CHAPTER 6

BARABAIG NATURAL RESOURCE MANAGEMENT

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SUMMARY

For nearly 150 years the Barabaig have managed the Hanang plains in a rational and sustainable manner and environmental damage has been minimal. Key elements of their land management are: protection of the grazing resource from encroachment, conservation of key grazing areas for periods when the potential of other areas has been exhausted, prohibition of permanent residence in some of these areas, and enforcement of these community decisions.

This highly developed communal-grazing system is now being destroyed by official failure to recognise and preserve its benefits. With aid from Canada, the Tanzanian Government is subsidising non-Barabaig people to farm the key grazing areas. Customary rights are becoming unenforceable and defensive action by the Barabaig is prohibited. As a consequence, the sustainability and productivity of the Barabaig system is breaking down. Unknowingly, government policies and programmes are turning parts of the Hanang plains into an unsustainable open-access system: creating the "tragedy of the commons".

If the Barabaig are to survive as a people then new property-right systems that build upon the principles that underpin their traditional grazing system, and that are capable of evolving over time, need to be developed.

INTRODUCTION

In recent years, attention has been given to the form of pastoralists' management strategies. An increased understanding of common-property management systems in extensive rangeland areas has emerged (National Research Council 1986; Lane and Swift 1989; Baxter 1989). African pastoral

production has been shown to provide good returns relative to other forms of ranch management in similar environments (Cossins 1985; de Ridder and Wagenaar 1986). It is clear that pastoralism is potentially an economically viable and sustainable form of land use in the savanna lands of Africa.

Pastoral systems, however, are under stress in many areas: through war and conflict, through changing market structures, through environmental change and through the removal of land resources from pastoral production.

This paper examines pastoralists' ecological management strategies with a case study from the Barabaig of Hanang district, Tanzania. By providing details of the traditional Barabaig pastoral land-use system, it will be argued that the way the Barabaig manage rangeland resources is a rational and sustainable form of land use. Evidence is given to show that their common-land tenure arrangements are both sophisticated and effective for both production and conservation of land but that an inappropriate and costly development project has undermined this system.

The case study illustrates the rationale for traditional Barabaig natural resource management. Such management is based on a close understanding of the interactions between components of the landscape and the requirements of a range of resources to sustain production. The case study demonstrates how an inappropriate assessment of the economic value of the pastoral production system, and the resources that it depends upon, has led to external intervention that undermines the sustainability of the existing system. The chapter argues for the development of a more thorough understanding of the dynamics of pastoral production systems and livestock-resource interactions. This would allow more effective support for land tenure rights and common-property management systems.

PERSISTING WITH OLD ORTHODOXY

The plight of the Barabaig is typical of a wider problem for pastoralists throughout Africa. Common-land tenure systems have long been thought incapable of efficient land use (Lane and Swift 1989). Evidence of rangeland erosion since colonial times has been blamed on the "irrational" behaviour of pastoralists to accumulate cattle for the reasons of social prestige in excess of their economic needs. Credence was given to this view by reference to the "cattle complex" that dwelt on the cultural importance of cattle in traditional pastoral societies (Herskovits 1926). This anthropological legacy has since been reinforced by the "tragedy of the commons" scenario which posits that individual herders have no incentive to restrict stock numbers, and the herding of private animals on communal pastures will inevitably lead to overgrazing and land degradation (Hardin 1968).

Despite the years that have elapsed since Hardin first published his essay

more than 20 years ago, and despite a mounting challenge to it on both theoretical and empirical grounds (Runge 1986), it has remained a powerful force in the minds of government officials and aid agency personnel to this day. A major problem has been the failure to distinguish between "common property" regimes with traditional control of individual exploitation and "free" or "open" access where such controls do not exist. This is highlighted in the continued espousing of the "old orthodoxy" that pastoralists have too many cattle and that, because of uncontrolled use of the commons, they will inevitably destroy the land through overgrazing (Lane and Swift 1989).

Despite the reality of pastoral existence in Tanzania, new thinking on pastoral development is not accepted by planners. An almost verbatim expression of the "tragedy of the commons" scenario is found in an article detailing measures for the "proper management of rangelands" by an official of the Tanzanian Ministry of Agriculture and Livestock Development:

> ... this practice of grazing private livestock on communal land constitutes the single major constraint to improved management of the natural pasture lands. The inevitable result of this system of livestock production is that the cattle owners keep excessive numbers of livestock which in turn leads to overgrazing, soil degradation, low fertility and high mortality rates (Bilali 1989).

Despite Tanzania's ranking as one of Africa's highest cattle resource countries, livestock production has failed to satisfy national demand for beef or dairy products and failed to exploit potential export markets (Raikes 1981). In response to this the government in 1982 published a National Livestock Development Policy that remains a guide for the direction of development in the livestock sector to the present day (Tanzania Government 1982). The preamble acknowledges that 99 per cent of livestock were in the hands of traditional producers, and that there was enormous potential for increased production. Yet the measures given to convert this wealth are based on the transformation of traditional pastoralism because it is regarded as backward and unproductive:

> The long term objective is therefore to bring about changes in traditional producers attitude and practices thereby increasing productivity to the level where this sector evolves into a modern subsector (1982:4).

The "modern subsector" envisaged in this context is made up of private and state ranches that do not include much pastoral involvement (Mustafa 1986). This has meant appropriation of large tracts of land and the destruction of pastoralists' traditional land-use management systems based on common land tenure.

THE BARABAIG OF THE HANANG PLAINS

The Barabaig are semi-nomadic Nilotic pastoralists who are a subtribe or section of a wider ethnic grouping known as the Tatoga. They number more than 30,000 in Hanang district. They fled from an invasion of the more numerous and powerful Maasai and surrendered occupation of the Serengeti plains and Ngorongoro highlands more than 150 years ago (Saitoti 1986). They moved south along the Rift Valley as far as Singida before returning to what they now regard as their territory on the Hanang plains (Wilson 1952).

All Barabaig herders strive to be self-sufficient from production of their cattle. Each household head manages his herd to maximise production of milk, meat and occasionally blood. However, they do not exist on a purely pastoral diet. Only those with very large herds receive half or more of their food energy needs from cattle products (Lane 1991a). Maize makes an important contribution to the nutrition of all Barabaig and is especially important in poorer households with fewer cattle. Grain is obtained through exchange or sale of livestock, and from shifting cultivation by households with the help of communal labour provided by relatives and neighbours.

