigenous people of the Usangu Plains, the Sangu, are crop cultivators as well as livestock keepers. However, they do not keep as many cattle as the Sukuma or Maasai. Under this system of crop cultivation and livestock keeping, the Sangu had their own way of managing the grazing land. With a relatively sparse population, the Sangu had clear demarcations between grazing land and arable land. The grazing lands were maintained by seasonal fires, which brought in fresh grass for the livestock. Seasonal fires are still in use to give fresh grass for animals, but this time these fires are not well controlled. Often, these fires have spread into farmland destroying crops. During the dry season livestock would graze on crop residues and land that was left as fallow. The total population of livestock, particularly cattle, in the Usangu Plains was less than it is today. Therefore, their impact on the environment (e.g. trampling) was very minimal.

The grazing system as practiced by the Sangu ensured that their animals were kept in close vicinity to their homes. Under this system it was relatively easy to ensure that their animals grazed in the desired areas without causing any destruction to either crops or irrigation canals. With the movement of more livestock into the Usangu Plains grazing land has become scarcer. As such, it was revealed during interviews that due to the

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ever-increasing number of livestock into the Plains it has generally become extremely difficult to manage the grazing lands. Although village governments have usually set aside land for the in-migrant livestock keepers, there are complaints by these people that the land allocated to them is too dry.

Maasai interviewed in Mahanjo village claimed that lands that they are allocated are very dry, and have no water. This forces them to move their cattle into the cultivation zone, very often leading to the encroachment into cropland by livestock; thus destroying crops and irrigation structures, trampling and compacting the soil, consequently making it very difficult to till. In the same village crop cultivators complained that due to shortages of grazing land the Sukuma and Barabaig graze their animals in maize fields even before the crop is harvested. These conflicts have often resulted in open fighting between the two parties.

This has often become one of the sources of conflicts between crop cultivators and livestock keepers. The main conflict between crop cultivators and livestock keepers emerges when animals trample on farmland, which as a result, becomes very difficult to till, as well as destruction of crops. Of the four villages studied, this problem was most serious in Mahanjo village (40%) where land-use conflict between crop cultivation and livestock keeping were most acute. Another source of conflict as identified by the respondents was the feeding of animals on crop residues (Table 2).

Table 2: Percent Response on Sources of Conflicts between Crop Cultivators and Livestock Keepers

| Source of conflict | Simike | Uturo | Mahanjo | Msangaji | Average |
|-----------------------------------------|--------|-------|---------|----------|---------|
| Cattle trampling on farmland | 32 | 32 | 40 | 22 | 31.5 |
| Cattle feeding on crop residues | 21 | 20 | 20 | 25 | 21.5 |
| Destruction crops by cattle | 20 | 10 | 22 | 30 | 20.5 |
| Cattle destroying irrigation systems | 13 | 20 | 12 | 4 | 12.25 |
| Expansion of farmland into grazing land | 10 | 10 | 3 | 10 | 8.25 |
| Spread of cattle diseases | 4 | 8 | 3 | 9 | 6.0 |

Immediately after farmers have harvested their crops, livestock keepers graze their animals into these fields. This situation affects the soils as most of crop residues are grazed. Local people claimed that soil fertility has always been maintained by burning the crop residues, thereby adding and/or returning nutrients into the soils. Understandably, farmers in the

Usangu Plains use very little fertilisers on reasons that their soils do not need them. However, as animals feed on these residues, there is nothing left for the farmers to burn to fertilise the soils. Thus, it is no wonder that these farmers identified this as one of their main problem. At the same time the post harvest grazing results into trampling the soil, and leaving the soils bare and prone to sheet erosion.

Destruction of crops by livestock is particularly done by cattle. About 20.5% of the respondents identified this to be their most serious problem (Table 2). This problem was most pronounced in Msangaji village (30%) and least serious in Uturo village (10%). About 12.5% of the respondents also identified destruction of irrigation systems by animals as a big concern. This was found to be more common in Uturo village where 20% of the people rated it to be the most serious problem (Table 2). Other respondents identified the spread of animal diseases as a source of conflict (6%) while about 8.3% of the people (particularly the livestock keepers) claimed that crop cultivators were invading their land.

There is large-scale farming and smallholder farming within the crop cultivation category. Both of these categories have been expanding at least in terms of area under cultivation. The expansion of large-scale farming (such as the establishment of state farms) has been at the expense of smallholder farmers. Yet in other cases, land-used for wildlife activities are also being invaded by pastoralists and crop cultivators in search for pastures and virgin land for cultivation respectively. In most cases crop cultivators have been pushed right to the edge of the National Park. Often these land-use conflicts revolve on the struggle to control and use water and land resources.

