FINAL REPORT

OVERVIEW OF COMMON POOL RESOURCE MANAGEMENT IN SEMI-ARID TANZANIA

Review of Common Pool Resource Management in Tanzania

Report prepared for NRSP Project R7857

ANNEX A

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1. Introduction

This report aims to describe the current situation with respect to common pool resource (CPR) management in semi-arid Tanzania and to analyse the factors that determine the way that management of these resources is developing. The contents of the report are based on the initial terms of reference for the project and cross-reference to the other more detailed project technical annexes. It thus acts as an overall summary for the project.

The analysis aims to:

1. Identify and classify the principal forms of common pool resource in Tanzania.
2. Assess the contribution of common pool resources to livelihoods and how their use fits into the broader livelihood strategies of the poor.
3. Review current and likely future changes in use and to identify key pressures on the resource.
4. Analyse the institutions that govern resource use and the way those institutions are responding to change.
5. Identify researchable constraints to the effective management of open access and common pool resources in Tanzania.
6. Assess the effective demand for new approaches to common pool resource management.

The terms of reference also ask for the different forms of common pool resource to be quantified. This was not possible as fieldwork revealed that CPR are too diverse and widespread to be sensibly quantified. Villagers identified most natural resources as CPRs, including water, forests, rangeland and wildlife. The different types of CPR also cannot be considered in isolation as they form an overlapping series of resources at a range of spatial scales.

A considerable amount of research has already been carried out on these issues, in Tanzania and elsewhere. The analysis concludes with a brief overview of the current state of knowledge on issues affecting CPR management in Tanzanian semi-arid system. The overview will address the following questions:

1. The extent to which there is a true management problem on a given resource.
2. What are the specific benefits that will arise from improvements in resource use?
3. What will be the cost, in particular the transactions cost, of improving resource management?
4. Under what circumstances will each of the potential solutions to CPR management issues be most appropriate: a shift to private tenure, community based natural resource management, regulation by outside authority or some intermediate position such as the issue of licences for particular aspects of resource use?
5. Do the conditions exist for the establishment of 'long enduring CPR institutions' (in the sense of Ostrom 1990)?
6. How can boundaries to a given resource and the membership of the user community be drawn effectively yet equitably, so as to ensure effective management without excluding some users or creating windfall gains to particular individuals or groups?

A key objective of the project is to provide a testable basis for the next stage of the Natural Resources System Programme (NRSP) semi-arid production system (SAPS) programme. The aim is to develop a synthesis of existing knowledge and that draws on literature and fieldwork carried out as part of the project. The synthesis will identify what gaps in knowledge there are and what must be done to fill those gaps during the longer second stage of the NRSP programme addressing Output 3 of the SAPS logframe:

Output 3 Livelihood strategies based on the sustainable use of common pool resources (including wildlife habitat) developed and promoted

3.1.1 Analysis of CPR dependence and interactions

d) CPR interactions (in Tanzania)

Other recent or ongoing NRSP projects in semi-arid Tanzania deal with other aspects of livelihoods, for example: household coping strategies (R7085 under output 1.1.1 a)), social and human capital (R7806 under output 2.1.1 b)) and policy implications (R 7973 under output 3.1.1 f)). In this project we have focused on institutional economics as a means of analysing CPR interactions. This is to avoid overlap with other projects which are assessing micro-economics (R7085) and law (R7973).

This report is a summary and cross-references to other project reports. These are of two types:

1. Field work reports that contain information gathered during field activities of the project. The field work reports consist of two workshop reports (Quinn 2000, 2001a) and the profiles of villages visited (Quinn 2001b, Quinn 2001c, Quinn et al. 2001). Characteristics of the villages visited are summarised in Table 1.

2. Technical supporting reports to explain concepts in greater detail. The inclusion of greater explanatory details of economic concepts and methodologies was needed as these aspects were rarely dealt with in the examples reviewed during the course of the project. The technical supporting reports are on the economics of common pool resource management (Adhikari 2001), economic valuation of different forms of land use (Kirby 2001) and mapping strategic interactions in common pool resources (Perez-Cirera 2001).

Table 1 Population, ethnicity and immigration of villages visited during project field work.

Village	Population	Major Ethnic Groups	Livelihood	Immigration
Kadando	450 households 1500 people (1998)	Pare, Sambaa & Kamba	Agro-pastoral	Seasonal for rice cultivation and farm wage work
Karamba	250 households 1100 people	Sambaa	Agro-pastoral	Seasonal for cultivation or pasture
Mfereji	2469 people	Maasai, Arusha & Meru	Pastoral	Seasonal for pasture
Naitolya	203 households 900 people	Arusha & Maasai	Pastoral	Seasonal for pasture and watering livestock
Sarame	250 households 680 people	Mbugwe	Agro-pastoral	Seasonal for pasture
Kisangaji	870 households 2725 people	Mbugwe, Iraq, Nyaturu & Barbaiq	Agro-pastoral	Seasonal for pasture, irrigation farming
Meshili	29 bomas	Maasai	Pastoral	Seasonal for pasture or government workers
Kakesio	100 households 27 Bomas 2808 people	Maasai	Pastoral	Immigration for cultivation Emigration is common
Msosa	295 households 1425 people (2000)	Sagala	Agro-pastoral	-
Isele	624 households 2080 people	Hehe & Gogo	Agro-pastoral	Seasonal for cultivation & pasture
Bolisa	253 households 2500 people (2000)	Rangi	Agro-pastoral	None
Bumbuta	567 households 3558 people (1999)	-	Agro-pastoral	Seasonal for cultivation

Villages were selected to provide variation in ecology, production system and culture. Four villages are traditional villages that date to pre-colonial times (Kadando, Karamba, Msosa and Bolisa). Four villages are upgraded sub-villages that were created when the original village became too big to be considered one village (Meshili – 1994, Isele, Mfereji – 2000 and Naitolya – 2000). The other four villages are new villages created by the villagisation act of 1975 (Kakesio and Sarame), by Operation Manyara (Kisangaji) and by the de-stocking programme undertaken by the British colonial government in the 1950s (Bumbuta).

The report contains nine sections. The first is the introduction. The second section by Stuart Stevenson provides general background to natural resource management in semi-arid Tanzania. This is discussed in relation to six different drivers: political change, economic change, access to land, demographic change, social change and ecological change. The third section by Jon Lovett provides an overview of ecology, and in particular looks at wildlife conservation as a land use. Land-use is divided into two types: wildlife good - cows bad, and pastoralism good - alienation bad. A third type of land-use, commercial farming is also considered, but not in detail. The fourth section by Hilda Kiwasila discusses the nature of different institutions involved in CPR management in semi-arid Tanzania. The situation is complex with multiple formal and informal institutions being involved. Behaviour of these institutions is strongly affected by cultural norms and perceptions. Section five by Hilda Kiwasila looks at the issue of demographic change in more detail. This is important because of the potential links between population growth, sustainable management and poverty. The sixth section by Celestin Muganga reviews some financial aspects of the management of the CPRs of water, land and forest. Gender is an important issue in CPR management and this is discussed in section seven which is contributed by Nyinisaeli Pallangyo. The final two sections which are edited from other project documents deal specifically with the points given in the project terms of reference listed above. Section eight addresses researchable constraints and section nine is a concluding overview by Claire Quinn.

1.1 Key findings

The key findings of the team are that the main researchable constraints for achieving pro-poor sustainable management of common pool resources in semi-arid Tanzania are in the field of governance. The broad nature of CPR management means that the areas to be researched are also broad as they need to be applied to a wide range of situations from access to national parks to allocation of rights from irrigation channels. There is a danger that the complex nature of CPR management prevents researchers from adopting rigorous methodologies. To avoid this situation we also recommend the application of economic methodologies to analysis of the problems and provide a series of background papers as technical annexes.

We recommend three main areas of research:

Making decisions:	Which land-use is preferable?
Institutional systems:	Do transactions costs prevent sustainable CPR management?
Institutional interactions:	What are the socially optimal interactions?

These three areas are important because:

- Recent major changes in Tanzanian land, forest and wildlife policy have emphasised the importance of village management planning. For example the new Forest Policy (GoT 1998) and Wildlife Policy (GoT 1998) stress the importance of involving communities in resource management, and the 1999 Village Land Act and Land Act attempts to clarify customary land ownership. However, evidence reviewed by this project suggests that many villages are not in a position to implement these changes due to the heavy load imposed by the need for strong governance at village level.

- Empowerment of villagers enables new approaches to be developed for improving livelihoods and sustainable natural resource management (Havnevik 2000). Whilst the substantial policy changes present new opportunities for poverty alleviation in semi-arid Tanzania, they also present difficulties. Foremost amongst these is the ability of villagers to respond positively and sustainably to increased control over CPR. Transfer of responsibility to villagers also carries a burden that is summarised in the term transactions cost (for more detail on transactions cost see project report by Adhikari 2001). This includes the costs of CPR management, monitoring and enforcement. If returns from the CPR are high, then it is likely that transactions costs can be covered. If returns are low, then it is possible that transactions costs cannot be covered or needs to be subsidised from other sources. The village survey carried out by this project indicates that transactions costs may be a major constraint in implementing pro-poor sustainable land-use practices.

- Estimation of returns from CPRs is not straightforward as there can be indirect use values in addition to direct use values (for more detail on economic valuation see project report by Kirby 2001). Different forms of land use, such as agriculture, pastoralism, tourist hunting, or wildlife viewing may offer differing returns. Decisions on which land-use, or combinations of land-uses, should be favoured by policy need to be based on appropriate economic analysis. For example, alienation of land for the exclusive use of wildlife conservation may lead to high economic costs following lost production. In some parts of Tanzania there is conflict over alienation of land from traditional management. The use of improved cost-benefit analysis will lead to better informed policy decisions.

- In addition to financial returns, economic analysis involves modelling interactions of institutions using tools such as game theory (for more detail, see project report by Perez-Cirera 2001). For example, the state may decide that wildlife conservation in a particular site is protected by an inalienable entitlement (i.e. because of a moralistic reason, Calabresi & Melamed 1972). Having established a wildlife reserve there are a range of possible options ranging from allowing uncontrolled access to complete exclusion to the protected area. The process of choosing the optimum policy can be assisted by using game theory as an analytical tool.

Other components of the project have revealed that:

1. A preliminary assessment of risk perception suggests that water is the key natural resource in semi-arid Tanzania. Natural resource based research is therefore most likely to be effective if it is focused on provision and access to water in contrast to range-land or forest which are more difficult resources to develop management institutions for (Quinn 2001b).

2. Spatial arrangement of natural resources in the landscape is an important constraint to successful sustainable management of CPR. Spatial and temporal variation in resource availability means that CPR management needs to be planned at a landscape level.

Application of Ostrom's (1990) criteria for long enduring CPR management institutions revealed that (Quinn 2001c):

1. Water is generally well managed through common property management regimes although institutions can be fragile when there are inadequate conflict resolution mechanisms or nested enterprises to deal with inter-village use of the same resource. Building institutional capacity between villages would serve to improve the robustness of water CPR management institutions.

2. Information from these villages suggests that many institutions, especially those for forest CPRs, are unable to adequately deal with change. Local population increases and the lack of suitable farmland has put new pressure on CPR management institutions that villages are not adequately equipped or supported to deal with.

3. New CPR management institutions can be successful if there is local participation in the design, implementation and monitoring of the CPR and transactions costs are low. However, when a new CPR management regime has negative impacts on livelihoods and transactions costs are high then institution failure is likely.

4. Range-land CPR pose the most difficult questions for long-term institutional survival. At present migrant pastoralists graze their cattle on a patchwork of CPR management regimes with arbitrary boundaries, that do not reflect the underlying ecological system, and with varied operational rules. CPR users are generally not involved in the development and modification of operational rules and as a result conflict between pastoralists and village residents are common. The nature of pasture CPRs and their use means that successful management, as defined by lack of conflict and ecological stability, is unlikely.

This analysis suggests that further research on CPRs is most likely to be successful if it is focussed on water. Catchments, irrigation schemes and boreholes have defined boundaries and can be allocated sets of users with clear rules. In contrast, ecological variability of range-lands creates a highly dynamic socio-ecological system which does not fit well into Ostrom's criteria for long-enduring CPR management institutions and presents particular problems for governance that are politically difficult to

overcome as responsive dynamic institutions are required to mirror spatial and temporal ecological dynamics.

2.0 Background to natural resource management in semi-arid Tanzania

The last ten years have been a period of great change for land-use in semi-arid Tanzania. Liberalisation of the economy in the 1990s, urged by the World Bank with a view to enhancing Tanzania's ability to repay international debt, was accompanied by abandonment of the ujamaa policies of the Nyerere presidency. This was followed by weakening of state control of the economy and state ownership began to diminish. Safari hunting and commercial ranching, mainly organised by foreign companies, boomed in semi-arid areas where rain-fed agriculture is not commercially viable. Driven by population growth, subsistence agriculture expanded into semi-arid areas where locally available water supplies, from springs or near-surface groundwater, permit pockets of cultivation in otherwise dry land. Simultaneously, many pastoralists drove their herds and flocks out the traditional pastoral areas into humid zones, seeking pasture and coming into conflict with farmers. Within this matrix of change, donor-driven conservation projects were imposed on many of the semi-arid areas and generously supported with foreign funds.

In consequence of these management changes, the stock and status of natural resources in the Tanzanian semi-arid zones today differs somewhat (though not fundamentally) from that of fifty years ago when customary management by indigenous people can (somewhat arbitrarily in respect of the date) be said to have been paramount. All of the trends and events mentioned in the first paragraph, above, affected and were affected by the others. Drivers of change are reviewed in this section of the report. Some are, of course, contradictory in their impacts – as on the 'social change' line in Table 2. They are here artificially separated for clarity of review; but multi-facetted interactive change was the reality.

Table 2 Drivers and manifestations of change in the semi-arid areas

Drivers	**Manifestations**
Political change	independence, *ujamaa*, centralization, donor dependancy; decentralization
Economic change	denial of the market, donor aid; poverty, subsistence; liberalization
Access to land	falling land area per head; sequestration of land, legal confusion
Demographic change	rapid population growth, population movement, urbanization
Social change	isolation, self-reliance; rising awareness and expectations; persistence of traditions; corruption
Ecological change	deforestation, bush encroachment; soil loss in some parts; diminution of biodiversity

2.1 Political Change

Governance of the semi-arid lands has changed (a) with the political evolution of Tanzania and (b) in response to foreclosure of traditional forms of land management over extensive tracts. Politically Tanzania changed direction three times: at independence in 1962, with the Arusha Declaration in 1967, and upon the hand-over of the presidency from Julius Nyerere to Ali Hassan Mwinyi in 1985. Inheriting an impoverished economy and obliged to negotiate with the IMF for funding, Mwinyi relinquished the socialist aspirations of the Arusha Declaration and its central command-and-control philosophy. Multi-party politics arrived and open dissent occurred, albeit with forceful discouragement in Zanzibar.

Environmental awareness dramatically reversed its position politically over the same period. Before and just after independence, conservation was attacked by politicians as an imperialist imposition – with some justification since a few technically unsound soil conservation efforts, draconian destocking schemes, sequestration of land for game reserves (starting with Selous in 1922) and sponsored deforestation exercises in the name of tsetse control and plantation agriculture had occurred in the first

six decades of the twentieth century. Indigenous knowledge of the environment had been weakened by displacement of people from their ancestral lands by villagisation and resettlement under ujamaa. The conservation ethic was sustained, with a wildlife focus, exogenously by the East African Wildlife Society, Frankfurt Zoological Society and New York Zoological Society.