Many studies have shown that pastoralists do not have excessive numbers of livestock. Even so-called "pure pastoralists" who practise a minimum of cultivation rarely have enough livestock on which to subsist on a pastoral diet (Swift et al. 1989). The average total number of cattle in a Barabaig household at Balangda is only 60 animals, or six per person. As only 30 per cent of these are milk cows, it means that each person receives milk from only two cows. As Barabaig cows provide only just over half a litre of milk a day for human consumption and their lactation is only for around 7–8 months, current herd size is clearly not enough for everyone to be self-sufficient in milk throughout the year (Lane 1991b). That is why the Barabaig and other Tanzanian pastoralists cultivate crops to supplement their diet.

The Hanang plains are divided by the Great Rift Valley escarpment which separates the northern and elevated Basotu plains from the lowland Barabaig plains to the south (see Figure 6.1). The Basotu plains are undulating with a series of depressions and many low hills and volcanic craters. As there are no perennial rivers, crater lakes provide some of the few sources of permanent water. Even with the provision of dams, built in colonial times, however, there is a severe shortage of water in the dry season.

The Barabaig plains, on the other hand, have permanent water from lakes Balangda Gidaghan and Balangda Lelu. These lakes also provide salt for the Barabaig and their livestock. Mount Hanang dominates the landscape rising to a peak of 3118 m above the surrounding Barabaig

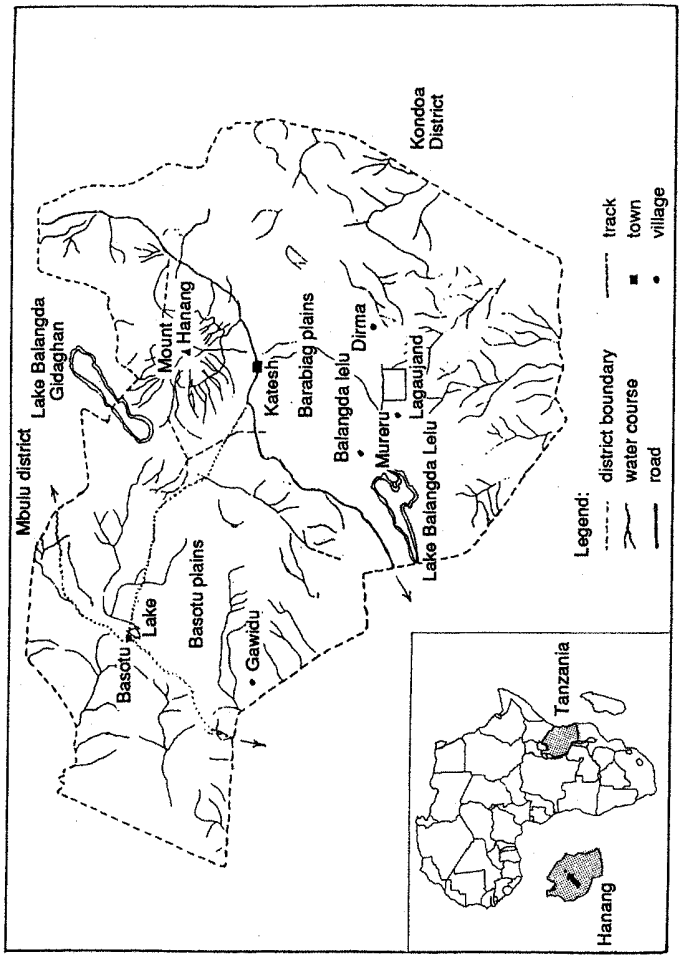

Figure 6.1 Map and location of Hanang district. Source: Agriteam Canada

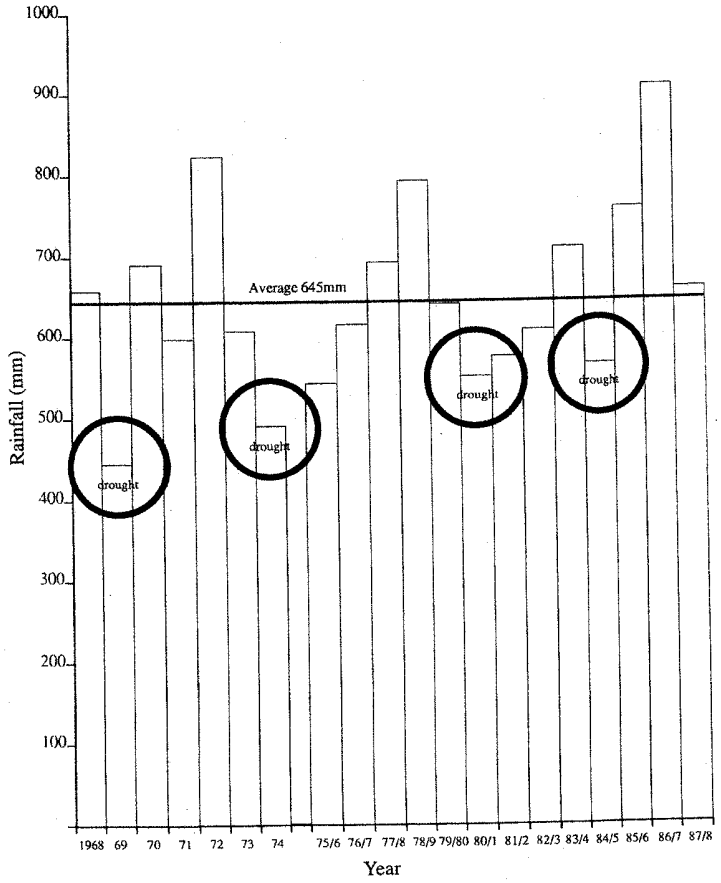

Figure 6.2 Rainfall distribution over 20 years, Basotu Plantation 1968–1988. Drought periods are circled

plains. The plains extend to the south as far as the Mureru range. Apart from bushland beyond the range, and the forest of Mount Hanang, the dominant vegetation is *Acacia* and *Commiphora* woodland interspersed with open grassland. The climate is semi-arid with periodic droughts and an average annual rainfall of around 600 mm (see Figure 6.2).

Hanang district can be divided into several ecological zones with contrasting soil and vegetation. Much of the area is covered with calcareous volcanic tuff, spread over the underlying granitic shield by the eruption of Mount Hanang. In the Basotu and Barabaig plains areas, soils are derived from volcanic materials and some are of very high fertility. To the south, sandier, poorer fertility soils are dominant, derived from granitic base rock supporting miombo woodland. In the volcanic soil areas, vegetation is characterised by a mixed *Acacia–Commiphora* woodland with areas of open grassland. The rift escarpments divide two major plains areas, establishing an important boundary within the district (Fenger et al. 1986; Newman 1970).