One notes some differences in the grazing systems on the part of immigrant livestock keepers. For example, although both the Sukuma and Maasai practice transhumance to avoid disease and to take advantage of seasonal pasture and water availability, their resource management strategies differ (Charnley, 1994). During the dry season, the Maasai graze their cattle in a line formation in areas where the water has dried up but the grass has remained green. They advance their herds as water recedes. During the wet season, the Maasai graze their animals in a different location each day, following a cycle that allows the grass in an area to regenerate before being grazed again. The Maasai strategies of managing resources have always been disregarded by the Sukuma. This has led to the abandonment of the dry season transhumance, thus forcing the Maasai to remain in the same localities all-year-round.

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3. Management of Water Resources

The Usangu Plains can be categorised as having semi-arid and sub-humid conditions that are dominated by erratic and unreliable rainfall. The amount of rainfall varies between 400 - 600mm that, on average, is lower than most crops would require. It is for this reason that crop production has to be supported by irrigation. In fact the Usangu Plains have the highest potential for irrigation in Tanzania. It is estimated that some 68,000ha of land in this area can be put under irrigation (Mbonile et al., 1997).

Irrigation in the Usangu Plains is carried out both at small scale and large scale. Smallholder farmers practice irrigation using traditional technology (furrow irrigation). In addition to this, there are large-scale irrigation schemes. These are Kimani, Kapunga, and Madibira irrigation schemes run by the National Agriculture and Food Corporation (NAFCO). In addition to the use of water for irrigation, this resource is also needed for livestock.

In history, the Usangu Plains have had no problems in the management of water resources. This can be explained by the fact that both the human and bovine populations were lower than they are today. Running water in rivers and streams belonged to the chief (now the village governments) who held it on behalf of his people. Thus, the construction of furrows was controlled by the chief, but each villager then constructed smaller furrows to tap water from the main furrow to their fields. The maintenance of the furrows was also organised communally.

The management of furrows in recent years has become a problem largely due to the expansion of farms, particularly those under rice. Such an expansion has led to shortages of water for irrigation. This problem is further compounded by the ever-increasing number of livestock in the area, which has led to upstream abstraction of irrigation water particularly due to uncontrolled grazing. Irrigation canals are also increasingly becoming difficult to maintain largely due to frequent destruction caused by livestock. As pointed out earlier, the increase in the number of people and livestock in the Usangu Plains has led to water management problems. Some farmers argue that this is the source of conflicts between crop cultivators and pastoralists.

Environmental Implications

The movement of people and livestock into the Usangu Plains have had some environmental impact on the area. The environmental changes as evidenced in the Usangu Plains are complex, and various studies have acknowledged the difficulties in pinpointing a single cause for the changes.

This study attempts to find out and contribute to the understanding of how in-migrants to the Usangu Plains have impacted on the environment. These changes may be said to be a combination of three major forces: (i) the heavy influx of livestock, and (ii) the expansion of cultivation, particularly large scale farming (Kikula et al., 1996), and (iii) the manner in which the land resources are being utilised.

The heavy in-migration of livestock by the Maasai, Sukuma and Barabaig combined with the extension of areas under irrigation has created a shortage of grazing land. The consequent grazing in farmlands result in trampling that leads to soil compaction, making it hard and difficult for the roots (especially rice) to penetrate deeper into the soil. In addition, the problem of trampling and compaction of the soils have affected the groundwater table which, as a result, has been lowered (Kikula et al., 1996) due to limited groundwater recharge. There are reports that this condition has in turn led to the draining of areas that used to be permanently waterlogged. Given that Usangu plains are semi-arid, agricultural production can be carried out only where there is water for irrigation (i.e. areas with irrigation potential). Thus draining such soils may reduce the agricultural production in respective areas. This may possibly contribute to the system becoming unsustainable in terms of agricultural production.

The abandonment of the dry season transhumance as earlier practiced by the Maasai herders has had an effect on the ecology of the Usangu Plains. To a large extent this abandonment has been caused by the conflicting grazing strategies among the pastoral groups, and the expansion of cultivation land. The abandonment of the seasonal transhumance has meant that livestock is kept in fewer concentrated areas all year-round, thereby increasing the grazing pressure on the land.

In Msangaji ward, wildlife has also been affected by the increase of human and livestock population. Basically this part of the Usangu Plains is very dry, and the soils are shallow and of low fertility (Mbyopyo, 1992). For this reason Msangaji is very sparsely populated, and the main farming system here is shifting cultivation. As more people move in, as is now the case, shifting cultivation is spreading into the Ruaha National Park. This has had the effect of the disappearance of some wildlife fauna (Charnley, 1994). This encroachment is relatively very recent and, according to the village elders in Msangaji village, such a change has been prompted by the incoming livestock keepers. The expansion in new areas involves woodland and forest clearance. The long-term consequence from such developments is the destruction of river catchments through deforestation, compaction of soils, soil erosion, and non-farm activities such as charcoal making.

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Yet on the other areas the competition for grazing land has led to the abandonment of the use of fires to regenerate grass for fresh pastures. One Maasai herder noted on bush fires that "I can not set the bushes on fire to get fresh pastures because I am not sure that no other Maasai or Sukuma will graze on them before I do." The reduction of seasonal bush fires has thus meant that bushland is now expanding in some areas. Indeed, as stressed by Charnley (1994) and Kikula et al. (1996), this may represent a very significant environmental change that can be largely attributed to the increased number of livestock into the Usangu Plains.