The turning point came in 1983 when the NEMC Act was passed. Initially the National Environment Management Council was a powerless advisory body. Slowly at first but at a quickening pace since 1996, NEMC has assumed the role of an environmental protection agency but still has no legal powers. Lack of legal power constrains NEMC from becoming a full environmental protection agency. Through its efforts (supported by the Vice President's Office, generous donor funding, and various researches on pollution undertaken by scholars at higher learning institutions in Tanzania) natural resources management and pollution abatement seems to have overlain (though not displaced) wildlife protection as the focus of environmental concern.

That is not to imply that environmental concern attracts universal support. On the contrary. For example the imminent extinction of the Kihansi Spray Toad, which is threatened by diversion of the Kihansi river, is trivialised by most commentators. Nevertheless, it is not ignored and the Lower Kihansi Hydropower Project, where the toad is endemic to the spray zone of the waterfall, has been subjected to much public commentary – unlike its predecessor at Pangani Falls, and indeed all earlier major infrastructural projects.

This transformation was greatly facilitated by public outrage at approval of the Rufiji Delta Prawn Farm project in 1996. After NEMC's disapproval was over-ruled at high level, local communities vociferously contested a central decision, receiving support from NGOs and the newly formed Lawyers' Environmental Action Team. The previously timid Journalist Environmental Association of Tanzania (JET), established in 1991, found its cause célèbre. The failure of the project has been dissected in detail in the press. Every daily newspaper now carries one or more leading articles on environmental issues.

In contrast, all official attempts to capture and own environmental concern have failed. Numerous environmental reports, plans and strategies have emerged from donor, NGO and government agencies in Dar es Salaam. All contain the same recital of environmental problems such as over-grazing, soil erosion, bush-fires and deforestation. In the modern paradigm, most eschew forceful measures (unlike those used sporadically in Kenya) and espouse popular participation in the management of natural resources, more education and public awareness, and a selection from the menu of improved stoves, tree nurseries, bee-keeping, improved rural water supplies, and various forms of conservation-with-development.

Locally, some of these endeavours have succeeded, to the benefit of all concerned; but not normally in consequence of the publication of environmental strategy documents that are often poorly presented and readily ignored by the line ministries actually concerned with agriculture, forestry and livestock (rather than with 'the environment'). Moreover the actual managers of the natural resource base, in their villages, never see these reports. How to overcome this dilemma as we produce another natural resource study is indeed a researchable constraint at this stage.

How can the argument of the preceding paragraph be squared with the earlier characterization of 1983 as an environmental turning point? NEMC did participate, albeit somewhat un-enthusiastically, in production of some of the conservation strategies and plans. Unlike the National Land Use Planning Commission, however, it did not tie its fortune to top-down planning. NEMC has assumed the role of environmental regulator rather than manager. Of course, it still has far to go but, practising the art of the possible, it has gradually strengthened its reach and seems likely to continue to do so.

2.2 Economic Change

In the late 1980s Tanzania was dosed with structural adjustment polices which were adopted as a series of economic recovery plans and strategies, accompanied by liberalization of the economy, a slow but relentless programme of privatization and abandonment of the loss-making parastatal enterprises and marketing boards.

Within the semi-arid areas, local economies remained mainly subsistence-oriented and dependant on agro-pastoralism which overlapped with areas of traditional transhumant pastoralism towards the drier fringe (as in northern Monduli district) and with rain-fed agriculture towards the wetter edge. The semi-arid areas support around half the national herd but only one-fifth of the human population.

These largely non-monetarised traditional local economies had long co-existed with pockets of the modern monetarised economy in trading centres and around tourist attractions such as Ngorongoro Crater. Earlier, the pastoralists had greatly expanded their area of occupation before the great rinderpest epizootic a century ago, at the expense of their more peaceful neighbours. Thereafter their coping strategy to deal with livestock disease, competition from monetarised enterprise, demographic growth and expansion of their neighbours and sequestration of land for game parks, has been to retreat into drier land. The inevitable failure of this strategy was accelerated by liberalisation of the economy which introduced competing uses (safari hunting, mainly) into the dryland while continuing to encroach on the margins with new hotels, commercial ranches and farms. Most infamous of the land use conflicts in the drylands was that between the state wheat farms at Hanang and the agro-pastoral Barabaig who were displaced. No winners emerged from that fiasco whereas, in more recent cases, driven by commercial acumen instead of state control, sequestered land has been profitably ranched or farmed, all around the humid fringes of the semi-arid zones.

Maasai reaction to these pressures has been to hold onto the driest land, to venture out with livestock into previously ungrazed wetter land, and to participate in rural-urban drift. Every large town on the fringe of Maasailand (from Nairobi to Dar es Salaam) has a substantial Maasai population.

Other dryland ethnic groups, such as the waSukuma and the waArusha, adapted their agro-pastoralist lifestyle to participate, albeit marginally, in the new economy while maintaining their largely subsistence orientation. Their participation in the cash economy is endangered by periodic certain failure of the rains in the dryland which is already marginal for the maize-beans-banana farming system. Maize tends to displace lower-yielding and more labour-intensive (drought-resistant) sorghum and millet throughout the African dryland but at enormous risk. When the maize fails, cassava and food aid are the only remedies.

Moreover entry into the cash economy is further discouraged by management risks associated with drought-resistant crops. Cotton is prone to pest attack and is beset with marketing handicaps (formerly punitive state marketing and now exploitative private traders). Tobacco can be sold locally but does not achieve sufficient quality for the international market. Sisal is labour-intensive and low value. Charcoal-making for the insatiable urban market is actually a better short-term option for the rural dweller in the drylands. By exploiting common property, the charcoal-maker exports the external costs of his trade to the community and future generations, while avoiding risk since he does not have to grow the trees.

2.3 Land Management

Every investigation into land tenure, everywhere, concludes that the system being studied is of above-average complexity. Tanzania conforms to this general principle. Tanzanian land law became ever more unfathomable and unworkable as numerous statutes were added to the 1923 Land (Law of Property and Conveyancing) Ordinance, and none was repealed. Okoth-Ogendo, 1995, notes that 44 laws and sets of regulation affect land. The 1923 Land Ordinance has now been replaced with the Land Act 1999 and Village Land Act 1999 which became enforceable in May 2001; however it will be sometime before matters are clarified. Almost every Ministry and many other official institutions assume some right to regulate land holding and/or land use. Every form of authority (Government, the courts, traditional systems) seeks to regulate land and land is subject to varying forms and degrees of control at every level of government from national through regional, district and ward levels to village councils. Okoth-Ogendo describes the system of land administration as ‘labyrinthine’ and ‘saturated with internal contradictions’ (page 28).

Land is vested in the state. An unfettered land market cannot emerge. The customary land holding system, whereby land is allocated by the chief or village council, assumes land availability. The reality, of course, is that no good land remains to be allocated. The extent of cultivated land has risen while yields have fallen for many years throughout the semi-humid and semi-arid lands. The marginal land is too dry and/or too remote to warrant investment which is, in any case, beyond the means of the

young family taking up farming on attainment of adulthood. The other option, to subdivide family holdings, has also been much used, with the result that average farm sizes have fallen dramatically over the last twenty years. However, they have not yet fallen significantly below the two hectares or so which is the practical limit of cultivation by two adults with hand hoes. What has changed is that the quota of land left fallow has been much reduced or even vanished.

At the drier fringe of the semi-arid zone, agro-pastoralists set annual bush-fires to force a flush of new grass and to discourage tsetse-flies. Tsetse still infest nearly half of the dry rangeland, securing it for wildlife and safari hunting but creating a frontier which can be pushed back by bushfires – a practice lamented by environmental authorities. Accompanying the push-back of the tsetse frontier by bush-fires is a large off-take of bush-meat, a trade that has converted under liberalisation from subsistence to a lucrative enterprise, given the market in neighbouring towns.

2.4 Demographic Change

Rapid growth (around 3% per year) and youthfulness characterise the population of the semi-arid zones, as of the whole nation. Notwithstanding movement to towns and the mortality associated with the AIDS epidemic, the population of the semi-arid zone continues to rise. Half the present population is below 15 years of age. This means a high dependency on the older half.

School attendance has been dropping for ten years, literacy rates falling and the quality of schooling is in decline. This combination adds a large annual cohort to the working- population with no marketable skills. While most do still remain in their home villages, the interior drylands have exported many girls to become illiterate maids and prostitutes in the neighbouring cities of Mwanza, Arusha, Dar es Salaam and Iringa (Mwaituka 1999; Lihawa 1995; NURU Network 2000) and an even greater brigade of young men who have become itinerant traders and occasional participants in the urban informal economy.

2.5 Social Change

Traditional social customs have been remarkably resilient in parts of the drylands. Witness the survival of the customary Maasai way-of-life. Family links remain strong between those who remain in the village and those who have moved to towns. Customary ways are, however, being eroded by the emergence of an urban-born generation. Many influences now combine to unravel traditional social fabric: exposure to the urban consumer ethos, the onslaught of AIDS as well as the resurgence of malaria, and the inability of traditional beliefs to support workable solutions to modern problems to do with money, sex and authority. Tanzania has never succumbed to the social meltdown that engulfed neighbouring Rwanda and Burundi, nor has it experienced the civil wars of neighbouring Uganda and Mozambique.

Corruption rather than ethnic strife is the toxin that poisons Tanzanian society. Transparency International characterised Tanzania as one of the world's most corrupt countries, possibly due to the socialisation of corruption which extends down the chain of command to obstruct many minor transactions involving petty officials. Most decision-making in Tanzania remains relationship-based ('guangxi' in Chinese) rather than rule-based, as in modern industrialised societies. Corruption can be viewed, not as the absence of rules, but as the presence of alternative norms (Chachage 1994, Robbins 2000). The poor become part of corrupt exchanges because they are unable to resist, and so become complicit in corruption (Robbins 2000).

2.6 Ecological Change

Deforestation, bush encroachment; soil loss in some parts and diminution of biodiversity are actual and much lamented manifestations of ecological change in Tanzania. Less lamented but equally influential is the fragmentation of ecosystems by linear infrastructure, the substitution of crops (especially maize) for natural vegetation, and the herding of cattle. Driven by population growth, technological change and perceptions of entitlement, the more obvious changes have occurred within and around settlements, and on well-watered lands. Little of the original ecology remains in such places.

In the extensive semi-arid areas, covering 80% of the country, much less has changed – but cattle-herding for centuries slowly induced a situation with fewer wild animals, less wilderness, smaller

forests and dirtier water. Hardly noticeable until the mid-20th century, the pace of change has accelerated. The size and dispersal of the herds in relation to the land available to them is all important: moderately sized and well-dispersed, as over most of the Maasai area, they diminish but do not displace the natural biota (Homewood et al. 1998). Compressed by the sequestration of land for game conservation and settled agriculture, the herding culture does gradually debase the productivity of the rangeland. Nowadays, it is the breakdown rather than the existence of the pastoral system that is changing the ecology. Settled pastoralists no longer adhere to the resource management tenets of their culture. Instead, they adopt a resource-depleting lifestyle within the area they can walk across in one day. In so doing, they exacerbate resource depletion just like their farming neighbours.

3.0 Ecology

An important feature of the ecology of semi-arid Tanzania is that ecological conditions and vegetation can change rapidly over short distances, these changes bring marked differences in land use. The vegetation in semi-arid Tanzanian can be divided into four main phytogeographical regions using the system of White (1983): Somalia Maasai region, Afromontane region, Zambesian region and Zanzibar-Inhambane Region. Although there has been some criticism of the definitions used by White (e.g. Lovett, 1993) the phytogeographical definitions are useful in that they can placed in a continent-wide framework. Ecology of the phytogeographical regions is far from uniform. For example the Somalia-Maasai region in Tanzania varies from grassland composed of widespread species, such as on the Serengeti plains, to woodlands in the Ruaha valley that are rich in rare plants.

The driest region is the Somalia-Maasai region, and the delimitation of this vegetation type corresponds to strict management definitions of semi-arid. However, it cannot be considered in isolation because:

- Closed forest formations on high mountains provide water for arid lands.
- People traditionally move between vegetation types depending on rainfall patterns.
- Conflicts between farmers and pastoralists are greatest at the junction of dry and wetter vegetation types.
- Alienation of land from traditional uses for natural resource conservation has resulted in people putting greater pressure on areas not traditionally used for pastoralism.

3.1 Phytogeographical regions represented in semi-arid Tanzania

3.1.1 Somalia-Maasai Region

The Somalia-Maasai region is the driest vegetation type of Tanzania, forming a tongue of arid land at its broadest in the north, narrowing in the south to a tip at the junction of the Tanganyika, Nyasa and Eastern Arc rifts. Strict definitions of "semi-arid" would limit extent of the area under consideration to the Somalia-Maasai region, but for management purposes the area cannot be considered in isolation as people move in and out of the region according to patterns of rainfall. The vegetation formations range from grassland on the volcanic soils of the Serengeti Plains and seasonally inundated Usangu Flats, to dense thicket and woodland in most other areas. The traditional land use was pastoralism, but large areas of arid Tanzania have been alienated for wildlife conservation, for example the Serengeti, Tarangire and Ruaha National Parks, and Mkomazi Game Reserve; and ranching such as government cattle ranches near Babati and Arusha. The removal of large areas of land from traditional seasonal usage has created many problems for pastoral peoples, and has been the subject of recent law-suits.

3.1.2 Afromontane Region

On high mountains, where lower temperatures and higher rainfall permit, closed Afromontane forest caps the mountain peaks. The forest may also contribute directly to water inputs through “occult precipitation” which results from condensation of atmospheric moisture on leaf surfaces (Kerfoot, 1968). These forests are important sources of water and are mostly protected as central government controlled catchment forest reserves (Lovett & Pocs 1993). For example, in arid nothern Tanzania the volcanic mountains of Ngorongoro, Kitumbeine, Monduli, Essimingor, Ufiome and Hanang, and the gneissic mountains of Longido and Mbulu have extensive high elevation forests and provide surface and ground-water which is used by communities in the drier lowlands. At high elevations there are also large areas of grassland, either as a result of forest loss following fire, or because of regular frosts and grazing by large mammals. At lower elevations the occurrence of ground water can lead to growth

of forests in otherwise arid areas, either as gallery forest along rivers or in more extensive tracts as in Manyara National Park.

3.1.3 Zambesian Region

The Zambezian region consists of woodlands commonly known as miombo in Tanzania, and are often dominated by trees in the genus Brachystegia. The region occupies a crescent in southern Tanzania. The rainfall is often greater than 1000 mm/ year, but it is seasonal and fires are a feature of the long dry season. The woodlands are often infested with tsetse flies and in the past the presence of tsetse has dominated land-use due to disease transmission to cattle and people. The presence of tsetse was also used as a reason for land alienation, for example creation of the Selous Game Reserve. Large areas of the Zambesian region in Tanzania are under national park administration (about half of Ruaha and all of Katavi), game reserve (Rungwa and Selous) and forest reserve. Although not strictly semi-arid the Zambesian region is used seasonally and in times of drought.

3.1.4 Zanzibar-Inhambane Region

The Zanzibar-Inhambane region covers the Tanzanian coastal plain and consists of small patches of closed forest in a matrix of drier thicket and woodland. As with the other vegetation types large areas of land have been alienated for game reserves (Saadani, which is being considered for national park status) and forest reserves. As with the Zambezian region, the Zanzibar-Inhambane region is not strictly semi-arid, but most of it has a marked dry season so it falls within broader definitions and is used seasonally by people from drier areas.

3.1.5 Centres of endemism

One of the criticisms of White's (1983) phytogeographical classification system is that it fails to recognise local centres of plant endemism (Lovett 1998). This is of importance for two reasons. Firstly local centres of endemism are the focus of conservation concerns as development activity or changes in land-use can cause species extinctions. Secondly the distribution patterns of species in an ecosystem can give an indication of resilience. Vegetation composed of species with widespread distributions is theoretically more resilient as the species are tolerant of a wider range of ecological conditions than those with restricted distributions.