Three major zones can be identified:

(1) The volcanic, high fertility Basotu plains;

(2) The lower altitude volcanic soil Barabaig plains; and

(3) The sandy soil miombo bushlands to the south.

The major zones can be differentiated according to soil fertility characteristics and, in relation to underlying geology. In savanna systems these properties have a major impact on both primary and secondary production dynamics (Frost et al. 1986).

Within each zone there are patches of distinct environments. These patches differ in size. They include the vertisol soil depressions of the volcanic plains which constitute a significant proportion of the Basotu plains; the riverine vegetation strips associated with the rivers and streams draining the higher ground; the lake margins of the crater and salt lakes, notably Lake Balangda Gidaghan and Lake Balangda Lelu, the valley bottomlands (*mbuga* in Kiswahili) of the bushland miombo zone; and, at a smaller scale, the particular vegetation types associated with abandoned homestead sites. Although small in area, these may represent "key resource" patches in terms of livestock production. Understanding the contrasting ecological dynamics of these zones, and evaluating the role of patches within them, provides the basis for interpreting Barabaig natural resource management strategies (Scoones 1991).

Fenger et al. (1986) record some basic soil characteristics of the major zones and patches within them. Soils in three areas can be contrasted (see Table 6.1).

Tables 6.2a and b extend the analysis by illustrating the range of resources according to the Barabaig classification of resource types. Soil type and underlying geology are related to availability of fodder species (grass and browse) and the key constraints to livestock production in each zone or patch. The use of the Barabaig ecological classification allows the interpretation of ecological pattern according to local criteria.

Table 6.1 Soil characteristics of different zones and patches at approximately 25 cm depth. CEC = cation exchange capacity. Source: Fenger et al. (1986)

Sample area	*Clay content* (%)	*pH*	*CEC* (meq/100 g)	*P* (ppm)	*K* (meq/100 g)
Basotu plain (Topland, volcanic soils; mollisols)	50	6	35	50	3
Basotu plain depressions (vertisols)	65	8	80	5	1.75
Rift valley/boundary area with granite soil bushland	30	6	15	1	1

Different zones within the district have contrasting ecological dynamics and constraints to pastoral production. The grasslands of the high fertility, volcanic soil plains have high potential productivity and provide good quality fodder. Variability in rainfall levels means that primary production is characterised by instability. Although these eutrophic savannas can potentially support high populations of livestock (Bell 1982; Coe et al. 1976), constraints of water availability mean that pastoral production must rely on "key resource" areas and flexible drought responses. The depression areas (*muhajega*; sing. *muyaded*) of the Basuto plains provide important wet season fodder, while the river banks and lake margins of the Rift Valley provide dry season fodder refuges. In times of drought, movement out of the area into neighbouring bushland and river valleys to the east and south of Hanang district sustains livestock production.

The bushlands to the south present a different dynamic pattern. Inherent low soil fertility of the dystrophic miombo savanna type predicts lower potential stocking rates according to Bell (1982). Although of lower biomass productivity and quality, fodder production can be expected to be more stable over time in this savanna type, with stability being increased by the availability of key bottomland grazing resources (e.g. *mbuga* depressions). The incidence of tsetse in these woodlands provides a further constraint to livestock production.

Barabaig livestock production is thus characterised by a tension between drought and lack of permanent water sources in the potentially highly productive volcanic soil plains areas, and tsetse incidence and savanna areas of lower pastoral potential to the south (cf. Birley 1982). The use of the area for livestock production will be centrally determined by trade-offs between the productivity and stability of grassland production in each zone and the existence of the different constraints of water availability and tsetse

Table 6.2a Landscape components and livestock production potentials and constraints in the *dararajand*, *muhajega* and *dararajega* used by the Barabaig

Land type	*Geology*	*Soils*	*Tree spp.*	*Grass spp.*	*Constraints*
Basotu plains (*dararajand*)	Calcareous volcanic tuff	Mollisols Deep fertile	*Acacia* spp. *Commiphora* spp. *Grewia* spp.	*Pennisetum* sp. *Aristida* spp. *Setaria* spp. *Heteropogon* sp. *Hyparrhenia* sp.	Lack of available water in dry season. Grass failure in droughts.
Bottomlands (*muhajega*)	Volcanic tuff	Vertisols Deep fertile	Few trees *A. drepanolobium*	*Eragrostis superba* *Pennisetum mezianum* *Cynodon dactylon*	Appropriation for wheat farms. Gully erosion in farms.
Barabaig plains (*dararajega*)	Volcanic tuff	Mollisols Deep fertile	*Acacia* spp. *Commiphora* spp.	*Pennisetum* sp. *Aristida* sp.	Intensity of use. Lack of grass in poor rainfall.

Table 6.2b Landscape components and livestock production potentials and constraints in the *ghutend*, *hayed*, *darabet* and *mbuga* used by the Barabaig

Land type	*Geology*	*Soils*	*Tree spp.*	*Grass spp.*	*Constraints*
Bottomlands: river and lake margins (*ghutend*)	Fluvial and lacustrine deposits	Sandy/silty clay loam Salt pans	Few trees	*Chloris gayana* *Cynodon dactylon*	Heavy livestock pressure Salinity
Hills/mountains escarpments/ ridges (*hayed*)	Volcanic tuff (plus granitic intrusions)	Lithic thin, stony, fertile clay loam	*Acacia* spp.	*Aristida* spp.	Mt Hanang forest reserve Steep slopes
Miombo woodland (*darabet*)	Granitic	Loamy sands Sandy loams infertile	*Brachystegia spiciformis* and other miombo spp.	*Aristida* spp. *Brachiaria* spp. *Tragus* sp. *Dactyloctenium* sp.	Tsetse fly Poor forage quality
Valleys and depressions (*mbuga*)	Granitic	Colluvial heavy fertile	*Cassia* sp. *Commiphora* sp. thickets	*Brachiaria* sp. *Dactyloctenium* sp.	Tsetse fly

incidence. The sustainability of the pastoral system over time is critically dependent on a flexible response to the changing patterns of resource availability and production constraints. This requires an opportunistic mode of natural resource use that allows for the exploitation of "key resource" patches, such as *muhajega/mbuga* and river or lake margins, at particular periods. These responses must be complemented by movement responses during drought periods.

Flexible movement, on a seasonal basis within the district and, in some years, outside the area, is thus the key to population persistence and sustainability. Wildlife movement in response to variations in fodder quantity, quality and mineral nutrition has been extensively examined for savanna in the Serengeti (e.g. Sinclair and Norton-Griffiths 1979; McNaughton 1985, 1990). A clearer understanding of similar patterns of ecology in other pastoral livestock populations is also emerging (Breman and de Wit 1983 for the Sahel; Scoones 1990 for Zimbabwe).