One indicator of the environmental changes taking place in the Usangu Plains is the trends in crop yields. In the view of most respondents during this study, agricultural production has encountered several constraints in recent years than they used to be in the past. Various reasons for these changes are summarised in Table 3. The main reason as observed by many respondents was the shortage of irrigation water. This problem was most noted in Simike and Msangaji villages that are predominantly on arable agriculture. Conditions are much drier in Msangaji village, and therefore shortages of water for irrigation are aggravating an already existing problem. According to Charnley (1994), the shortage of water in Usangu Plains is not because there is less water flowing from the Southern Highlands than did in the past, but because of uncontrolled upstream abstraction.

Table 3: Major Concerns on Recent Trends in Agricultural Production in the Usangu Plains (%)

| Reasons | Simike | Uturo | Mahanjo | Msangaji | Average |
|----------------------------|--------|-------|---------|----------|---------|
| Water shortages | 52 | 12 | 18 | 53 | 33.75 |
| Declining soil fertility | 14 | 46 | 13 | 8 | 20.25 |
| Animal trampling the soils | 8 | 20 | 48 | 2 | 19.50 |
| Lack of fertilisers | 6 | 4 | 4 | 18 | 8.00 |
| Crop diseases and pests | 10 | 8 | 8 | 5 | 7.75 |
| Decreasing rainfall | 8 | 3 | 3 | 10 | 6.00 |
| Poor husbandry | 2 | 7 | 6 | 4 | 4.75 |

The introduction of large-scale irrigation schemes has contributed quite significantly to the diversion of water from its normal channels, making it less available to small-scale farmers. The combination of low and often erratic rainfall and high number of livestock in the drier parts of the Usangu Plains, such as in Msangaji and Mahanjo villages, has resulted in often totally bare soils and severe sheet erosion.

The other constraints to agricultural production include: declining soil fertility, destruction of soil structures as a result of trampling, lack of

fertilisers, presence of crop diseases and pests, decreasing rainfall, and poor crop husbandry. To a large extent, most of these factors have resulted from the changes in environmental conditions. In the long run such situation may result in small-scale farming systems becoming unsustainable.

In general, the environmental damage caused by the influx of people and their cattle have had an effect on almost the whole country. This is because almost all the rivers in the country originate from the south. Therefore, such environmental damages in the Usangu Plains have affected the whole country. It is a general perception that the environmental processes taking place in the Usangu Plains have contributed to the water shortage in Mtera Dam, downstream the Great Ruaha River, thus affecting the whole economy of the country. Likewise, conflicts are emerging between different user groups with increasing land and water shortage in the plains.

Conclusions

This study examined how the difference migrant groups have influenced land management in the Usangu Plains, and the implications of such management strategies on the environment. Findings of the study indicate that while rural-rural migrations in Tanzania are not a totally new phenomenon, they have been more pronounced particularly beginning the 1970s. This has involved long-distance and permanent migrations involving both pastoralists and crop cultivators. The Usangu Plains have been one of the important migrant destinations. Two main forces have given rise to these migrations in the Usangu Plains, which are, shortage of farming land and/or the worsening environmental conditions, particularly drought and increasing grazing pressure in the original places.

Apart from the increase in the numbers of people and livestock, these migrants have modified the local land management patterns. Although the introduction of new crops into the Usangu Plains has been a positive contribution to the farming system by increasing the agro-diversity of the area, such introductions have created additional pressure on the land. In some areas of southern Usangu Plains, vegetables production is increasingly becoming intensive, taking advantage of the irrigation potential of the plains. With increasing population density the traditional methods of maintaining soil fertility such as the fallow system has been abandoned. Land is cultivated continuously, and not being allowed to 'rest' as was the case when the population density in the area was low. At the same time, the practice by indigenous farmers in the Usangu Plains of burning crop residues in order to fertilise the soils is no longer viable due

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to post harvest grazing that leaves the fields almost bare. As such the soils are deprived of potash nutrients. Therefore, farmers are forced to increase the area under cultivation by expanding into fallow lands and further into catchments, and also by encroaching into areas bordering the Ruaha National Park in order to maintain the desired crop yields.

The effect of pastoral and agro-pastoral migrants on land management on the environment in general is quite profound. Perhaps the most significant effect of cattle brought into the Usangu Plains has been on land degradation. Most of these pastoral and agro-pastoral groups keep large herds of cattle. As a result, trampling and soil compaction have led to lowering the groundwater table, thereby leading to draining out of areas that used to be permanently waterlogged. Sheet erosion has also become common in most areas settled by in-migrant pastoralists. This raises a concern on the sustainability of the farming system in the Usangu Plains. It may be of great interest to look into more detail on the effects of these ongoing environmental changes, particularly as they affect agriculture.

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