There are two such local centres of endemism in the semi-arid regions of Tanzania. One is the Ruaha valley in the rain-shadow of the Udzungwa mountains and the other is the dry scrub of the coastal plain. Both are woodland formations used for seasonal grazing by pastoralists displaced from the central grasslands.

3.2 Vegetation dynamics and management conflicts

The relationship between the ecology of semi-arid eastern Africa and management has been the subject of considerable academic debate. The traditional view of a set of climatic conditions giving rise to a particular physiognomic vegetation condition (i.e. the Clementsian concept of climax vegetation states) has now been replaced by the idea that vegetation can exist in a series of alternative stable states in any particular climatic. For example, at a single location in semi-arid eastern Africa under the same edaphic and climatic conditions, the vegetation might be grassland, thorn scrub or woodland. The vegetation formation is not necessarily directly climatically determined, but is rather a function of fire and grazing by wild large mammals or domestic cattle. The nature of the management regime thus determines the state of the vegetation, and therefore its potential for different types of economic activity. So, for example, heavy grazing by cattle might reduce grass cover, which reduces fire incidence through reduction in flammable biomass, which then permits growth of unpalatable thorn scrub. Or high elephant population densities reduce woody cover, leading to more open grassland and reduction of tsetse habitats, which in turn facilitates livestock herding.

The ability of vegetation in semi-arid eastern Africa to exist in a range of stable states is important when considering different discourses on the effects of different management regimes. Vegetation formations of a certain physiognomy and species composition will provide a particular set of products. For example, a grassland composed of palatable grasses will be suitable for cattle grazing. A woodland might be better for wildlife and other forest products such as fruits. Both vegetation types can exist in

the same place, and which type occurs where is a function of management inputs, such as burning regime. Cultural immigration can result in change in land use and change in ecology. In the Eyasi-Yaeda basin trees have been removed as agriculturists and pastoralists move into the area, and this affects traditional hunter-gatherer livelihoods of the indigenous Wahadzabe (Armitage 1996). Deciding which vegetation state and its associated biota, or "state of nature", is best depends on what you want, and this choice often depends on socio-political ideologies that are determined by moralisms. Two viewpoints are discussed here broadly divided into the **wildlife good - cows bad**, and the **pastoralism good - alienation bad** discourses. In the first discourse the moralism is that it is important to conserve wildlife for the common heritage of humankind, in the second it is that the basic human right of security of property and access to natural resources is paramount. Both approaches are contained in the Convention on Biodiversity, for example Article 8 on *in situ* conservation requires the signatories to:

"8(a) Establish a system of protected areas or areas where special measures need to be taken to conserve biological diversity", whilst at the same time under "8(j) Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge, innovations and practices."

A third approach, which will not be discussed in detail here, is to use semi-arid land in Tanzania for intensive agricultural production, for example by planting ground-nuts, wheat or beans, or through livestock ranching. Land alienation for cash cropping in semi-arid Tanzania has had mixed results. Ecology of the region mitigates against establishment of large-scale plantations. Aperiodic inter-annual climate variation is a defining ecological characteristic, with mean annual rainfall fluctuating widely. The ill-fated 1947 ground-nut scheme at Kongwa cost nearly £36 million (equivalent to total Tanganyika Government expenditure between 1946 and 1950, Iliffe 1979 p. 441) and failed because of drought. More recently, government backed schemes for cattle ranching and wheat farming in northern Tanzania have similarly failed. Privately owned farms have fared better, particularly if they have good access to key resources such as water. However, privatisation of water resources can seriously disrupt pastoral and small-holder livelihoods through loss of livestock watering points and irrigation flow. Conversely, a stable commercial enterprise can provide steady employment, an important factor for poor households which rely on multiple sources of income including cash returns from labour. Development of irrigated agriculture is complex in that it has four different interest groups: plantation agriculture supported by the State for export crops, large farmers for local production for urban areas, subsistance farmers who sell surplus in local markets, and nomadic pastoralists who need to survive the dry season (Unruh 1990). Alienation of land for cash cropping can also lead to migration and subsequent ecological changes many hundreds of kilometres from the establishment of farms. For example, this "cascade effect" has caused environmental problems in the semi-arid Usangu plains following establishment of coffee farms north of Lake Nyasa and cotton farms in central Tanzania (Charnley 1997).

The following two sections briefly review elements of the **wildlife good - cows bad** and **pastoralism good - alienation bad** approaches. For the sake of argument the discourses are presented here as polarised alternatives, though in practice there are many variations on a range of themes. Different interpretations of ecological dynamics are not the only reasons for disparate views. The discourses are also rooted in different socio-political ideologies, which can add vehemence to debate. Language in these debates can have an important influence on the policy process (Rydin 1999). For example, ecologists talk of biodiversity being important for maintaining ecosystem productivity, stability and sustainability (Tilman 1997), thereby emphasising the need for management to retain as many species as possible. Alternatively sociologists might describe western natural science as hegemonic and able to "constrain people's lives in often brutally repressive ways" (cited in Sullivan 2000 p. 15), implying that science is an instrument of political repression.

3.2.1 Wildlife good - cows bad

The wildlife good - cows bad discourse has its origin in ecology, but is associated with land alienation during the colonial period and external pressures for conservation at the expense of traditional culture and lifestyles.

3.2.1.1 Ecology

The paradigm of wildlife good - cows bad is derived from the ecological concept of maintenance of biological diversity being important in sustainable utilisation of semi-arid range land (Vesey-Fitzgerald 1973). The importance of biodiversity in maintaining sustainability, resilience and productivity has a strong empirical basis (reviewed in Tilman 1997) with observations from the Serengeti confirming the link between diversity and productivity (McNaughton 1993). The management implication is that semi-arid African range lands are best utilised by maintaining a diverse native fauna because grazing by a reduced species complement, such as in a modern cattle and goat based pastoralist regime, does not take advantage of the full potential of the range and can cause damage and degadation when overstocked (Du Toit & Cumming 1999). The practical outcome of this discourse is that, once ecological criteria are satisfied by maintaining a multi-species system, the management challenge is to maximise returns from game cropping or tourism. Poverty alleviation is then achieved through distribution of revenues in such a way as to benefit the poorest groups.

3.2.1.2 Socio-political context

By emphasising the importance of native large mammal diversity in maintaining range-land ecological health, the wildlife good - cows bad approach is also compatible with a conservationist paradigm. This is that African wildlife are a common heritage of humankind and should be conserved for their own sake. The debate amongst conservationists does not centre on the importance of wildlife for maintenance of ecological productivity, as this is taken as agreed, rather it concerns the merits of tourism over game cropping. On one hand is the view that wildlife should only be shot with a camera, and on the other the "use wildlife or lose it" argument stresses the importance of maintaining financial returns from those areas which might not have high tourist potential. The former holds an ethical position for the right to life for the remarkable African large mammal fauna, and the latter has a pragmatic stance that if we want to keep this fauna we have to make it pay for itself, even if this means game cropping for animal products such as meat and ivory.

This results in some interesting solutions which attempt to reconcile both camps and which centre around the concept of opportunity costs. The logic is that in order to both maintain ethical wildlife conservation and make wildlife pay for itself, the opportunity cost of land conservation should be met by the global community, for example by the Global Environment Facility (James et al. 1999, Norton-Griffiths & Southy 1995). The State and potential land-users are thus financially compensated for lost production from land set aside for conservation of the common heritage of mankind. Alternatively, local communities are compensated by being given permission to obtain natural products in the reserved areas through community-based wildlife management programmes. However, compensation from external sources does not take into account cultural values or recognise claims to ownership (Lovett 2001) and community-based wildlife management programmes have been regarded as simply a way of attempting to make alienation for conservation more acceptable (Songorwa 1999).

3.2.2 Pastoralism good - alienation bad

The pastoralism good - alienation bad discourse has its origin in concepts of equity and the importance of social capital in maintaining ecological productivity. This paradigm recognises rights of pastoralist communities to land which they might only occupy seasonally, pointing out that it is not equitable to confiscate this land for the purposes of wildlife conservation. It also recognises the fact that African semi-arid landscapes are a product of thousands of years of management, and that this management is integral to retaining modern landscape features. More controversial is the concept that human population increase also increases productivity of the land (e.g. Boserup 1965, Tiffen et al. 1994). Improved cropping systems and more secure land tenure increase output, but the species complement may change which means that more intense management can have a negative impact on conservation values.

3.2.2.1 Ecology

The central ecological notion of the pastoralism good - alienation bad paradigm is the "myth of wild Africa" which regards the African landscape as the product of active management by indigenous communities, rather than a wilderness in need of protection (Leach & Mearns 1996, Adams & McShane 1997, Neumann 1998). This argument is not incompatible with an ecological conservationist

approach as it implies that, historically at least, human economic systems have existed sympatrically with wildlife and so there is no reason for them not to do so in the future. For example, livestock herding in Maasailand is at least as old as 4000 BP (Collett 1987) and fire use has a history of hundreds of thousands of years (Bird & Cali 1998; Brain & Sillen 1988; Brain 1993). Moreover, the landscape and biota that we see today are the result of integrated management, and that exclusion of people from areas designated for conservation is not only unnecessary, but may cause imbalance that adversely affects wildlife.

3.2.2.2 Socio-political context

Conservation in Tanzania has tended to take the form of land alienation, with some 25% of the country being gazetted as national park, game reserve or forest reserve (IUCN 1987). Semi-arid regions have been particularly affected with large areas becoming national parks. In most places in dry land Tanzania, forests on the tops of high mountains have become forest reserves. Both wildlife and forest laws severely restrict access and activities within the gazetted areas. A rapid expansion of State control over natural resources and land in the 20th century has been interpreted as a means of consolidating colonial power through a European vision of conservation (Neumann 1995, 1996) or "scientific forestry" (Neumann 1997) that has led to land alienation and loss of customary rights. In areas of semi-arid Tanzanian that were not alienated, such as the Usangu plains, land-use systems based on common property resource management regimes have also been shown to be a colonial invention rather than an indigenous form of governance (Charnley 1997). Land-use conflict is not confined to the colonial period, for example an influx of pastoralists into the Mkomazi Game Reserve eventually resulted in a full scale eviction from the area in 1988 (Brockington & Homewood 1999).

Community conservation approaches have been suggested as a way of combining species protection with retaining traditional access to natural resources (Leader-Williams 1996). This approach is not without its detractors who draw attention to the failure of community based conservation to protect wildlife (for example Oates 1999 in West Africa). Or the inability of local institutions to respond rapidly to changes in natural product extraction and the appropriation of natural resource revenues from community projects by regional government (Campbell et al. 2000). Moreover land use law can divide modes of primary productivity according to use type and ethnic origin (Wanitzek & Sippel, 1998). For example, the pastoralist Maasai have rights to graze stock in the Ngorongoro conservation area, but not to cultivate, and the hunter-gatherer WaHadzabe and WaNdorobo are exempted from prohibition of hunting. This is not only a division of land use by ethnic origin - a practice which has been deplored elsewhere in Africa - but also a freeze on cultural development (Neumann 1995).

3.3 The contribution of ecological knowledge to management

Given the polarised views on management of common pool resources in semi-arid Tanzania - how can ecology be used to inform the debate? There would seem to be an impasse. The conservationists claim scientific legitimacy for recommending maintenance of ecosystems rich in native species. The socio-culturists require equity and recognition of customary land rights, and point out that the ecological landscape is in any case a product of human use. The balance between the respective views in policy is a matter for political debate, but ecological science (as can social science) can be useful to debunk claims that lack substance:

"*If pastoralists today have too many cattle and cause overgrazing, and if animal husbandry threatens wildlife, then the established scientific arguments stand. However there are many reasons to suggest that the relationship between cattle numbers and grass cover, livestock and wildlife, and pastoralists and their environment, are more complex than once thought*." (Brockington & Homewood 1996 pp. 95-96).

Examples are given below of studies relevant to each of the discourses discussed above.

3.3.1 Wildlife good - cows bad

If it is accepted that an important management goal is to conserve Tanzania's remarkable wildlife, but that revenue should be created from its sustainable exploitation, then on the evidence so far it seems that National Park or Game Controlled Area status is needed to maintain large mammal populations. Wildlife populations have declined in areas outside land covered by legislation that restricts land use

and hunting, which argues for the need to alienate land for wildlife conservation. The management problem is then to maximise financial returns from this area through tourism or hunting. Poverty alleviation comes through ensuring that local communities receive adequate flows of benefits from the protected area. These benefits will also act as incentives to respect and maintain management for conservation. But are wildlife populations affected by activities such as tourist hunting? And is tourist hunting ecologically sustainable?

Ecological studies can assess the impact of revenue-generating utilisation on wildlife. For example, large mammal populations can survive sustainable tourist hunting in Game Controlled Areas, but not local hunting in partially protected areas such as forest reserves (Caro 1999a). The loss of large mammals from areas outside land specifically set aside for mammal conservation is leading to "empty forests" (Redford 1992 cited in Caro 1999a) where, although the vegetation that could sustain large mammal populations still grows, the animals no longer exist because of hunting. This means a potential loss of revenue, either from locally marketed “bush meat” or rather more lucratively from tourist hunting. Animal population censuses can provide information on the viable levels of game that can be subjected to tourist hunting. For example a recent census estimated that tourist hunting quotas for some species in protected areas could be increased, but for other species such as the Eland and in certain areas, such as around Serengeti and Tarangire National Parks, quotas should be decreased (Caro et al. 1998). Behavioural observations show that there were few differences in large mammal species demography, such as group size, adult sex ratio and young-female ratio between unexploited and exploited for hunting parts of the Katavi ecosystem, but some species show differences in behaviour being more likely to flee an observer in exploited areas (Caro 1999b).

Although revenue can be obtained from tourist hunting in protected areas, large mammal conservation can have adverse effects over and above the issue of land alienation. Villages adjacent to Selous Game Reserve and national parks in Tanzania have suffered from crop trampling, livestock predation and deaths caused by wild animals (Newmark et al. 1994, Songorwa 1999). In the analysis of costs and benefits of wildlife conservation, it is difficult to place an adequate value on loss of human life resulting from attacks by animals.

3.3.2 Pastoralism good - alienation bad

Poverty has been caused by land alienation and denying traditional access to natural resources. A logical way of alleviating poverty is thus to reverse the alienation process and recognise customary rights and ownership. However, as noted above under the “cows bad” paradigm, it has been suggested that pastoralism can be ecologically unsustainable at high stocking densities and that wildlife conservation is a more ecologically efficient land use. Much of the ecological conflict between alienation of land for wildlife conservation and pastoralism centres around three issues:

- The spatial dimension of access to key ecological resources.
- Disease transmission between wildlife and livestock.
- Loss of productivity and soil erosion caused by herding.

By researching these issues it may be found that the ecological discussion needs to only focus on a few “hotspots” of conflict rather than the whole of Tanzania’s protected area system. The spatial dimension of impacts of pastoral herding is key to understanding the relationship between ecology and the pastoral production system. Research can reveal where herding takes place and what factors affect this distribution. Access to dry season forage and water is the central controlling factor for the production system of pastoralists and livestock industry in semi-arid areas. In the Rukwa valley, cattle herds maintained by agro-pastoralists only travel as far as their water source in the dry season (Coppolillo 2000). Problems arise when agriculture develops in places with dry season water, thereby limiting access by pastoralists to the key resource (Unruh 1990). This can result in range degradation as cattle are overstocked in areas which cannot support them, or lead to direct conflict between agriculturists and herders. Similar problems are caused by restricted access to seasonally available resources in conservation areas. The Serengeti National Park is shaped to permit seasonal migration of ungulates, but the same thought was not put into the landscape design needed by pastoralists who were alienated from the park. Pastoralists in the Ngorongoro Cconservation Area have lost important dry season grazing grounds and been disadvantaged by controls on burning (Lissu 2000). Research on spatial distribution of herding could resolve some conflicts between wildlife conservation and livestock ownership. Pastoralists may only use a limited area of semi-arid land, and so might not overlap with

either wildlife or other land uses. For example, in the Rukwa Valley herders tend to use high-density settlement areas and disturbed areas as grazing lawns. In these places there is shorter more palatable foliage and fewer ectoparasites (Coppolillo 2000).