BARABAIG MANAGEMENT OF SAVANNA RESOURCES

The following sections discuss the key elements of the Barabaig natural resource management strategy.

Traditional seasonal grazing rotation

Variety of soil types, topography, vegetation, and the availability of ground water provide the basis on which the Barabaig classify pastures (see Table 6.2). They recognise specific forage resources that are associated with eight geographical features. So as to utilise pasture when it is most productive, and to rest areas and allow them to recover, the Barabaig have devised a seasonal grazing rotation that exploits the forage regimes at different times of the year. An opportunistic response during times of drought is particularly important.

The rotation is not always regular as climatic variation can cause deviations (see Figure 6.3). Presented here is a stylised model of a complex and variable cycle.

The Barabaig year begins in May. This is the start of the late rains (*mehod*) when pasture availability and livestock production are at a maximum. It is a time of relative plenty and recovery from the deprivations of the dry season. It is also the time when the Barabaig like their herds to be on the *muhajega*. These are depressions on the plains containing fertile soils that sustain a mix of grasses and herbs that the Barabaig call *nyega nyatk*.

The Barabaig regard the forage of the *muhajega* as the most productive pasture available to them. It is valued for its capacity to produce high milk

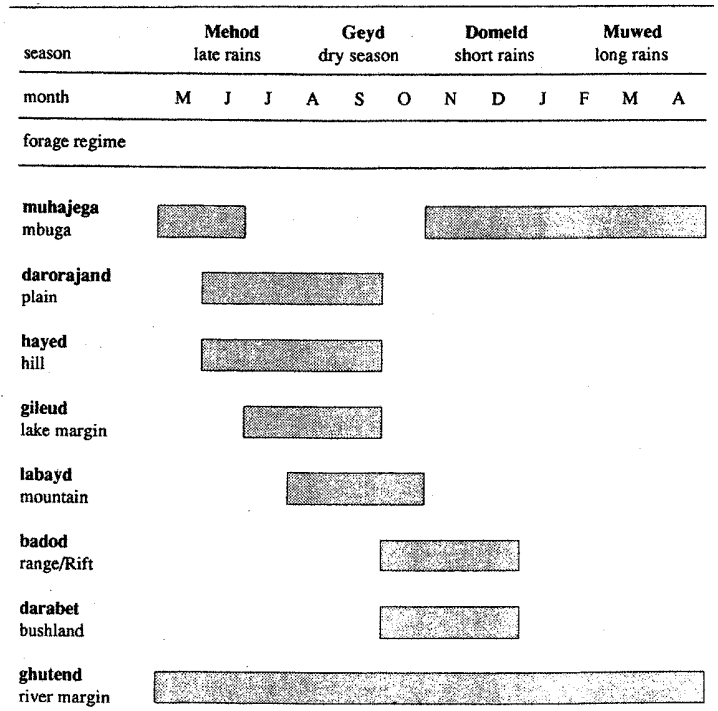

Figure 6.3 Traditional Barabaig grazing rotation

yields, induce growth, and for its recuperative powers for livestock suffering ill health from the stresses of the dry season and droughts. The *muhajega* are found in greatest abundance on the Basotu plains. It is on these plains that the Barabaig congregate during the rains. This is only possible for as long as surface water is available there.

When the rains stop in May, June or July, and surface water dries up on the Basotu plains, many Barabaig move down the Rift escarpment onto the Barabaig plains. Here they are able to draw on permanent water from wells at Lake Balangda Lelu that sustain them through to the months of August, September and October of the dry season (*geyd*). At this time they gather on the plains (*darorajega*) of Balangda and the many low hills (*hayed*) to the east of the lake. As grazing becomes depleted they begin to move to the miombo bushland (*darabet*) with its associated risks from tsetse flies and predation from wild animals.

As soon as the short rains (*domeld*) begin in November or December and surface water is found again on the Basotu plains, the Barabaig move their herds back onto the *muhajega*. They remain there for the 6 or more months of the rainy season (*domeld*, *muwed* and *mehod*) until the water dries up again. But for the river margin (*ghutend*), the *muhajega* supports the Barabaig for longer than any other forage regime. As the *ghutend* is confined to the few small perennial rivers that flow a short distance from Mount Hanang it is much less important than the *muhajega*, which the Barabaig value more than any other forage resource.

Thus, for the Barabaig, availability of water acts as the most limiting factor in pasture use. Whereas most other pastoralists need to locate pastures in the dry season to sustain them (sometimes they are preserved for this purpose), the Barabaig are forced to move away from their richest forage regime when they need it most. The availability of dry season "key resources" on the lake and river margins, however, are critical during this period. These areas must be complemented by the plains grassland of the *darorajega*, where in the dry season animals congregate near the permanent water afforded by wells at Lake Balangda Lelu.

Grazing management

Grazing on the plains areas is also actively managed. Deliberate burning of pasture is called *ghwardaida ngy'anyid* and is mainly practised between September and November to burn off remaining dry stalks of vegetation that have survived the dry season. This allows rapid vegetative response of new shoots with the first rains. This is preceded by *lajitaghed*, the burning of firebreaks around the homesteads. Sometimes such fires do get out of control, but every effort is made to manage fire carefully lest valuable dry season fodder is destroyed.

The Barabaig not only use burning as a management tool for grass production, they also use it as a strategy for reducing the incidence of ticks. Tick-borne diseases are a major cause of livestock mortality in the area (Lane 1988). Burning, combined with intentional heavy grazing, helps to reduce the extent of tall grass stands and so tick populations.

Tsetse control measures

Tsetse incidence in the miombo bushlands is a major factor preventing the exploitation of this area. Dry season pressure on other grazing resources means that herds are often forced to enter this zone. A variety of strategies

is used to reduce tsetse fly populations. Burning intentional heavy grazing both act to reduce tsetse habitats and to increase the quality of grazing in the poor sandy soil areas. Bush clearance is another strategy for improving the pastoral potential of this savanna type. The adoption of a shifting cultivation system by the Barabaig removes dense bush cover in certain areas. Cultivation is concentrated at Mureru along the ecotone between the Barabaig plains and the miombo bushland. As the Barabaig remove the bush to cultivate, they are not only reducing the area of tsetse infestation, but also expanding the area for dry season grazing.

Controlling resource access: common-property management

Barabaig movement of herds and homesteads around the plains is a response to the vagaries of climate, so as to make best use of scarce and variable pasture resources. To make this possible the Barabaig accept that everyone must have general access to pastures. Open rangeland is regarded as the property of the whole community. This enables herders to choose when and where to be on the plains according to their individual assessment of pasture quality.