Disease transmission also has an important spatial component. In northern Tanzania, lowlands are the preferred grazing land, even though they are more drought prone than fertile wet forested mountain areas. This is because of ectoparasite disease transmission in the wet uplands which affects cattle from the lowlands without immunity, and means that upland cattle need to spend time in the lowlands away from the source of transmission (Potkanski 1994). The exclusion of cattle from wildlife conservation areas may be a question of aesthetics, rather than an ecological problem such as competition for resources or disease transmission, as wildlife and cattle have co-existed for thousands of years. For example, with the exception of buffalo and wildebeest, most wild animals are not significantly involved in the transmission of disease to livestock (Bourn & Blench 1999).

Concern that grazing may be responsible for lowering primary productivity, as in the "cows bad" scenario could be misplaced. Research has revealed that productivity is determined by physical constraints, such as rainfall, rather than grazing per se (Mwalyosi 1992). Productivity might be affected by grazing leading to soil erosion through gullying along cattle tracks and erosion off cultivation, thus leading to soil loss and loss of fertility and therefore loss of productivity, especially where cattle are concentrated because of land alienation (Mwalyosi 1992). But even here research has revealed that the case against cattle might not be clear. Gullying, although a dramatic indication of soil erosion, is indicative of sheet erosion higher in the catchment and may not be due solely to the tracks created by cattle (Stocking 1996).

3.3.3 Summary

The ecology of Tanzania's semi-arid regions is highly heterogeneous. This leads to diversity of land-use, cultures and livelihood strategies that can come into conflict. For example wildlife conservation can conflict with both agriculture and pastoralism, pastoralism can conflict with agriculture, and commercial agriculture and ranching can conflict with traditional forms of subsistence. Ecological research can provide answers for questions regarding productivity for sustainable utilisation natural resources, but it is dependent on the policy environment – which is determined by Government. Policy decisions tend to precede ecological research and therefore define the research context. For example in the HADO soil erosion control project near Dodoma (see section 8.1.1) there was a delay between start of conservation programme and research, which lead to a tendency to judge success of conservation initiatives solely from growth of vegetation (Kikula 1999). In wildlife conservation, a political decision was made to conserve Tanzania's remarkable fauna through the establishment of national parks, this in turn has led to a great deal of high quality ecological research (for example Sinclair & Norton-Griffiths 1979, Arcese & Sinclair 1995). However, there is a philosphical debate over the need to conserve wildlife to future generations, as it also valid to propose that we should create just and equitable systems of allocation of natural resources as a bequest (Beckerman, 1997). Alienation from traditional uses of large areas of land for conservation means ignoring usufruct rights, but to grant those rights may mean the loss of a unique flora and fauna. This tension is apparent in Article 8 of the Convention on Biological Diversity which recommends both establishment of a system of protected areas, and maintenance of traditional lifestyles. In the case of conservation areas such as the Serengeti and Mkomazi reserves this has not so far proved to be possible with pastoralists being evicted from these areas in preference to land-use as an exclusive wildlife habitat.

A topic which has not been discussed here, but could potentially have enormous impacts on poor people in semi-arid Tanzania, is global climate change. Ecological knowledge can also contribute to future planning in the face of climate change. Correlations between crop yields and sea surface temperatures in the eastern Pacific demonstrate the global nature of climate (Cane et al. 1994). Predicted global climate change has the potential to cause massive ecological disruption that will make any local problems pale into insignificance with major impacts on infrastructure, power supplies, food production and wildlife conservation (Magadza, 2000, Hannah et al. in press).

4.0 Institutions

The concept 'institution' has often been used by sociologists to connote a variety of patterns of social organisation. Sociologists see that all present societies can be analysed in-terms of a handful of formal

and informal institutions each of which regulate important aspects of life. For a society to function properly it therefore has to have functional institutions, be they formal or informal (Mann 1983:172). However, some scholars (Uphoff 1986, Maganga 1995, Berkes 1989) make a distinction between informal and modern institutions. The latter have been registered and assigned specific tasks by their act of establishment and the former, mainly traditional institutions also called indigenous institutions, have not. Some such traditional or indigenous institutions may always have existed but may be hard to find (Upholf 1986, Maganga 1995). Indigenous institutions are assumed to have evolved in almost all societies as they struggled against nature for survival. The institutions supported people to deal with diverse problems of an economic, cultural, religious, political and social nature. Traditionally, each institution that evolved developed common values, complex rules and norms of behaviour for governing its mission and mechanisms for enforcing rules, norms and customs over a resource. According to Uphoff (1986), the norms and values determined rights and obligations between people over specific resources. Uphoff further suggests ways of categorising the terms "institution" and "organisation", which are at times used interchangeably and contribute to ambiguity and confusion.

He sees three categories of institutions: (a) institutions that are organisations, (b) organisations that are not institutions, and (c) organisations that are institutions (Uphoff 1986:8). Bearing in mind the above definition, Uphoff suggests that institutions (whether they are organisations or not) should be considered broadly as a complex of norms and behaviours that persist over time by serving collective values. Considering the above broad understanding of institutions, the study on CPR did not restrict itself to examining formal institutions such as village government or resource management committees alone. The study also covered traditional institutions governing resources. This approach is in agreement with a warning from Feeny et al. (1990) that in analysing resource use and management systems, we should not look only into century-old institutions or systems but also look into how people are functioning at present and the basis of their behaviour. Some institutions, be they formal or informal, are very recent, emanating from peoples' innovations in finding ways of surviving or solving problems related to resource use and interactions. Feeny also identifies the co-existence of many property regimes in one geographical community and how people are able to appropriately match resource use with management regime. The mix is maintained for survival and sustainability of resources.

In analysing the property regimes of natural resources, Bromley and Cernea (1989) saw that all types of property ownership systems (be they traditional or formal modern systems) have a tendency to evolve an authority system to ensure that rights and duties are adhered to. They call this authority a regime. According to them, the regime will include, among other things, structures and an authority system of management, rules, system maintenance, use rights, sub-systems, exchange rights and systems of distribution of entitlements (access rights and control). If any of the above degenerates, the self-management system ceases to function. Livelihoods of those managing the regime might then be affected negatively.

According to this research study CPR can exist in any property regime. The study on CPR was therefore designed to look into the existence of institutions managing CPR resources in semi-arid areas. In present day Tanzania, all resource management requires institutions at local, regional and national scales. It is assumed that local communities will support formal management institutions or systems if those systems serve local people's interest. The study wanted to know if institutions for managing resources exist, to what category they belong (formal, informal), their rules and effective ways of managing resources and solving conflicts. Of interest was also to find out about interactions to see if control of resources by one part of the system can be drawn up without disadvantaging sustainable use of resources by another part of the system.

In Tanzania, multiple formal institutions are involved in activities that impact on CPR and natural resources in general. These include sectoral ministries responsible for specific resources such as fisheries, wildlife, irrigation water, minerals, and forestry. Others include regional, district and municipal authorities, private commercial companies, Non-Governmental Organisations (NGOs, such as Care International), individual proprietors and communities as institutions. Several studies on natural resource use and management in Tanzania have shown duplication of responsibilities and a lack of institutional control from the national to the district and village levels in co-ordinating the environment and natural resource sector. The Division of Environment is supposed to play a co-ordinating role on environmental and natural resource matters. However, the division is not represented at regional, district, division, ward and village level to link with the respective body for

integrated planning and co-ordination of environmental activities. With the present local government restructuring programme, it is expected that much co-ordination of environment and natural resource issues will be done by the Ministry of Regional Administration and Local Government at national level and by regional and district authorities and their agencies at local level in their respective geographical locations. Pilot districts are already experimenting with this structure. However, this study focused more on institutions functioning at community level that have a bearing or impact on poverty and poverty alleviation.

The study will show later that despite the existence of top-down colonial and post-colonial structures of governance and their firm rules and repressive institutions governing resources, traditional institutions managing natural resources have survived. In both pastoral and agro-pastoral communities as well as in purely agricultural communities traditional institutions co-exist side by side with formal institutions.

4.1 Culture

Culture is defined as a body of learned beliefs, customs, traditions, values, preferences, and codes of conduct or behaviour commonly shared among members of a particular community. Taken as a whole, culture embraces ideas and practices or learned knowledge and the symbolic artefacts of specific human groups (Mann 1993). The learned knowledge acts as perpetual filter for information and a mental map for surviving in the world. The mental map tells people where they are in relation to the world, its resources and its other inhabitants. Culture provides people with both general direction and very specific details as to the behaviour or practices required in their interactions with natural resources, services and others human beings. They also determine boundaries between men and women, young and old, powerful and powerless. People within the same culture share a similar mental map, but this may vary depending on many factors like education, life experiences, exposure to other cultures or the outside world, isolation, exclusion or connection with the mass media and inclusion in other systems (Mohamud 1992).

In general, culture in relation to CPR influences management of natural resources. This is because it defines the value placed on resources and how they should be used, which technology is used for exploitation, by whom (entitlements) and how they should be managed. The values on use and management are transmitted through the generations and are what has brought about the different customary land resource and management regimes in the country (Kimambo 1969, Madox et al. 1996, Maganga et al. 1999). Culture may facilitate or retard poverty and poverty alleviation. The way culture moulds people's attitudes towards wealth defines poverty and the rights of the rich and poor, defines and provides rights over resources, facilitates ownership and access rights through local institutions and cultural norms may facilitate, hinder or buffer poverty. The culture of a community may allow and strengthen social networking (part of social capital). Scholars have noted that social networking has a role in society when livelihoods fail. Networks may function as a buffer to poverty and/or alleviate poverty. In pastoral and agro-pastoral communities, someone without livestock or who has lost them due to natural calamities or cattle theft can care for other peoples' animals in return for permission to use milk as food. In others, like in the Pare culture, a hungry person can harvest mangoes from a privately owned tree and eat them under the respective tree without being punished by the owner as long as he doesn't harvest them for sale and doesn't take them outside the farm. In the Maasai culture food (milk, meat) that is privately owned is considered a CPR. Culture requires that a hungry person should not be denied food. Therefore, an individual can travel and rest in any boma or visit a boma that has plenty of food and they will be provided with meat and milk. A clan is also supposed to provide livestock to relatives who have lost their own (Brockington 1997). Some NGOs are now looking into ways of reviving these traditional poverty alleviation institutions.

Culture is determined by ethnicity. Tanzania is a multi-cultural country with more than 150 ethnic groups each having its own ways of managing resources reflecting ecological adaptations. However, the whole country has undergone a socio-cultural transformation. This started during the colonial period when formal land tenure was instituted and local leadership and cultural ways were effected. This was followed by the total abolition of traditional rulers (Chiefs) in 1963 and in their place formal government structures were erected from national to village level. In 1974-1976 the country experienced massive collectivisation of previously scattered communities into nucleated villages under the objective of reducing costs in providing basic socio-economic services. Traditional ethnic and formal boundaries created in the past under chiefs and the colonial administration were dismantled further. Furthermore, since independence, people have been allowed to move freely within the

country. Today in Tanzania one can find heterogeneous communities where different ethnic groups co-exist. In some areas formal conflicting policies and laws have eroded customary ways of sustainable resource use and management under which people were given access to land through tribal identity. In other places, customary regimes and institutions have been resilient and co-exist with formal regimes and institutions and have facilitated sustainable resource use, sharing, management and livelihoods. The presence of heterogeneity in ethnicity and intermarriages brought about after independence by state interventions may have reduced cultural conservatism to some extent, extended social networking and facilitated development in some areas. On the other hand, heterogeneity may have reduced the strength of some cultural practices, which were protective of people's survival and access to resources. However, culture is not static. Local people have always devolved local ways and have adapted formal ways to suit their needs. They have devised ways of sharing resources with immigrants familiar and unfamiliar to them (culture of reciprocity or non-exclusive tenure). Strangers looking for pasture or irrigated farmland are accommodated for permanent or temporary use of resources at specific times of the year. Heterogeneity of ethnicity in some areas is treated as part of development and its related interactions.

5.0 Demography

This section focuses on the demography of the areas visited by the project and looks at the levels of district, ward and village.

Semi-arid areas in Tanzania occupy a considerable proportion of the country and accommodate a major part of the population. They also accommodate a large population of rural to rural migrants who are occasionally on the move looking for pasture for livestock and or moist land for farming (Boesen et al. 1996). The importance of looking into demography, mainly population distribution, growth rates and density in semi-arid areas, is to address the assumption that population is a major obstacle to sustainable management and a contributory factor to poverty. Population growth is believed to accelerate poverty by increasing the demand for natural resources such as land for human activities (grazing livestock, farming, mining, housing). It also increases demand for firewood and water for farming and animals. Pressure on land reduces the fallow period and other sustainable ways of retaining soil fertility through natural rejuvenation of plants and land. Coupled with the poor technology used in farming, a lack of inputs, poor management of soils, mounting pressure on land resources paves the way for changes in existing forms of sustainable environmental management. Other effects of population pressure noted in Tanzania include:

- Scarcity of land forces people to look for extra land in wooded areas. Clearing of woodland or forests for farming or settlement strips land bare and makes it susceptible to erosion. It also interferes with the hydrological cycle.
- The depletion of nutrients in soil due to overuse of land, limited of use of agricultural inputs and poor land husbandry (mono-cropping) forces people to farm poor soils and make them susceptible to erosion by natural forces.

Poor soils mean low productivity, hence low income and poverty. Poverty forces people to pursue more environmentally damaging activities such as charcoal making to cater for urban needs, hence more tree cutting and degradation. Others may decide to encroach on protected areas for pasture or farmland. However a few exceptions are reported by scholars whereby population pressure has led to increased innovation, environmental recovery, productivity, raised income and more conservation (for example in Machakos, Kenya, Tiffen et al. 1994).

The role of the market and access to markets provided by modern infrastructure should not be ignored. In many semi-arid areas of Tanzania, infrastructure (roads, telephone, transport) is poor, markets are exploitative and run by middle men and agricultural inputs are costly and have to be purchased and hauled from distant places. Extension services are lacking or intermittent and extension workers are demoralised and lack the necessary equipment to offer any meaningful advice or help. Villagers in most cases rely on their social networks. Some extend their networks through migration to distant places beyond their resource use boundaries. The current constitution in Tanzania allows people to live anywhere in the country provided they do not violate the laws, rules and regulations (except in a few places such as the Ngorongoro Conservation Area where inhabitants have to be of a particular ethnic background). Political statements encourage people to move from concentrated or overpopulated areas to areas where land is plenty and there are lower human and livestock densities. The notion of the

existence of vast unoccupied land in Tanzania has allowed people to move from traditional places and use land without limits. Some are reported to have settled inside protected forests – for example the Kazimzumbwi forest in the Coast Region and the Kwamtoro Forest in Dodoma However, these movements have not occurred smoothly without conflicts and blood shed in some areas, penalty or court cases in others.

The population of Tanzania tripled during the period between 1948 and 1988. Growth rates between 1967-1978 and 1978-1988 have however, declined from 3.2% per annum to 2.8%. There are pronounced differences in regional and district growth rates as well as between villages in the same district. Between the 1967-78 censuses, pronounced growth was experienced in the Dar es Salaam region (7.8%) and the semi-arid region of Tabora in the central part of Tanzania (4.4%).