So as to facilitate this use of forage resources the Barabaig, like other African pastoralists, have a form of common-land tenure (see, for example, Makec 1988). They describe the land that makes up the range as *ng'yanyida madagh* (*madagh* = common). But this is not a case of universal and uncontrolled access to land and its resources by everyone and anyone. The Barabaig recognise the right to protect land; *weta ng'yanyid* (*weta* = protect). In the past, they also recognised the need to protect this resource from intruders and deployed a warrior set to act as a guard. Due to the breakdown of the process that formed this socio-political unit, and as a result of the imposition of centralised control by the state, however, they are no longer able to defend their territory as they had done before.

Within the commons, rights to property range from communal access to exclusive private property. The Barabaig regulate rights of use and access to land through a tripartite jural structure, each with its own sphere of interest and authority: the community, the clan, and the individual household. In this system access to and use of land is controlled by a set of customary rules.

The Barabaig have a hierarchy of jural institutions that control access to and use of land, interpret customary rules and adjudicate in rare conflicts over rights and duties. Matters concerning the community as a whole are dealt with by a *getabaraku* or public assembly of all adult males. This has ultimate authority on common-property rights over open rangeland. Decisions are made by consensus. If the problem has particular gravity or

involves the application of sanction, a committee of the *getabaraku*, called *makchamed*, is formed. The *makchamed* deliberates in camera and hands down its decision to the assembly.

Women have their own council (*girgwageda gademg*) which has recently involved itself with land issues. Their interest in land stems from their authority on matters involving offences by men against women, and their special role in Barabaig spiritual life. Desecration of sacred property or the failure of men to protect such property is currently of particular interest to them.

At the clan level, a clan council (*hulandosht*) controls all clan property, such as burial sites (*bung'eding* (pl.)) and wells. At the neighbourhood level, authority is vested in a neighbourhood council (*girgwageda gisjeud*). Anyone wishing to come and live in a neighbourhood can only do so with the endorsement of this council. In this way the council effectively controls the entry of too large or too many herds and limits the potential for overgrazing.

Sanctions against those who infringe common-property rules generally take the form of an order from whatever judicial moot has authority in the case. Most often the offender is simply asked to desist from the offence. If damage is done, an offender may be asked to pay a fine to the elders, or compensate an individual who has suffered as a consequence of the offence. Fines are collected by a group of youths (*orjorda*) which ensures that the transgressor complies with the ruling. Punishment for more serious offences can be greater. In the past the women's council has been known to have issued a curse (*moshtaida*) on male offenders for breach of rules related to sacred land. This curse is most effective as it is known to bring ruin to people's lives and is much feared by all Barabaig (Lane 1991a).

Grazing resource use is controlled through access to water; by regulating use of a key limiting factor, an efficient system of control can be evolved. Although surface water is universally accessible to everyone, its use is controlled by rules. Routes to and from water are not to be restricted by the construction of homesteads, and water sources must not be diverted or contaminated. A well becomes the property of the clan of the man who digs it. Although anyone may draw water from a well for domestic purposes, only clan members may water their stock there.

Rights to trees are also subject to certain rules. The Barabaig protect sacred trees, such as the *Ficus* species, by banning any form of use or damage to them. Other trees that are regularly used for meetings (predominantly *Acacia* spp.) are also protected in this way. Clans also have rights that cover property in land. The most important example of this is the burial site (*bung'ed*). Private property is recognised by the Barabaig in the form of a man's homestead and its surrounds. For example, a grazing refuge (*radaneda nyega*) is marked off with thorn tree branches to protect forage near the homestead, which can support small stock and sick animals

that cannot keep up with the main herd. Private property also extends to trees that give shade to the household and those selected to hang beehives.

Effective common-property management is based on regulation of access to areas that are enforced through sanctions (Runge 1986). The Barabaig system of resource control includes such components. It is far from a pattern of open access assumed by the "tragedy of the commons" scenario. To remain effective, however, common-property management systems must be based on definable rights supported by legal instruments to ensure that the system is not undermined (see below).

Regulations to control degradation

Barabaig regulations to control resource access also aim to limit degradation, particularly of key resource areas. This is mediated through customary regulations on the siting of settlements.

Without adherence to the movement of herds and rotation of pastures, some herders would possibly remain at the river margin (*ghutend*) where there is permanent water and persistent vegetation. The Barabaig, however, understand that this would result in destruction of this resource and have a customary rule that bans settlement at the *ghutend*, and denies herders the right to graze the forage if they are not there to water their stock.

As water in the crater lakes of the Basotu plains is insufficient in the dry season to sustain all the livestock that congregate there, some herds have to be moved elsewhere. The wells of Lake Balangda Lelu provide alternative permanent water. Their use, however, is dependent on dry season fodder availability in the surrounding plains. Like restricted use of the *ghutend*, grazing of the Balangda plains must be limited if pasture is to be available at the time when it is most needed. To achieve this the Barabaig traditionally banned permanent habitation on the *darorajega* at Balangda. This customary rule was made a by-law by Gejar, Chief of the Barabaig Native Authority (*ca.*1936–1952), who recognised the threat that permanent habitation on the *darorajega* would have on this vital resource.

BARABAIG ECOLOGICAL MANAGEMENT: A CHALLENGE TO THE OLD ORTHODOXY

The components of Barabaig natural resource management strategies outlined above represent a challenge to the old orthodoxy. It is clear that resource use is not based simply on an "open-access" situation, but regulations control use under a common-property management system. Access to a range of resources within different ecological zones and savanna

types is critical to the sustainability of the system. Allocation of land title in restricted blocks would disrupt patterns of flexible movement that characterise the pastoral system.

Range management recommendations that demand destocking, restriction of movement and the cessation of grassland burning or shifting cultivation in order to "conserve" rangelands from "degradation" can also be seen to be misconstrued. High stocking rates are required to sustain the economic livelihoods of the population and also are used as an explicit strategy to control disease incidence. Controls on movement would also undermine the key pastoral strategies to ensure survival, during droughts and resource shortage periods during the year. Burning of grasslands and bush clearance can also be interpreted in terms of a basic pastoral rationale to offset the dual threats of the tick and tsetse fly. Analysis of Barabaig natural resource management strategies therefore suggests the need for a re-evaluation of "orthodox" range management recommendations.

There are, however, limits to the ability of traditional Barabaig practices to cope with changing circumstances. For instance, with increased land pressure from encroaching Iraqw and Nyaturu farmers, some Barabaig have had to ignore the customary rule and live permanently on the Balangda *darorajand*. Today, neither customary rules nor new state laws have protected the *darorajand*, creating a legal vacuum and a situation of virtual open access. Similarly, removal of access to *muhajega* grazing resources through the establishment of commercial wheat farms in the Basotu plains has increased pressure on other resources, resulting in land degradation (see below). Conflicts arise during drought periods when migrations are made outside the area in search of fodder. Movement options are restricted because of the existence of extensive agricultural lands in adjacent districts.

Such contemporary constraints are not arguments for abandoning the pastoral land-use system, but should prompt strategies for reinforcing its central components and addressing issues of conflict. This requires a reassessment of the old orthodoxy and an exploration of patterns of technical and legal support for common-property management.

The appropriation of land for agriculture has been the most serious threat to the Barabaig production system. The consequences of loss of land due to the establishment of a large-scale wheat project is explored below.

LOSS OF LAND: TANZANIA–CANADA WHEAT PROGRAMME

Since the beginning of the colonial era the population of Hanang district has increased dramatically. Human pressure on land in the Mbulu highlands to the north of the district resulted in Iraqw farmers encroaching on what

was Barabaig grazing land. Although the British administration attempted to stop this, it proved impossible (Schultz 1971). After a brief respite from encroachment by way of the Barabaig Native Authority prior to independence, encroachment on Barabaig pasture land continues to the present day.

The practice of a seasonal grazing rotation means that at certain times of the year, and sometimes for long periods, land is free of human habitation and grazing livestock. This has led some people into thinking that some pasture land is unoccupied. It is because of this that Barabaig pastures are sometimes taken over by others and put to non-pastoral use.

The inherent fertility of the volcanic soils of the Basotu plains makes it ideal for farming. Inevitably, farmers take the best agricultural land. Just as this land has attracted Iraqw farmers, so its agricultural potential has also been noticed by developers. In 1968 a Canadian mission identified many of the soils on the Basotu plains as "highly suitable for mechanised dryland farming" (Fenger et al. 1986). This has led to government appropriation of large tracts of land on the plains, for an extensive wheat scheme. In the early years of the scheme the critical grazing resource of the *muhajega* was not regarded as ideal for mechanised agriculture, because of the dry season cracking and wet season waterlogging of the vertisols. In the later stages of the scheme development, however, these areas were also included and "land suitability" assessments revised (MacMillan and Ngoma 1983).

In response to an expected increase in demand for wheat, the Tanzanian and Canadian governments agreed to develop the Basotu plains for agricultural production via a Tanzania–Canada Wheat Programme (TCWP). The scheme is based on a technological package reminiscent of the "green revolution", with mono-cropping of hybrid varieties using large-scale mechanical equipment along the lines used by prairie wheat farmers in Canada (Lane and Pretty 1990). The Tanzanian partner in the venture – National Agriculture and Food Corporation (NAFCO) – set about acquiring land in the area for seven farms of 10,000 acres each, making a total combined area of 70,000 acres for the scheme. This was later increased to 100,000 acres.

The TCWP farms now cover 12 per cent of all the Hanang district land (see Figure 6.4) (Lane and Pretty 1990). The significance of this loss to the Barabaig, however, is far greater than just the land area involved. Together with the land occupied by encroaching farmers, it represents the loss of virtually all the crucial *muhajega* forage resource that is so important for pastoral production. This has altered the seasonal grazing rotation and had a negative effect on herd productivity and Barabaig welfare (Lane 1991b).

Despite the fact that some Barabaig were resident in the area appropriated for the wheat scheme and that the *muhajega* were a vital forage resource,

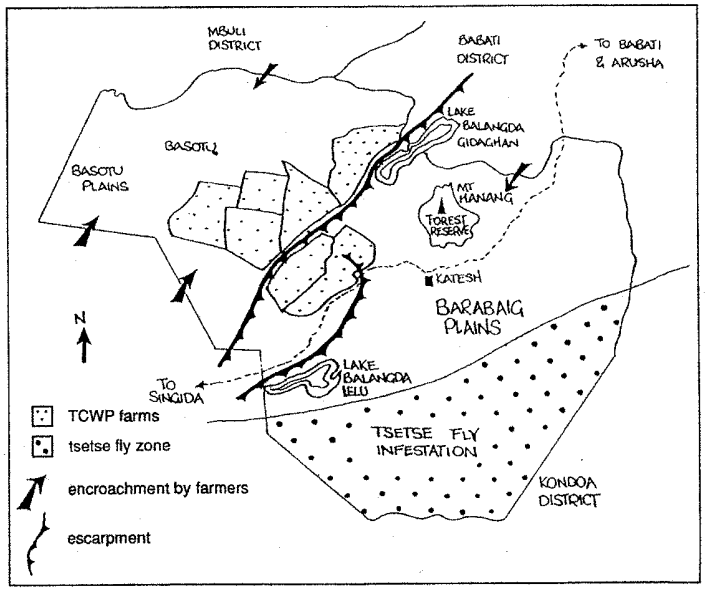

Figure 6.4 Map of the Hanang district showing major land-use features (TCWP = Tanzania-Canada Wheat Programme)

this land was described as "idle" during project assessments (Young 1983).

Some serious inadequacies in the economic evaluation of the wheat project are highlighted on closer examination.

THE ECONOMIC VALUE OF PASTORAL RESOURCES

The wheat project assessment was inadequate on two important counts. It overestimated the potential economic returns of the scheme and ignored the opportunity costs of reductions in land to the pastoral system.

Assessing the scheme's economic performance

The economic performance of the TCWP has been challenged by both internal evaluations and independent assessments. Early evaluations of the scheme showed positive cost/benefit ratios and a 40 per cent internal rate

of return (Stone 1982). In 1982, however, the economic realities of the TCWP came to light. Two internal evaluations revealed that, whilst the farm accounts showed the TCWP was profitable in financial terms, the full economic costs including aid, subsidy and tariffs protection exceeded the economic benefits (Prairie Horizons 1986; Michael Mascall and Associates 1986). In addition, increasing problems of soil erosion in the farms (Fenger et al. 1986) highlighted the additional "hidden" environmental costs of the scheme; these never entered the economists' equations.

In 1986 an independent study was done with the purpose of testing the efficiency of resource use and to find out whether it makes economic sense to grow wheat using the methods employed on the scheme when compared with smallholders using oxen, and relative to the cost of direct importation of wheat from the rest of the world market (Carter et al. 1989). The study concluded that the scheme had a negative net financial profitability and a negative cost/benefit ratio. This led to the conclusion that the TCWP "is not economically viable nor does it make effective use of domestic resources in saving foreign exchange for Tanzania to use large-mechanised wheat production to satisfy the domestic demand for wheat" (Carter et al. 1989).