District population figures for areas covered by this study also show that population growth rates in semi-arid areas are higher than the national rate (2.8%) for at least half of the districts where census data were available (Table 3).

Table 3: District population and growth rates for study districts

District	Popul. 1967	Growth Rate 1967-1978	Popul. 1978	Popul. 1988	Popul. Growth 1978-1988	Growth rate 1988-2000	PROJECTIONS			
							1995	1996	1998	2000
Babati	125,838*	5.6*	229,063*	3.43*	207,352	3.3	261,097	270,007	288,429	308,109
Monduli	71,854	4.68	118,796	4.13	108,964	3.6	140,154	145,388	156,241	167,906
Ngorongoro	-	-	-	-	69,101	3.4	87,625	90,709	97,092	103,924
Same	149,635	-	133,628	1.4	169,733		187,562		195,608	201,162
Iringa Rural	-	-	290,497	-	363,605					
Kondoa		3-	275,278	2.4	340,554					

*Figures were for Hanang District and Babati. Babati District had not yet been formed.
Source: Planning Commission Dar es Salaam and Regional Commissioner's Office Arusha (1999) Hali ya Uchumi na Maendeleo ya jamii Kilimanjaro. KIUTA printing press Tanzania.

Population density by district is also shown below (Table 4):

Table 4: District population density (people per sq. km.)

District	Land Area in sq. km	Pop Density 1988	Projected Density 1995	Projected Density 1998	Projected Population 2000
Ngorongoro	14,036	4.9	6.2	6.9	7.4
Same	5,186	30	33	35	36
Monduli	14,201	7.7	9.9	11	11.8
Babati	4,969	41.9	52.5	58.1	62
Kondoa	14,435	20[1]			
Iringa Rural	-	-	-	-	-

Source: The Planning Commission DSM and Regional Commissioner's Office on Regional Socio-Economic Profiles.

From the above table, it can be seen that population density has increased at a fairly steady pace. Babati and Same have greater population densities than the rest of the districts. This is possibly because of irrigation farming and the grazing opportunities available in these areas. On the other hand, despite low densities, other studies such as Mung'ong'o (1995) have documented localised high densities inside and outside the Kondoa Eroded Areas (KEA), mainly in the Kondoa Irangi hills and the lower Irangi Plains (where rain **is** unreliable and a constraint to livelihood). It is possible that where

[1] Data from Mung'ong'o (1995:55)

district population densities are low on average, areas within the district endowed with resources are experiencing high population pressure (Table 5 & 6).

Table 5: Ward population growth rates

Ward Name	Type	Households 1988	Total Population 1978	Total Population 1988	Population Growth Rate 1978-1988	Population Projection Year 2010[2]	Ward Aver. House -hold Size	District Average Household Size
Monduli Juu	Rural	1,253	2,910	5,941	.071	8590	5.0	5.3
Makuyuni	Rural	1,937	6,682	9,861	.039	14,371	5.0	5.3
Mwada	Rural	1,636	5,260	7,275	.032	9,228	4.4	5.3
Magugu	Rural	3,177	11,286	14,580	.026	22,725	4.5	5.3
Maore	Mixed	2,035	10,480	10,002	-0.047	10,336	4.9	5.6
Ndungu	Mixed	2,356	10,368	10,430	.0.596	23,968	4.4	5.6
Kolo	Rural	1515	8,148	7,660	-.062	10,038	5.0	5.0
Mbumbuta	Rural	1,828	6,939	9,660	.033	12,753	5.2	5.0
Itunundu	Rural	2,227	9,220	11,554	.022	20,938	5.1	5.0
Mahenge	Rural	2,415	8,853	12,103	.031	16,735	5.0	5.0
Kakesio	Rural	323	-	1880	-		5.8	5.4
Olbalbal (former included in Ngorongoro)	Rural	1,648		7,440	.151		4.5	5.4
		19,935	70,993	96,283	2.5	149,682	4.9	5.9

Table 6: Study village population growth

	Village	District	Population 1978	Population 1988	Growth rate	Total households in 2001	Present Population (2001)	Growth rate 1978-2001
1	Kadando	Same	1201	1433	.017	450	1500	.095
2	Karamba[3]	Same	1600	1849	.014	250	1100	-.022
3	Mfereji[4]	Monduli	2910	*			2469	-.071
4	Naitolya	Monduli	1972[5]	*		203	900	-.033
5	Kakesio	Ngorongoro	1153	*		100	2808	.038
6	Meshili	Ngorongoro	-	*				
7	Sarame	Babati	1064	*		250	680	-.019
8	Kisangaji	Babati	2054	*		870	2725	.012
9	Bolisa	Kondoa	3604	3845		253	2500	.015
10	Mbumbutu	Kondoa	2151	2394	.010	567	3558	.022
11	Isele	Iringa Rural	999	*		-		
12	Msosa	Iringa Rural	Not in census	*		-		
	Total		18,708			2,943	18,240	.036

* Data could not be obtained.

[2] Formula used is rate or r=1/t ln(P(t)/P(o) where P(t)=later size, P(0) earlier population size. Population projection formula = $P(t)=P(o)e^{rt}$

[3] Karamba was part of Mgandu village from 1974 - 1977 under Kihurio ward, thereafter joined with Kalemawe under Ndugu Ward and Division until in 1994 when it was registered as a separate village. Before 1994 Karamba village was joined with Bagamoyo village each area was therefore as a sub-village. The 1978 census data has Bagamoyo/Karamba as one village. The Bagamoyo part included Kalemawe village. The three villages namely Karamba, Bagamoyo and Kalemawe are at present separate village entities.

[4] During this time Mfereji was a sub-village of Enguiki. This data is therefore of two villages

[5] During this time Naitolya was part of Mbuyuni Village. This data is therefore of two villages

The above two tables show that the human population in the respective wards has increased one and a half times. This does not include in-migration and increases in livestock populations. However some wards and villages have experienced negative growth. Maore experienced negative growth in 1988 due to the eviction of pastoralists from Mkomazi game reserve. Some of those evicted had to leave for areas outside the ward and the district to gain access to pasture. Some left voluntarily while some were transported by government vehicles. Mfereji has pastoralists who practice transhumance. It is likely that when the census was being undertaken they were out of the village searching for pasture. Data for Naitolya are affected by the split of Mbuyuni and Naitolya into separate villages. Sarame is a dry place with frequent episodes of drought and famine. Migration in and out of Sarame is a common phenomenon which would account for the negative growth between 1978-2001. It was reported that people migrate out of Sarame when weather conditions are bad and back to the village after it has rained.

Increases in human and livestock populations in Karamba, Sarame, Naitolya, Meshili and Mfereji have created great pressure on the resources within these villages resulting in shortage of pasture, irrigated farm land, land for rain-fed agriculture, drinking water, firewood and building materials. In Karamba, immigrants with large herds are asked to graze inside Mkomazi Game Reserve. In Mfereji, farming is not permitted in order to prevent any long-term immigration for arable land and the taking over of land by strangers. Restrictions are also imposed in order to reduce potential conflict between pastoralism and crop farming. However, such measures have contributed to the impoverishment of people because they cannot produce their own grain and they have no livestock. In other areas such as Sarame in Babati District, Naitolya in Monduli District and Kadando and Karamba in Same District the two modes of production systems co-exist. Traditional zoning of land use, and traditional institutions guiding resource use norms, facilitate co-existence, though not always without conflicts. Conflict between environmental conservation, livestock keeping and agricultural production for nutrition and income or poverty alleviation exists wherever the two modes of production occur.

Furthermore, migration of people (rural-rural) was reported to be a viable long term strategy for risk aversion in the livestock and agricultural sector. The Same District Commissioner reported Maasai migrating to Same from Kiteto and Monduli for grazing. Villagers in the study villages in Same reported this to be an old pattern of movement that includes the Sambaa people moving from the Usambara Mountains to Same. Schultz (1971) in Mung'ong'o (1995) found the Rangi to be the largest group of immigrants in the adjacent district of Mbulu. Therefore the patterns of rural to rural migration that we are observing today have a long history in the cultures that we are dealing with.

6.0 Financial aspects

This section covers village-level financial aspects of management of the CPR of water, land and forests for the villages visited during the field work.

6.1 Water

Water's indispensability endows it with high value but makes its financial management very sensitive. Villages with irrigation schemes like Kadando and Karamba in Same District, Kisangaji in Babati District, and Msosa and Isele in Iringa Rural District manage their irrigation schemes through water committees. Members of the water committee are selected from villagers and most of them operate under supervision of the village government. Committees are generally made up of both men and women and in most cases the composition ratio is 3:2 respectively, except in Isele where the water committee has no female members.

Water committees usually have a bank account, where all the money collected should be kept. At Isele village, the distance from a bank prevents them from holding an account. The water committee is responsible for deciding how its funds are spent. In some villages, it is unclear whether villagers or even the water committee can justify the costs of water use.

Water rates are variable, from being low when water is plentiful to high when it is scarce. In some areas, rates are only just affordable by villagers. At Kadando village, for example, farmers pay TShs 200/= per week when water is allowed into the farm. In Karamba village, the water from Mfereji wa Idara (an irrigation canal constructed by the Ministry of Water) costs TShs 1000/= per acre per year.

At Msosa and Isele, water rates are perceived to be too high to bear by villagers while in Kisangaji the abundance of water means that irrigation water is free for every villager and charges are only made when repairs are necessary.

In areas that experience severe droughts during the dry months, access to water resources provides income generating projects for the village and ward authorities. For example, in Naitolya, the cost of a bucket of water from a diesel pump borehole can be as high as TShs 20/= and owners are charged TShs 20/= for a cow and 10/= for a goat or sheep every time they are taken to be watered. Herders (especially those with large herds) sometimes have to sell some of their livestock to pay for water during drought.

Yet at Bolisa buckets of water from a gravity piped scheme only cost TShs 5/= and watering livestock is free of charge. Even so, the project is still successful and running costs are covered. In this way villagers are not put under financial pressure during the dry season. The fees charged by river basin management authorities are often condemned as being responsible for the high rates charged to water users. The above contrast in cost of water can be related to the type of technology used to provide water. Bolisa villagers pay less for a gravity fed piped water supply, where-as Naitolya villagers have to buy diesel, pay for a pump care taker (TAS 15000 per month), pay for repairs and buy spare parts when needed. The pump caretaker has to work day and night as people come from distant villages for water (6 other villages). Some ferry water using donkey and others use trucks. The borehole itself is 10 km from the central part of the village.[6] Operators of tourist camps that are in Naitolya also buy water from the village borehole. However, surface water (from dams) is free for use but norms of use have to be adhered to.

6.2 Land

Most villages visited have little or no arable land left idle. This fact has stimulated the emergence of a land market, about which many people feel resentful. Many villagers find paying for use of land is a new and unwelcome experience.

Except in Kisangaji, irrigated land is the scarcest natural resource. The only problem Kisangaji has is blocking of water by sugarcane plantation owners whose farms are on the head side of the river. In villages where irrigation is practised, all irrigated land suitable for farming has been distributed and is owned privately by individuals. Land provides the main source of income for people, either through farming or renting. This is the situation in Kadando, Karamba, Naitolya, Msosa, Isele and Bumbuta. High land rents mean that landless villagers find it difficult to make a living or to cultivate enough land to produce sufficient food. Rents range from TShs 20000 to 50000/= per acre of maize or rice in Kadando, to as high as 100000/= for a one acre onion farm in Msosa. Young people are often unable to afford to rent land and have to migrate to other areas for work or use cheaper but marginal farmland, a common situation in Bumbuta. In Babati District the District Council charges a farm ownership fee of 300/= per acre on top of the other fees for water use or crop-cess. This type of land fee was only found in Babati. Seventy five percent of the income from land rent charged by the District Council is retained by the village government for village development activities. However, the fee from land rented-out by members is appropriated wholly by the customary owner.

Diversified non-farm activities and piecework in farms are commonly used as ways of paying land rent. The landowner rents out some of his land in return for receiving half of the harvested crops. These agreements vary between villages but generally favour the landowner so that they often get more than half the total harvest. This method of renting is popular and convenient for poor families who are unable to pay for land in cash before the harvest. It also means that they are not tied to a fixed amount of money before the harvest is collected. This is especially useful when the climate can be unpredictable and crops can be lost. It is also useful to elderly people who are unable to pursue farming themselves and have no relatives to provide them with food. They can rent out their productive land for cash or in-kind returns.

[6] We were informed by local authorities that the borehole was formerly owned by an Australian settler. The hundreds of hectres that the settler owned (300,000 acres) have 6 deep boreholes without pumps. Some of these are now being taken-over by district authorities to provide water to the villagers who manage the schemes by themselves.

Pastoralists often move with their cattle into other areas for grazing and water during the dry seasons. These villages usually charge from TShs 5000 to 10000/= per Boma for access to pasture for one season. In this way, villages gain an income from seasonal migrants who might not otherwise contribute to cost of management of the natural resources and water infrastructure that they will be using, which may be negatively impacted. However, the money is often embezzled by village authorities and does not go directly to natural resource management.

6.3 Forest

Fees imposed on the harvesting of forest products are intended to prohibit excessive deforestation; but when the fees, levies and fines for the use or misuse of a natural resource turn out to be a good source of revenue for the villages, wards, districts, and even central government, then there is an obvious contradiction, and a conflict of interest. This is the case in Same and Iringa Rural District where the fees for logging, charcoal making and firewood collection are sources of income for the districts. As a result, in these areas the deforestation rate is high. The licences issued by the Iringa forestry office for three months of charcoal making cost TShs 100000/= but they do not restrict where the licence holder can work; so they can be used in multiple places and cause intensive destruction. In Babati and Monduli Districts licences for charcoal and logging are not issued except when villagers want to harvest trees from their own community forest and when there are special needs for timber for construction works in public services. In Babati District Council and Ward, authorities re-distribute illegally harvested timber and charcoal to public institutions free of charge in order to remove motives for deriving income from illegal exploitation of trees. Despite this effort, illegal logging still takes place. In Monduli, much of charcoal making was reported to take place in farms with leaseholds. Farm labourers and other workers produce charcoal for either the farm owner or for themselves as part of their income source. Some farmers in both Monduli as well as Babati also cut down trees for charcoal for the lucrative Arusha charcoal market under the pretext that they are clearing new land or trees for farming, reducing crop pests or shade over crops. The conservation law does not prohibit those with leasehold and customary owners from preparing their farms and making charcoal from removed vegetation.

7.0 Gender and Common Pool Resources

Gender concern addresses the relationship between men and women and their roles in the community in terms of decision-making, plus access to and control over income and property. Gender has tended to be overlooked in the recent major changes in land reform in Tanzania (Manji 1998).

Resources used effectively would support all members of the community in an equitable manner. Resource distribution determines its use within a community and its impact on different community members. The ownership of resources, decision-making and the role of each member in the community influences resource use and who the main beneficiaries are. Men are generally the owners of resources and are the main decision-makers while women are the main users of the resources and require access to support their families.

In the studied areas, both men and women depend on land to provide food and generate income. In most areas, land is considered the property of the family and all members of the family have a role in the decision-making process. In Iringa, however, there is a system where men own land in addition to the land belonging to the family. The family is expected to work on this land first before the family land even though the family does not receive any direct benefits. In many cases this means that the productivity of the family land is reduced because crucial time is spent working on the other land. In this situation, ownership is used to exploit others for individual benefit.

The traditional system in Tanzania is such that resources like land, forests and water are owned and inherited by men with the exception of a few tribes that have a matrilineal system. The present economic situation has created a condition which is more favourable to the few women who have money. They can buy or rent land for farming. Those with land can also rent-out their farm plots for money or in-kind benefits. But in the majority of ethnic groups in Tanzania women become the property of their husbands through marriage and so are not entitled to inherit from their fathers. This affects decision-making processes as without equal ownership women are excluded from management of resources. Young people who do have the right to inherit land are increasingly having to wait many

years for their inheritance because of land shortages following population increase. This also reduces their ability to participate in the decision-making process.

Forests provide a source of energy and building materials for communities. Women generally have access to forests to collect firewood, traditional medicines and building materials for domestic use but not for other activities. Men are able to gain permission to cut timber, firewood or make charcoal for sale. These activities lead to depletion of the forest and, as a result, women are unable to collect enough wood and must go further for supplies, adding to their daily workload. This is evident in Bolisa where fire-wood collection was a major problem before the introduction of the HADO project. Women had to walk for up to four hours a day to collect firewood after unsustainable tree harvesting and poor farming methods caused widespread deforestation and soil erosion.

The depletion of forests can also lead to reduction in quality of water sources. Women and children who are responsible for collecting water suffer the consequences because they are then required to walk long distances in search of water. Even though women collect water for domestic purposes, they exercise no control over the construction or location of domestic water distribution systems in the village.

Livestock are owned by men and tended by children. Milking is carried out by both women and children and the milk is still owned by women. However, money accrued from milk sales is not used by women for personal requirements but in paying for family daily needs (kerosene, maize flour, sugar, relish etc) and daily school needs for children. Lack of livestock ownership means that women do not benefit from being able to plough land with cattle and so cultivation takes much longer for women than for men. In areas where zero-grazing is practiced, both women and children have to cut grass to feed livestock as well as clean the barns and collect water but income from sale of cattle is appropriated by the husband/father.

Women and children can benefit from wildlife when those benefits are directed towards the community as a whole. However, traditionally women do not hunt. They only benefit from hunting rights when the meat is made available for the whole family.

7.1 Present role of women in the management of CPR

Since introduction of the ujamaa policy which advocated equality, the role of women has been changing slowly. Women have begun to be involved in village government, allowing them to participate in decision-making processes. To ensure that women are able to participate, the policy set the condition that there must be a 25% female representation in village governments. This gives them the opportunity to voice their grievances, to participate in planning and evaluation of conservation activities and to demand equitable benefits from resources. In the Ngorongoro Conservation Area women are participating in Cultural Boma activities including selling cultural artifacts to tourists, providing and sharing information with tourists/visitors to Bomas.

The recent land law changed the inheritance system so that now women have the right to inherit land and its resources. Once women have equal rights over land inheritance then they will be able to own other resources because they will become the beneficiaries of their work. For example, women who are able to keep the proceeds from the sale of grain that they have harvested can use the money to buy livestock, more land, agricultural implements and inputs in order to improve their farming techniques and food resources.

7.2 Problems

Population increase and the finite availability of resources is another hindrance to equitable distribution of resources. While policy supports equal distribution, increasing pressure on resources means that current owners are unwilling to give up control. This is especially difficult when there are few other sources of income generation.

Customary laws, such as those in the Maasai community, deny women and the younger generation the right to own resources such as livestock. Even where women could benefit from common resources through benefits accrued from national parks or the wildlife department, their subordinate position in the community means that they are often excluded. The traditional laws of the Maasai people

disadvantage the majority of the population. Traditional leaders use their position and power to serve their needs and those of their families over those of the community. These are the same people who resist change because it would mean relinquishing their hold over the community. As a result the majority of the community, including women and young people, remain in a subordinate position.

The distribution of benefits in villages near National Parks is rarely fair. Often the leadership appropriates the money for their own use and villagers are generally not in a position to question or address the problem. For example, in Mfereji, villagers have not benefited from the money allocated by TANAPA to the village over the last three years. Women especially have suffered because they have no say in the community. A milling machine donated to the women of the village has never worked because the money allocated for running the machine has been misappropriated. Without a stronger position in the community and resource ownership, women are unable to get credit to set up businesses and to work independently from men.

Participation of women in decision-making processes is not yet effective because many women are unable to talk openly in front of men. This is crucial in the Maasai culture where women as well as men are forbidden to talk to strangers or to participate in a village meeting without permission from their traditional leader (Laigwanak). Women have to get permission from their husbands for activities they intend to undertake. They are not even allowed to sit near men during local community formal and informal meetings. This was also the case in Iringa where fear of reprisals prevented women from speaking freely about their problems.

The differing interests of owners and users of resources means that where there are no democratic grassroots systems, making it difficult for decisions to be made on the priorities of the community with regard to resource management. Fair distribution of resources will only be possible when there is equal ownership and distribution of benefits within the community irrespective of gender. Once this is achieved then there will be a more balanced management of natural resources that benefit the whole community.

8.0 Researchable constraints in Tanzanian semi-arid CPR.

The researchable constraints focused on by this project are ones that lead to improved livelihood strategies for the poor in semi-arid Tanzania based on the sustainable use of common pool resources. There has been a great deal of research conducted on production systems in semi-arid eastern Africa, including pastoralism, wildlife management, rainwater harvesting, soil erosion, and crop production. All the research aims to improve the flow of sustainable benefits from natural resource management in an environment that is inherently unpredictable. Whilst this is clearly fundamental to livelihood strategies, in CPR management, even if appropriate technical solutions are found, many questions remain that relate primarily to using research to inform policy. For example there may be a choice between wildlife management and pastoralism, or pastoralism and agriculture. Or a project may develop a particular land use policy, such as destocking eroded areas or village-level control over hunting, that needs to consider if the village can take over monitoring and enforcement when the project ends. This section reviews some projects that have been working on issues related to semi-arid Tanzanian CPRs and concludes the review by looking at the following three points in the context of the projects:

Making decisions:	Which land-use is preferable?
Institutional systems:	Do transactions costs prevent sustainable CPR management?
Institutional interactions:	What are the socially optimal interactions?

Recent major changes in Tanzanian land, forest and wildlife policy have emphasised the importance of village management planning. For example the new Forest Policy (GoT 1998) and Wildlife Policy (GoT 1998) stress the importance of involving communities in resource management, and the 1999 Village Land Act and Land Act attempt to clarify customary land ownership. Empowerment of villagers enables new approaches to be developed for improving livelihoods and sustainable natural resource management (Havnevik 2000). Whilst the substantial policy changes present new opportunities for poverty alleviation in semi-arid Tanzania, they also present difficulties. Foremost amongst these is the ability of villagers to respond positively and sustainably to increased control over CPR. Transfer of responsibility to villagers also carries a burden that is summarised in the term transactions cost (for more detail on transactions cost see project report by Adhikari 2001). This

includes the costs of CPR management, monitoring and enforcement. If returns from the CPR are high, then it is likely that transactions costs can be covered. If returns are low, then it is possible that transactions costs cannot be covered or need to be subsidised from other sources. Estimation of returns from CPRs is not straightforward as there can be indirect use values in addition to direct use values (for more detail on economic valuation see project report by Kirby 2001). Different forms of land use, such as agriculture, pastoralism, tourist hunting, or wildlife viewing may offer differing returns. Decisions on which land-use, or combinations of land-uses, should be favoured by policy needs to be based on appropriate economic analysis. In addition to financial returns, economic analysis involves modelling interactions of institutions using tools such as game theory (for more detail, see project report by Perez-Cirera 2001). For example, the state may decide that wildlife conservation in a particular site is protected by an inalienable entitlement (i.e. because of a moralistic reason, Calabresi & Melamed 1972). Having established a wildlife reserve there are a range of possible options ranging from allowing uncontrolled access to complete exclusion to the protected area. The process of choosing the optimum policy can be assisted by using game theory as an analytical tool.

8.1 Project Reviews

This section contains short reviews of some of the projects that are working with CPRs in semi-arid Tanzania. The projects were chosen because they coincide with areas visited by the team during the field work phase. More information on the areas can be found in the village profiles (Quinn et al. 2001). The section concludes with a brief discussion on decisions and institutions and the type of research that is needed to promote sustainable livelihoods of poor people using CPRs.

There are many ongoing projects, programmes and research in the semi-arid regions of Tanzania. The projects and programmes focus predominantly on soil and water conservation measures. Research conducted in these zones by local and foreign, students and professionals alike tends to also focus on soil and water related issues since these naturally become the main topics of concern for inhabitants of these regions. Projects do not only concentrate on largely the same themes, they also tend to be located in the same areas within the semi-arid regions. The Kondoa Eroded Area (KEA) of Kondoa region, for example, has received a lot of the research and project attention as have the Kondoa Irangi Hills and the surrounding settlements. Examples of ongoing projects include: HADO-Hifadhi Ardhi Dodoma (Dodoma Land Conservation Project), MALISATA-Man-Land Interrelations in Semi-Arid Tanzania Research Programme, RELMA-Regional Land Management Unit, SPFS-Special Programme for Food Security, SWMRP-Soil and Water Management Research Programme, VAP-Village Afforestation Program, HIMA-Hifadhi Mazingira Iringa (Iringa Environmental Conservation Project), MERP-Mkomazi Ecological Research Programme, HASHI-Hifadhi Ardhi Shinyanga (Shinyanga Land Conservation Project), LAMP-Land Management Programme (in Babati), TNFHC-Tanzania National Freedom From Hunger Campaign, RVRP-Rift Valley Research Project, PIDP-Participatory Irrigation Development Programme. In the short reviews below, only those projects which directly affected villages visited by the field team are discussed.

8.1.1 Hifadhi Ardhi Dodoma (HADO) in Kondoa

The HADO project was started in 1973 in order to control soil erosion in key areas in Dodoma Region and is well known for its controversial destocking programme, starting in 1979, in which livestock were excluded from selected eroded areas (Mbegu 1988). The HADO project was initiated without prior research or gathering baseline data. Subsequently, in 1988, the Man-Land Interrelations in Semi-Arid Tanzania (MALISATA) programme was started as a joint research project between the Institute of Resource Assessment and Swedish research institutions to conduct research in the area (Christiansson & Kikula 1996). The MALISATA research was a continuation of the Dar es Salaam/Uppsala Universities Soil Erosion Research Project (DUSER, Christiansson 1992) and was interdisciplinary covering a wide range of topics including geomorphology, sociology and farming systems (Christiansson & Kikula 1996).

Early in the HADO project total destocking was recommended, rather than partial destocking, because the largest herds belonged to leaders and so it would difficult to set up an equitable system (Wenner 1983). Alternatives to loss of milk yield from destocking, such as improved agriculture and planting of fruit trees were suggested (Wenner 1983), and later the introduction of zero-grazing (Kerario 1996). Although destocking and other technical anti-erosion measures may help in the short term, the erosion problem appears to be associated with a long history of political and ecological change leading to

deforestation, rather than population increase per se (Mung'ong'o 1991). Moreover, even though erosion is associated with human impact, it may also be related to tectonic activity (Christiansson, 1996). Nonetheless the destocking policies employed by the HADO project are viewed as a success with the perception that "land has come back" (Mbegu, 1996). To achieve this end required the drastic action of destocking that was only possible through a strong central government project. It would not have been possible to do this through grass-roots participation and village government.

Despite the need for central government control, village-level planning was considered important. For example, concern was expressed that Maasai might invade improved communal pastures during times of drought with the recommendation that demarcation of village borders was an important step to control over grazing land (Wenner 1983). By-laws were enacted in 1984 to provide a firm legal basis for control of stocking and burning. With fewer staff and resources available to the HADO project as the project comes to a close, the difficulty now is enforcement of these by-laws. This is not easy given that the larger herds belong to influential individuals and outsiders may bring herds into the area following drought in other places. Policing and monitoring are the responsibility of the village, but this is not fully effective as herders grazing cattle in contravention of the by-laws can escape punishment by bribing in the District courts, or through avoiding capture by exerting social pressure on the village rangeland guards. To phrase the problem in economic terms, transactions costs are high and have been passed to village level. If they exceed benefits then sustainability of the no-grazing policy is in doubt.

Key points:

- transactions costs are high and have been passed to village level where they are least affordable
- strong central government intervention was required to initiate the project

Relevant Village Profiles: Bolisa and Bumbuta

Bolisa is in the Kondoa Eroded Area (KEA), so villagers had to destock and move their cattle elsewhere. The village now uses zero grazing to provide milk and have improved farming methods. The destocked areas are used for beekeeping. However, the by-laws restricting access to the destocked areas are difficult to enforce. Bumbuta is outside the KEA, so was not destocked. Problems identified by the villagers include shortages of firewood and replacement of grazing land by agriculture.

8.1.2 Matumizi Bora ya Mali Asili Idodi na Pawaga (MBOMIPA) Project and Ruaha National Park

The MBOMIPA project developed out of the Ruaha Ecosystem Wildlife Management Project, which was initiated in 1993 with support from DfID. Initially the purpose of MBOMIPA was to develop in the project area "an effective and sustainable wildlife system under community authority and responsibility". This has been changed to come in line with increasing DfID emphasis on poverty alleviation to "improve livelihoods of people in the proposed Lunda-Mkwambi Wildlife Management Area by establishing sustainable natural resource management under community authority and responsibility in Pawaga and Idodi divisions". The project helped channel revenue from large mammal hunting licences to villages and is regarded as being generally successful (Murphree 2000). MBOMIPA contains three categories of community conservation: (a) community outreach programmes by state protected areas; (b) co-management and resource/ benefit programmes; and (c) community-based NRM programmes with devolved authority responsibility and benefit (Murphree 2000). The test of project success will come when it starts to devolve more responsibility to village-level committees, as there is still a need for structural development and training and capacity enhancement (Murphree 2000). Financial return to the villages from hunting was considered to be relatively low, so the possibility of realising full economic benefit from natural resources needs to be further investigated (Murphree 2000). If financial returns are relatively low and the costs of maintaining village level administrative structures relatively high, then attention needs to be paid to some form of cost-benefit analysis and the case made for support to cover transaction costs. For example income from tourist hunting in 2000 was spent primarily on district government expenses rather than being put back into the villages (Walsh, 2001). The MBOMIPA project has had a great deal of success, but this is hampered by problems arising from lack of accurate district boundaries, double allocation of hunting quotas, and a reluctance to by those with controls over natural resources to devolve power to village level (Walsh, 2001).

Key points:

- it is difficult to get power devolved to village level
- it may not be possible to generate sufficient funds to overcome transactions costs
- there is a lack of established boundaries and a mechanism for village-village interaction

Relevant village profile: Isele (Msosa is an interesting contrast)

Isele village is adjacent to Ruaha National Park and part of MBOMIPA, so benefits from the sale of hunting quotas in hunting blocks adjacent to the park. In response to recently obtaining this source of income the village has extended the hunting areas further into village land. The villagers have also reached an agreement with migrant pastoralists to minimise conflict. This was possible through the intervention of the District Commissioner. Msosa village adjacent to the Udzungwa National Park also receives benefits from the park, but not to the same extent as Isele as there are no hunting blocks.

8.1.3 Ngorongoro Pastoralist Project (Ereto)

The objective of the Danida supported Ngorongoro Pastoralist project (ERETO) is to assist pastoralists of the Ngorongoro Conservation Area (NCA) to reduce poverty. This is achieved through a development programme that includes water rehabilitation, restocking and veterinary services (Danida 1997), for example the social programme transfers livestock and associated support services to poor and destitute individuals (the Ewoloto programme, ERETO 1999). Ewoloto is a traditional Maasai social support mechanism. The project is based on earlier research, such as that reviewed by Homewood & Rodgers (1991) and carried out by Potkanski (1994). The NCA, particularly Ngorongoro crater itself, receives a large income from tourist based activities, estimated at 3 million USD in 1997 (Danida 1997). The ability of the wildlife and unique landform of the crater to generate revenue is in stark contrast to poverty in surrounding villages where it was estimated that 58% of all houses of single wives out of a total of 9195 were classified as poor, very poor and destitute, of which 21% were in the destitute category and 16% in the very poor category (Danida 1997). Although the Ewoloto system works well, concern has been raised that the livestock transfer programme does not reach the poorest of the poor (Morindat 2000). Some administrative structures are also thought to be in need of reform; for example it has been suggested that the pastoralist council does not reflect the needs of the Maasai people (Morindat 2000). Some 12% of revenue derived from wildlife in the NCA is given to the Maasai Pastoral Council (PC) and the allocation of these resources is a subject of debate. The suggestion is that there should be a search for strategies and approaches which emphasize "participation, empowerment, power sharing and partnership for development" (Morindat 2000). Such strategies will result in increasing transfer of transactions costs to local communities and open more possibilities for inter-community conflict over resources.