Opportunity costs to the pastoral system

These re-assessments of return from the wheat project must be combined with losses in economic returns to the pastoral system. Assessing the economic value of pastoral resources is complex. Costs and benefits are difficult to assess in quantitative terms, presenting problems of subsistence production valuation and the assessment of the costs of environmental impacts. Difficulties in economic evaluation are also compounded because use is made of different areas at different times of year. Benefit streams from different components of the landscape thus vary over time, both seasonally and interannually. Land is not "idle" if it is not used continuously. Indeed, access to particular key resources may be critical to the long-term sustainability of the system. Removal of land from pastoral use may impose major economic costs in the long term, both through reduced pastoral production viability and increased land pressure and environmental costs on other areas.

A framework for economic assessment

Such complexities, however, are not an excuse for ignoring these issues completely. Recent developments in environmental economics suggest possible frameworks for economic valuation in pastoral situations (Barbier

1989; Dixon et al. 1990). Box 6.1 outlines the possible components of such an economic framework that would be needed for a more complete evaluation of the direct costs of removing key grazing areas from the Barabaig and placing them into the TCWP. Box 6.2 then presents information on the *indirect* and *non-use* costs associated with this loss.

The loss of land to the wheat scheme can be seen to have a significant cost. A quantitative assessment is impossible with currently available data; however, a framework for assessment is proposed. A critical point is that the opportunity cost of lost *muhajega* land is not simply the reduced value in proportion to the area removed. This is because of its crucial role in the seasonal grazing rotation. The economic value of key resource patches needs to take a central place in economic assessments. The impacts of this land loss are considered further below.

IMPACT OF LAND LOSS ON THE SEASONAL GRAZING ROTATION

The impact on the seasonal grazing rotation by the loss of *muhajega* has forced the Barabaig to adopt a new grazing pattern (see Figure 6.5) and to rely more heavily on the seven remaining forage areas.

They have been forced to use of *darorajand*, *hayed*, and *gileud* forage when these would otherwise be rested from grazing. Further, together with the *ghutend*, it means that these areas are more intensely used at traditional times of use. Only the mountain (*labayd*), Rift escarpment (*badod*) and bushland (*darabet*) are relatively unaffected by the loss of the *muhajega*, as these are unable to match the productivity of the other forage regimes. Shifts of resource use to these low resource potential areas, however, may result in adverse impacts on the environment and animal productivity. Possibilities include more erosion as a result of increased use of shallow soil hill slopes and declines in animal productivity from increased exposure to tsetse fly in the bushland.

Environmental impacts: degradation

Changes in pastoral land use induced by the establishment of the wheat scheme have resulted in a range of environmental impacts. These are outlined in Table 6.3. This is based on information derived from data collected and interviews with the Barabaig carried out during 1987 (Lane 1991a), plus environmental assessments carried out in the wheat scheme area (Fenger et al. 1986). Impacts are not uniform and it is necessary to dissect the range of impact in different land types and explore the consequences for livestock production in the area.

The land resources of Hanang district support a pastoral population of approximately 35,000 Barabaig with around 207,500 cattle (based on a 1984 census with 2.25 per cent annual growth). This represents a considerable standing capital value. If each animal is conservatively valued at $US 84 (*c.*Tsh. 8,377/- actual average sale price for marketed animals in 1987) this represents a total value of approximately $US 17.5 m. This price does not include premiums that would be paid for productive females (as high as Tsh. 30,000/-, *c.*$US 300 per animal). The flows of products from these livestock include the regular production of meat and milk. Assuming a conservative 5 per cent meat off-take this represents an annual flow of $US 726,000. Milk products should be added. Assuming production of 157.5 litres/lactation are available for home consumption, a calving interval of 15 months and 30 per cent of the total herd as milch cows, this results in a total yield of 4.57 million litres per annum (Lane 1991). If milk is valued at 50 US cents per litre (the average replacement cost of milk purchased in Babati in 1987; range: 35–60/-), the total value of annual milk production is $US 2.3 m.

A full assessment of herd value should also include the increments to the herd through births and acquisition (approximately 2 per cent per annum). Based on calculations of milk and meat outputs only, the "average" animal produces approximately $US 14.5 worth of output per year. Any significant reductions in herd size or decreases in productivity would thus result in a significant cost.

Further outputs from the system include wood products, agricultural produce, wild foods, and honey. A total assessment of direct use value would have to consider the whole range of products harvested from the savanna ecosystem.

Estimated costs of the removal of land by the wheat scheme are difficult to assess. However, declines in cattle populations in areas adjacent to the farms have been assessed by Barabaig elders at around 30 per cent over the past 7 years. Productivity levels of the remaining herd have also been reported to have declined due to the loss of land. If a third of half the district herd is depleted by the scheme then there is an additional capital loss of $US 2.9 m.

Such economic losses due to decreased livestock populations need to be reflected in the assessment of the direct costs of the scheme; these are likely to be significant if the approximate valuations attempted above are an indication.

Box 6.1 A Barabaig perspective of the direct costs and benefits of the TCWP

Coupled with the direct costs and benefits of key savanna areas to the Barabaig, it is necessary although difficult, to assess the economic value of the ecological functions of the various components within the landscape. Soil and water processes in savanna ecosystems remain poorly understood. Rigorous assessment of the economic benefits of such processes to production systems is therefore impossible. However, the impact on ecological functions should not be excluded from an economic framework that incorporates considerations of sustainability (Barbier 1989).

The impact of mechanised farming operations on the Basotu plains includes the costs of soil erosion. The long-term impact of this on the productivity of the system, through siltation or disruption of hydrological processes, remains unknown.

The Barabaig regard land as more than a physical resource. For them it can also have great spiritual significance. The Barabaig bury certain of their esteemed elders with a *bung'ed*, which is both the name of the burial mound and the funeral ceremony associated with it. The ceremony involves thousands of people and costs what amounts to a fortune for the Barabaig, including as it does the slaughter of many livestock and the brewing of vast quantities of honey beer. These burials constitute one of the most important expressions of Barabaig culture. The presence of a *bung'ed* provides an attachment to land that cannot be broken in Barabaig culture.

The ploughing up of burial sites as part of the wheat scheme clearly represents a major social cost of the scheme.

Box 6.2 A Barabaig perspective of the indirect costs and benefits of the TCWP

Various types of impact are identified in Table 6.3. Do these constitute "degradation"? Abel and Blaikie (1989) offer a definition of land degradation in pastoral systems that explicitly recognises the economic dimension. They describe degradation as "an effectively permanent decline in the rate at which the land yields livestock products under a given management system".