Key points:

- funds are transferred to the community from wildlife conservation, the problem is equitable distribution
- their are legal constraints on land-use and ethnicity within the Ngorongoro Conservation Area

Relevant village profiles: Kakesio and Meshili

Kakesio village is inside the NCA and so immigration of people from outside is prohibited. Only ethnic Maasai from the area can live in the village, which is a source of conflict with other groups outside NCA who feel they also have a right to live in the NCA especially so when Maasai from a neighbouring country have access (though illegal) to residency, pasture and livestock inoculation services inside the NCA. Those who have worked in the NCA for many years, have retired or are about to, and have established businesses or acquired property feel that they also have the right to live in the NCA. However, all villages in NCA have to conform to the formal laws of the NCA which prohibits immigration, agriculture and tree cutting, in return the village receives income from the NCA distributed via the Pastoral Council. Meshili village is also in the NCA, so is subject to similar restrictions. However, restrictions are not always adhered to. Cultivation inside the NCA takes place and has over the years raised a lot of controversy over indigenous rights in alleviating hunger versus wildlife conservation interests (McCabe et al. 1992).

8.1.4 Land Management Programme in Babati

The key objective of the Land Management Programme in Tanzania (LAMP) is to increase productivity in natural resource use in a sustainable way (Havnevik et al. 2000). The project is supported by SIDA and operates in Simanjiro, Kiteto, Babati and Singida. It contains four components: land security, community empowerment, extension and business enterprise and capacity building. The project is closely involved with CPR management, for example it has done extensive work on village level forest reserve management (Wily 2001). Placing greater responsibility on villagers for management of natural resources increases the transactions costs associated with managing CPRs at the level where people are poorest, so the LAMP project aims to develop administrative capacity in the villages. LAMP supports Integrated Multi-Disciplinary Development Activities (IMDA) in which villages contribute in both resourcing and planning. In Kiteto there were 25 demands for IMDA, all requesting water supplies. The high cost of water schemes in water scarce environments is a disincentive to developing water-based IMDA (Havnevik et al. 2000). The high transactions costs of IMDA in terms of the complex and cumbersome process, conditions for entry together with high project costs have stalled many requests for IMDA. Sustainable support for LAMP requires increased tax collection, however transactions costs are high at District level, for example 80% of tax revenues are used for staff salary payments in Babati District leaving little for social development. There is also concern among poorer farmers that LAMP helped to increase village level taxation, but not that of large-scale farmers, big hotels and tourist operators (Havnevik et al. 2000). It is possible that villagers are not aware that commercial farmers pay land rents.

Key issues:

- High transactions costs are a constraint to implementation of village level activities
- There are conflicts over resources with commercial farmers
- There are conflicts with migrating pastoralists
- Wildlife can cause crop damage and personal injury

Relevant village profiles: Kisangaji and Sarame

Kisangaji village has extensive commercial agriculture but there is seasonal migration into the area for grazing and irrigation farming. A major cause of conflict in the village is sharing irrigation water with commercial sugarcane plantation owners who block the flow of water, especially during dry season when water is scarce, as formal water rights allow them certain volumes of water. The dispute over water has led to serious conflict, with a well publicised case of serious physical assault a few years ago when a villager attempted to release water.

Sarame village suffers from frequent episodes of drought and wildlife attacks from Tanrangire National Park, which is only 3 km from the village boundary in some areas. Wildlife destroys crops and injures people. Between 1999-2000 lion were reported to have eaten 110 cows and 9 human beings. One man was pulled out from his bed with wife and children watching. A child was snatched from her mother when they were fleeing from where the husband was being mutilated. Despite bearing such costs of living next to a national park, Sarame has not yet received direct benefits from TANAPA although promises have been made. Furthermore, the village suffers from frequent episodes of drought. Seasonal immigration of pastoralists from other adjacent districts is a source of conflict especially when they graze livestock in village protected forests and in farms, and water them in protected water catchment areas. Sarame shares a gravity-fed drinking water supply scheme with four other villages. Sarame is on the tail end of the scheme and has not received water since 1995/96 due to diversion of water by villagers in the upper area of the scheme. Villagers in Sarame are contributing TAS 2000/= each adult person in order to rehabilitate the water scheme at the cost of TAS 12 million. LAMP has promised to contribute TAS 7 million.

8.1.5 Mkomazi Ecological Research Programme

Between 1993 and 1997 the Mkomazi game reserve was the focus of an ecological and sociological research programme initiated by the Royal Geographical Society (Coe et al. 1999). The research programme not only documented the flora and fauna in the reserve but also investigated the history of land management and conflicts between traditional use of the CPRs and wildlife conservation (Brockington in press, Homewood et al. 1997), and attempted to relate vegetation dynamics to human

impact (Canney 2001). The case of Mkomazi illustrates several important points relevant to management of Tanzanian semi-arid CPRs. Firstly the conflict between wildlife conservation and pastoralism in semi-arid Tanzania is not restricted to high profile areas such as the Ngorongoro Conservation Area and Serengeti. Secondly, such conflicts have a long history and it is necessary to understand the historical background to put present actions and positions into context. Thirdly, special interest groups can dominate the debate. In this case pastoralists of a particular ethnic background are on one side and overseas based conservation groups on the other. Issues relevant to other groups tend to be ignored in the polarised discussions. Fourthly, people migrate in response to climatic variability and groups from outside the region moved into Mkomazi precipitating a policy decision to evict all people resident in the game reserve even though residents had previously been granted rights. Spatial and temporal variability in CPR as a function of climate change makes it difficult to define resource boundaries. Finally, there is a lack of a coherent and transparent decision-making process that can assist in negotiating conflict resolution.

Mkomazi was gazetted as a Game Reserve in 1951 and pastoralists were allowed to graze livestock in the reserve by agreement. In the 1970s livestock levels increased in the reserve, particularly as a result of immigration into the area. By the early 1980s Tanzania was suffering severe economic problems, control over the Mkomazi was weak and commercial wildlife poaching was rampant. In 1988 there was wholesale eviction of people livestock from within the reserve, and in 1989 a conservation group, the George Adamson Trust, began operating in the reserve. Evicting pastoralists caused economic losses in cattle markets adjacent to the reserve, and there is a long running dispute between central government and pastoralist groups over boundaries and the right to live in the reserve (Homewood et al. 1997).

Key issues:

- conflict over priorities: wildlife conservation vs pastoralism
- the spatial arrangement of resources is important in planning access to CPR

Relevant village profiles: Kadando and Karamba

In Kadando village, villagers felt they had some rights to Mkomazi GR, but were not reliant on CPR from the reserve, nor were they overly bothered by animals from the reserve. In Karamba village there was considered to be adequate grazing land, though immigrants with large herds are not allowed to graze in the village, and pasture in Mkomazi was used by those with large herds who were prepared to take the risk of being caught by game scouts. Neither Kadando nor Karamba benefit directly from wildlife conservation in Mkomazi.

8.1.6 Monduli District Programme

The Monduli District Programme started in 1993 as a food aid project which then changed in 1994 to a structural development programme with a plan of operations developed in 1996 (Kooiman 1997, Meindertsma & Kessler, 1997). Shortage of water was identified as the most crucial problem in the District affecting pastoralists, semi-settled and livestock keepers (Vlakved & Scheffer 1992). The programme targeted marginalised pastoralists as a special focus and led to the realisation that many social and economic problems in this group related to land access and tenure. This in turn led the project to include a strong land use planning and natural resource component. Land use policies are changing rapidly in Tanzania but the main impediment to developing land use plans is not the policies themselves, but the resources to implement them (Kooiman 1997). The lack of resources includes both human and physical capital and extends from village to central government. Without wishing to appear overly negative it is useful to list some of the problems found by the Monduli District Programme in their problem analysis of land use planning as these are relevant to other areas in semi-arid Tanzania. For example some similar problems were experienced by the MBOMIPA project in Iringa.

Problems were recognised in the areas of policy, co-ordination, district land use planning, village land use planning and land allocation. Land and natural resource policy was lacking at District level because district office responsibility has been to parent ministries. This creates a difficulty of co-ordination between district offices and confusion over areas of responsibility. In Monduli no district land use plan was available and there was no formal systematic way of gathering information on natural resources resulting in patchy information availability. At district level both human and capital

resources for land use planning were very limited. Similarly at village level there were no land use plans. Village land use is mostly governed by customary rules and practices, but as these rules are not codified then outsiders are immune to customary sanctions and so local communities are unable to control use of their resources by immigrants. Village level institutions are poorly developed, without clear lines of authority and limited management skills, for example no institutional framework exists in the village to deal with overlapping land claims. Land allocation suffered from the following problems (Kooiman 1997):

1. Many allocations did not follow proper procedures and too much land was allocated to outsiders.
2. Many land holders occupy more land than was allocated.
3. Unsuitable land was allocated for agricultural purposes.
4. Land is misused, used for different uses than stipulated or hardly used at all.
5. Land on which customary land claims rested was allocated to others under statutory law.
6. Land was allocated without involvement of the communities (village assembly).
7. Rights of access to water sources or routes of transit are not adhered to.
8. No proper land allocation register or noting plans are available at the district level and thus the district is powerless to control land allocations.
9. No information on income from land taxes is available. At present it seems that most income from this source goes to central government.
10. Customary land allocations in villages are generally the responsibility of a few village leaders, and can lead to discrimination against women and some groups.
11. No land allocation records are kept at village level.
12. Poor financial administration of villages hampers transparent management of funds from premiums and rent from customary land allocations at village level.

Key issues:

- The capacity and proceedures of governance at village and district level needs to be strengthened

Relevant village profiles: Mfereji and Naitolya

In Mfereji village there is plenty of land for grazing, but in dry conditions men migrate out of the village and sometimes out of the district in search of pasture. Formal village leadership is not as strong as traditional leadership at village level, but only formal village leadership is recognised at the district level. In contrast the village leadership in Naitolya village was much stronger. Both Mfereji and Naitolya benefit from income derived from wildlife tourism.

8.1.7 Discussion of project reviews

8.1.7.1 Making decisions.

Making decisions on land use is often made without adequate analysis. An example is replacement of communally managed common pool resources with privately owned commercial farms. As Tanzania's economy recovers from the lows of the 1980s and increasing inward investment is attracted, there is interest in establishment of large commercial farms. For example, farms are being established in grazing range in Monduli district. Some advantages of commercial farms are that they generate food for sale in cities, or foreign exchange earnings such as through the cut-flower trade, and create employment. The disadvantage is that the farms alienate land, often with key resources such as water, preventing traditional use of common pool resources. Both commercial and customary land use systems can benefit the poor. A commercial farm can provide steady employment and support (and tax revenue to government for social services), a common property regime can provide access to resources for subsistence or small scale marketing.

In deciding which land use is preferable – a common property management regime with multiple users, versus a private commercial farm – village and district planners need to have appropriate information on the costs and benefits of each land use. One suitable tool for this type of analysis is the production function approach (see project report by Kirby 2001). A researchable constraint for improving management strategies is decision support analysis and how it can be used in the case of benefiting poor people using common pool resources in variable semi-arid environments. Such techniques can

also be used to evaluate decisions such as stock exclusion in the HADO project and establishment of wildlife protected areas. An important point often overlooked in use of decision tools (particularly economic ones) is that they do not actually make a decision, but inform the policy process through making the relative merits of different courses of action transparent.

8.1.7.2 Institutional systems.

The management of common pool resources through common property management regimes can be expensive in terms of transactions costs (see project report by Adhikari 2001). If transactions costs exceed the benefits derived from CPR, then the management system will fail and the CPR be exposed to free-riding and overexploitation. If decisions on land use favour a common property regime (see section 7.1.7.1 for decision making), then a suitable institutional system needs to be set up where the level of transactions costs are lower than the benefits. The examples given in the project reviews above illustrate the importance of transactions costs in designing management strategies for CPR management.

In the HADO project the institutional system supported by the project was responsible for negotiating agreements, evicting livestock from the project area, monitoring use of the project area, and enforcing penalties against transgressors. Those are all transactions costs associated with managing the grazing commons. The project is now devolving these responsibilities, and associated costs, to villages. Interviews carried out during field work suggested that the costs of monitoring and enforcement of by-laws created by the HADO project to control grazing and burning are more than can be sustainably maintained by the villagers. In the Ngorongoro Conservation Area residency is limited to a particular ethnic group, the Maasai, and residents are restricted to those that favour wildlife conservation. In return the Maasai pastoral council receives 12% of revenue from the NCA. However, allocation of these resources is controversial and politically charged. Dissenters suggest that too much is taken up in transactions costs by the pastoral council and not enough is spent on social programmes. In Babati high transactions costs associated with complex Integrated Multi-Disciplinary Development Activities (IMDA) are an impediment to design and implementation of schemes for sustainable common pool resource management. Tax revenues collected by the LAMP project are being used primarily to support transactions costs, with 80% going in staff salaries, rather than social development. Transactions costs are also a concern to the MBOMIPA project in Iringa, as revenues from tourist hunting are used to support district level administration. As greater responsibility is devolved to village government transactions costs will be a greater issue at village level Similarly sustainability of the successful village forest reserves in Babati may depend in the long term on minimising transactions costs.

These cases illustrate the importance of research into institutional systems and associated transactions cost as central to developing management strategies for sustainable management of CPR. In particular effective institutions need to be designed to channel benefits from CPR management towards poverty alleviation rather than supporting the transactions costs associated with extensive bureaucratic structures.

8.1.7.3 Institutional interactions.

By its very nature, management of common pool resources involves numerous strategic interactions between individuals and institutions. In designing management strategies for sustainable CPR utilisation, it is important to determine what the socially optimal interactions are (see project report by Perez-Cirera 2001). For example, it might be possible to design suitable incentives to enable pastoralists to settle in a particular range rather than to travel extensively and cause disruption in the common property management regimes of other groups. Or analysis of strategic interactions can be used to evaluate the problem of free-riders in utilising protected grazing ranges as in the HADO case. Similarly, modelling interactions can suggest possible solutions for the problems associated with encroachment and protection of Mkomazi Game Reserve. For example the technique has been used to model community-based wildlife management programmes such as CAMPFIRE (Mesterton-Gibbons & Milner-Gulland 1998).

8.2 Summary of researchable constraints

The summary presented in this section returns to the topics given in the introduction as part of the terms of reference for the work and provides a brief summary under each topic.

8.2.1 Principal forms of common pool resource in Tanzania

During the project field work the villagers were asked what they consider to be common pool resources. The results are summarised in Table 7, with more detail given in the field work reports (Quinn 2001). The perceptions of what are common pool resources show remarkable consistency in the different villages despite the wide geographical range of the study, the broad ethnic affinities of the people interviewed and the different types of production systems which included agriculture, agro-pastoralism and pastoralism.

Table 7. Common pool resources identified by the villagers during the field survey. For further details see Quinn et al. (2001).