Degradation is thus measured in relation to the economic returns from the livestock enterprise. Changes in environmental factors therefore do not necessarily imply degradation; they must have a direct impact on the yield of livestock products and they must be irreversible. If this is accepted, certain impacts outlined in Table 6.3 may not represent degradation under this definition.

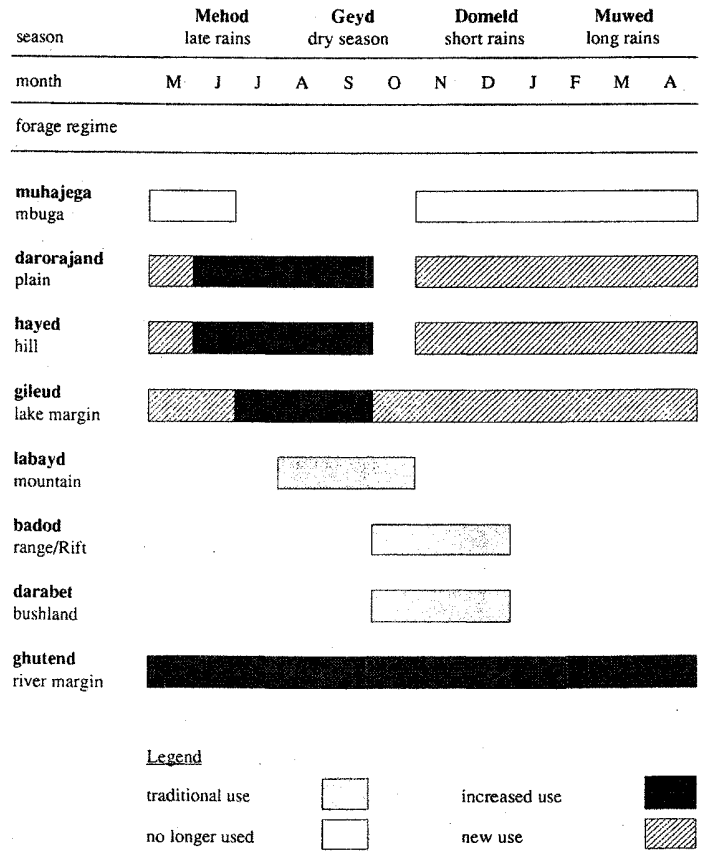

Figure 6.5 New Barabaig grazing pattern

For instance, loss of soil from hillslopes may result in longer-term reductions in grassland productivity, although the time scale over which this is likely to occur is unknown. The fact that livestock make little use of these areas suggests that this is probably not a key area of concern to the Barabaig. The same applies to the reduction in tree cover in the miombo bushland. In fact, because of tsetse reduction, this impact is likely to have a positive impact on livestock production.

Table 6.3 Forms of environmental impact due to the Tanzania-Canada Wheat Programme (TCWP)

Resource type	*Impact*
Topland range resources	
Plains	Decreased perennials
Hills/mountains	Soil loss
Bushland	Bush clearance
Bottomland key resources	
Muhajega	Farm land – gully erosion
River and lake margins	Heavy grazing, erosion, hoof damage
Lakes/springs	Siltation

Shifts in grass species composition may be due to rainfall changes; a period of drought naturally increases the percentage annual cover in savanna grasslands. This may be reversed with increased rainfall or decreased livestock pressure. Annuals may also provide good quality fodder during the rains with a rapid response to rainfall onset. Changes from perennial to annual grasslands, therefore, do not necessarily represent degradation. In the Barabaig plains, however, the decreased perennial cover has persisted over some time. According to local informants, this loss in perennial cover is not the result of recent droughts, since field observations followed a period of high rainfall (see Figure 6.1). This shift is also more likely to be detrimental to livestock production than in other savanna areas, since the plains areas are used for dry season grazing. A good dry season grazing resource requires perennial grasses that persist throughout the year. Although possibly reversible (with changes in livestock pressure), there is a good reason to regard the changes on the *darorajand* as "degradation". Certainly this concern is echoed by the Barabaig who point to the loss of key grass species in recent times (Lane 1990).

The impacts that represent the major threat to livestock production are those situated in the "key resource" areas of the river and lake margins and the *muhajega*. The removal of the *muhajega* from pastoral production has resulted in a transformation of the seasonal grazing pattern (see Figure 6.5). Increased reliance on alternative key resource areas has resulted in localised increases in stocking rate in riverine areas, lake margins and *muhajega* not used for the wheat scheme which have resulted in changes in resource productivity of these areas.

A focussed approach to environmental impact, that recognises the relationships between natural resource base and its use, is needed. This requires an understanding of pastoralist management strategies and ecological classification. In this case, recognition of the "key resource" areas has allowed the assessment of environmental impact in a systems context.

CONCLUSIONS: THE WIDER IMPLICATIONS FOR SAVANNA LAND MANAGEMENT

What are the lessons that can be drawn from this case study for the management of pastoral systems in savanna environments? Several interrelated themes are highlighted:

(1) Future plans for savanna land use should be based on existing traditional forms of management, and include the involvement of local land users in the formulation of land-use plans.

(2) It is necessary to understand the rationale for indigenous pastoral land use. Pastoralists' ecological management strategies are generally founded on a detailed understanding of the dynamics of the savanna system and the constraints of livestock production in such environments. The old orthodoxy of range management recommendations must be re-assessed in this light.

(3) Pastoral systems are dependent on a range of different land resources used at different times and in relation to different constraints. It is essential to identify "key resource" patches and management strategies (notably movement) that sustain the system. Recognition of their role will improve economic assessments of the impact of the land removal and degradation processes.

(4) Frameworks are needed for economic valuation of pastoral systems that incorporate appropriate valuation of direct use, indirect use and non-use values. The impact of external interventions should be assessed, with an explicit assessment of the opportunity costs and environmental impacts of land appropriation from pastoral areas.

(5) The management of natural resources in pastoral systems is based on regulation as part of common-property tenure systems. The patterns of regulation need to be understood and reinforced by securing legal rights over land (particularly key resources) and providing regulated access to areas needed for drought survival.

The case of the Barabaig of Hanang district is not an isolated one. It is typical of many situations in the savanna lands of Africa. A more complete understanding of pastoral issues argues for a re-evaluation of the old orthodoxy, replacing it with new thinking, elements of which have been outlined in this paper. However, a resolution of the problems of pastoral peoples requires concrete political commitment by governments and others to the consequences of this new thinking, most notably in the area of land rights. This may prove more difficult to achieve.

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