District	Village	CPRs identified by the villagers
Same	Kadando	Forested village lands and rangelands, land, swamps, Hingiriri River, irrigation system, Mkomazi Game Reserve
Same	Karamba	Pasture land for grazing livestock, village land, irrigation furrows and irrigated land, mineral resources such as gypsum, Lake Karamba and Kalemawe Dam (Kalemawe dam is outside the village), forested areas and trees found around the village, Mkomazi Game Reserve
Monduli	Mfereji	Water supply, forests, land and pasture, milk and meat (shared with strangers or visitors), wildlife
Monduli	Niatolia	Grazing land, firewood, water supply, catchment forest, land
Babati	Sarame	Land, village forests, water, rangelands
Babati	Kisangaji	Farmland, forests, irrigation water, pasture, rivers
Ngorongoro	Kakesio	Rangeland, farmland, water bodies, Ngorongoro Conservation Area, wildlife
Ngorongoro	Meshili	Land forests, water supply, rangelands
Iringa	Msosa	Rainfed agricultural land, irrigated agricultural land, residential areas, village forest, pasture for grazing livestock, village land, forest reserve, wildlife, fish
Iringa	Isele	Rainfed agricultural land, irrigated agricultural land, game controlled area, village game controlled area, grazing land, residential area, forest set aside for building poles and ropes, forest for firewood, riparian forest reserve, wild animals, water
Kondoa	Bolisa	Land, forests, livestock (milk goats from the HADO project), water
Kondoa	Bumbuta	Land, forests, livestock, water

Given the inclusive nature of villagers perceptions of what CPRs are, there is little use in subjecting them to an artificial classification. In a policy context perhaps the most useful term that can be applied to them is "natural fruits" as used in the preamble to the 1923 Land Ordinance:

"WHEREAS it is expedient that the existing customary rights of the natives of the Tanganyika Territory to use and enjoy the land of the Territory and the natural fruits thereof in sufficient quantity to enable them to provide for the sustenance of themselves their families and their posterity should be assured protected and preserved;"

The 1923 Land Ordinance was in effect until May 2001, so the principle of access to natural fruits has been the guiding policy for much of recent land use in Tanzania. The exception to this in semi-arid areas has been extensive alienation of land for wildlife conservation, ranching and agriculture.

Quantifying common pool resources presents similar problems to classification. Some attempts have been made to value CPR, for example through estimating market value of land and/or produce; shadow pricing of non-marketed goods and services (cost of substitute); and the 'production function' method. Non-timber forest resources, for example, have been variously valued from US$5 to US$420 ha^{-1} $year^{-1}$. No-one has attempted to value an ecosystem comprehensively.

8.2.2. Contribution of CPR to livelihoods

The field survey assessed contribution of CPR to livelihoods through requesting information on the ownership, use and management of CPRs. Details are in the field survey report (Quinn et al. 2001). Given the broad range of natural resources identified as CPR noted in section 7.2.1 above, it follows that CPR are central to the livelihoods of most people living in rural semi-arid Tanzania. This covers production strategies that range from pastoralism, agro-pastoralism to agriculture as all land, vegetation and water are effectively regarded as common pool resources. More significantly for designing research into management strategies for poverty alleviation is to assess how the use of CPRs fits into the broader livelihood strategies of the poor. In defining poverty it is possible to have many different definitions: for example if a per capita income criterion is used then most of the population of Tanzania will be classified as poor as the per capita GDP is around $160 (source WRI). Perhaps more useful is identifying the definition used by communities in which poor people live. In the field survey respondents were asked to give a wealth ranking which revealed characteristics of poverty. Two examples are given in Tables 8 and 9. Further details can be found in the field survey report (Quinn et al. 2001).

Table 8. Wealth Ranking in Kadando village. The production system is a combination of agriculture and pastoralism.

Wealthy Class	**Livestock**	**Grain**	**Non-farm activities**
Rich	50-100 cows 30-100 sheep and goats	Produce more than 30 bags of rice per season, 10 bags of maize per acre per season and 1-5 bags of beans	Shop, sells more than 30 bags of rice per season
Medium Rich	20-30 cows 20-100 sheep and goats	1-10 bags of paddy rice per season, 1-10 bags of maize per season, one bag of beans	Sells used clothes, middle man in purchasing and selling of grain
Poor or Low Income earner	1-5 cows or nothing 5-10 sheep and goats	1-3 bags of rice per season, 1 bag of maize or less	Sells firewood, manual work on farms and herding, fishing and selling fish instead of using them for food, dependency on foraging and selling wild edible products, sells grain obtained from farming

Table 9. Wealth ranking in Mfereji village. The production system is pastoralism only.

Wealth Class	**Cows**	**Sheep**	**Goats**
Rich	100-600	50-100	200-300
Average	50-100	30-50	100-200
Poor	20-50	10-30	20-50
Very Poor	0 –15	5-10	5-15

To summarise from wealth rankings in all the villages and the livelihood characteristics of poor people from the field survey, they would typically have:

Housing - made from mud, sticks and thatch
Livestock - none, or few livestock
Land - small amount, a few hectares (in the case of agriculture)
Labour - sells labour for food or wages
Food security - insufficient for full year
CPR use - reliant on CPR for firewood, fish, foraging.

Housing is obviously an indicator of wealth, but it is a result of income-generating activities and not an area to focus natural resources research. Increasing livestock ownership would lift people from poverty, provided they had equitable access to rangeland or were able to use zero-grazing. For example the Ewoloto programme in Ngorongoro helps poor people obtain livestock, and the HADO project in

Kondoa has supplied milk-goats for zero-grazing. However, increasing livestock ownership in terms of livestock numbers will eventually result in ecological carrying capacity being exceeded. Poor families hoarding livestock and income accrued from sales of livestock and livestock products without investing it in livelihood improvement might also prevent poverty alleviation. Moreover, in terms of the contribution that CPR rangeland makes to livelihoods, it is wealthy people with large herds that benefit most from access. Poor people will be competing against the wealthy for access to prime resources in the rangeland commons. Increasing land availability for agriculture in semi-arid areas would equally not necessarily help poverty alleviation because the limiting factor may be quality of land, unavailability of rain or water for irrigatation, farm inputs and labour supply for tilling land. For example, for poor households in Babati District the main constraint in agriculture has been identified as not the shortage of land, but capacity to use available land (Lindberg 1996).

Improving security of employment for poor people would alleviate poverty, for example through establishment of large-scale commercial farming and supportive labour laws. However, this might cause further problems through further alienation of common property and large scale farming can result in soil depletion; for example, in Kiteto District, 10000 ha is estimated to have been abandoned since 1990 (Havnevik 2000). Food security is a function of seasonal agricultural or pastoral productivity; so the poor could be assisted by improving productivity through dry periods, for example through secure water supplies for irrigation or for watering livestock and pasture. CPR use is important for many sectors of the community, both rich and poor. For the rich it might be rangelands to graze large herds, for the poor it might be the last resort for food from bush meat or wild fruits, or a source of products for small-scale marketing such as fuelwood, building materials, charcoal and medicines.

8.2.3 Changes in use and key pressures on CPR.

Use of CPR is changing rapidly in Tanzania. The villagers' views from the field survey (see report by Quinn et al. 2001) gives a fairly idealised perception of CPR. They consider that in the past traditional management of resources meant equal access to all community members and resource sharing on a much larger scale than at present. The practice of transhumance was much more widespread. In Same District the traditional chiefs controlled land with a varied ecology that included different types of production systems, such as semi-arid lowlands and montane forests, so that their people had access to resources all year round and utilised resources seasonally. This management system meant that people were much less susceptible to the seasonal and inter-annual variability that characterises semi-arid zones. Spatial arrangement of different types of resources is an important topic of research for designing sustainable management strategies for the utilisation of Tanzanian semi-arid CPRs as changes in land use and tenure have tended to disrupt seasonal access to different parts of the CPR.

Recent changes have affected traditionally accepted ways of CPR management. Technical solutions have been imposed in many villages, not all of which have been successful. For example, in Msosa improvements in the irrigation system have led to improved cultivation while in Kadando the new irrigation system introduced by SNV-TIP has led to conflict between villages over access to irrigation water in the out-flow furrow area. Differences in success can been attributed to village governance and level of community participation in project development operated under both the traditional and modern village government system. Those projects with the least consultation are more likely to fail or cause conflicts, in other words there is a high transaction cost in initial negotiation. Changes in lifestyle are also influencing management of CPR. In Meshili the traditional boma is being replaced by more permanent structures that require more wood to build, thereby increasing pressure on forest resources. The Maasai mode of production is also changing with an increase in farming on land traditionally used for pasture or water protection such as catchment areas. This has led to conflict in the NCA where laws governing land use in the area prevent resident Maasai from cultivating.

Changes in land tenure of the last 100 years through the introduction of private farms, state controlled ranches, forest reserves, national parks and game controlled areas has had a varied impact on villages. In some places this is seen as beneficial. New benefit-sharing arrangements permit villagers to receive direct benefits through revenue derived from the state controlled resource, the aim being to encourage wildlife protection. In other villages, ranches and national parks have reduced the amount of land available for pasture and disrupted the spatial arrangement of traditional transhumance, leading to increased land scarcity and degradation. More recently, changes in land policy and implementation of the new Land Act, aimed at improving security of village land tenure, will assist in stabilising sustainable use of CPR under village control. However, the Policy and Act might prevent traditional

forms of land use and resource sharing whereby different users from close and distant villages and districts were able to migrate seasonally to other places for grazing and farming. The new government instruments will increase individualism, value of land and transactions costs in sharing of land resources.

In the future, increasing use of benefit-sharing arrangements from state controlled CPR and improved village land tenure are likely to enhance CPR sustainable management. The greatest threats to natural resource management in the future appear to be increasing populations of both people and livestock and issues of governance. With devolution of authority to villages, undemocratic village leadership systems can prevent direct benefits, for example from the wildlife sector, from filtering down to the majority. District councils with such arrangements (Monduli, Ngorongoro) do not audit villages for fear of being accused of intruding into local level 'democratic village systems' or 'traditional cultural systems' which might in practice be autocratic and conventional in their operations, corrupt or exploitative.

The possibility of major climate change is a large threat that needs to be considered in future planning. Climate change has been blamed for the droughts over the last three years that have increased food insecurity and poverty. Climatic variation is not new to eastern Africa but there are limits to resilience of traditional management systems with conflict and migration being recorded in times of drought. Traditional ways of resource sharing (apart from being protective and livelihood enhancing) may encourage immigration, as there is the possibility of free-riding on commonly managed resources. Immigration, together with internal population growth, has left many villages with problems of land or water scarcity that are likely to increase in the future. Already some villages are changing from traditional common resource management to individual ownership to cope with population increases.

8.2.4. Institutions that govern resource use and their response to change

Norms governing the use of natural resources are found in the form of national laws, district laws, village by-laws and informal traditional laws. The institutions that create, monitor and enforce these laws are central government, regional government, district government and village government. Until the mid to late 1990s, national laws such as the Land Ordinance, Forest Ordinance and Wildlife Ordinance were those developed and implemented during the British administration of the then Tanganyika. Through the 1990s national policy and law governing natural resources have been changed to reflect commitments to international agreements such as the Biodiversity Convention, and to provide greater participation at village level. In the process districts are being given greater authority and power. There is a see-saw trend in centralisation and devolution of power. Power was centralised in the state during the British Administration, followed by devolution of power to the regions following independence, then recentralisation of control over natural resources in the 1970s and '80s, and now devolution of power to the districts. The central state still retains control over national parks and catchment forest reserves, but districts and villages now have a much greater role in planning and decisions relating to land tenure.

In many villages traditional laws have been incorporated into formal structures and form the basis for village by-laws. Most norms are prohibitive and place restrictions on when and where certain activities are allowed. It is usually when these norms are not followed or enforced that conflict arises and CPR management breaks down. An example of this is in Bolisa village, which is inside the area covered by the HADO project. Some villagers are grazing livestock within the HADO area although there are laws in place that prohibit grazing. However, inadequate enforcement of the law means that the likelihood of these people being sufficiently punished to stop grazing is low. The problem lies in the fact that many of the law enforcers are villagers and are related to the offenders and if the case does go to court many offenders are released without punishment by the district.

In most villages conflict resolution is carried out by the village government and if necessary the ward or district authorities. In most Maasai villages this role is taken on by the traditional leadership, which tends to be stronger and more respected than the village government. However it may not always represent the best interests of the villagers; for example in Mfereji and Ngorongoro the traditional leadership was said to have unfair access to resources. Internal village conflicts are generally resolved quickly but the formal system can be inadequate and unnecessarily bureaucratic at solving conflicts between villages or ethnic groups. The conflict between Kadando and neighbouring villages over farming in the village protected forest and revival of a traditional irrigation canal have been going on

for over a year but are still to be resolved. In contrast, intervention of the DC in the conflict between pastoralists and farmers in Isele has led to an agreement between the two groups and a resolution of the conflict.

Institutions governing resource use are responding to change rapidly. For example, state controlled natural resource managers are increasingly involving local people in benefit-sharing arrangements around national parks, forest reserves and game reserves. However district and village level institutions may not have the capacity to respond to the rapidly changing policy environment (see section 7.1.6 on the concerns raised over increased responsibility for land use planning at district level).

8.2.5 Researchable constraints to the effective management of open access and CP resources in Tanzania.

Three key issues were identified by the project in management of CP resources in semi-arid Tanzania. These are (a) governance (b) water as a natural resource (c) spatial arrangement as an ecological question.

(a) Under the general governance, three principle researchable constraints to the effective management of CP resources in Tanzania were identified and described in detail in sections 7.0 and 7.1.7 with additional technical information in project reports by Kirby (2001), Adhikari (2001) and Perez-Cirera (2001). They are:

Making decisions. Which land-use is preferable? For example what are the economic returns from an area of land when it is put under different land-uses such as commercial agriculture, wildlife conservation or traditional forms of land-use.

Institutional systems. Do transactions costs prevent sustainable CPR management? Establishment of community wildlife projects or tightly controlled grazing regimes may assist in the equitable sharing of benefits or aid prevention of soil erosion. But if the costs of administering and monitoring the schemes exceeds the benefits then they are unlikely to be successful.

Institutional interactions. What are the socially optimal interactions? In designing joint management schemes there will be a tendency for free-riders to over-exploit resources at minimal cost. By applying tools such as game theory it is possible to guide the design of institutions to reduce costs and conflict.

(b) The question as to which of the many natural resources regarded as CPR should be the focus of a research programme was tackled through a risk mapping exercise (see report by Quinn 2001b for further details). The resource identified as the one which gave rise to the most concern over risk was water.

(c) Ecologically, CPR management is spatially arranged with different resources being used at different seasons or in response to climate variability. Changes in land tenure can disrupt spatial and temporal use of CPRs. Research into management strategies thus needs to be supported by spatial analysis of CPR.

8.2.6 Effective demand for new approaches to CPR management.

The demand for new approaches to CPR management is high. A new land use policy is codifying village tenure and considerable changes have been made to policy on CPRs, particularly with respect to engaging villagers in benefit-sharing from wildlife management (e.g. Ngorongoro and Iringa), development of village forest reserves (Babati), and village control over grazing (Kondoa). This is leading to problems of sustainability as villages take on the transactions costs associated with CPR management, concern over decisions relating to privatisation of land for commercial farming, and conflicts between agriculturalists and pastoralists as land scarcity grows. In brief, each of the questions posed in the introductory section are answered below:

1. The extent to which there is a true management problem on a given resource.

There are numerous problems associated with management of the resources in semi-arid Tanzania. Water has been diverted to commercial farming away from communal irrigation systems, as in Babati. Range-land has been alienated for wildlife conservation, for example in Mkomazi and the Serengeti. Overgrazing has lead to soil erosion, for example in Kondoa. Pastoralists come into conflict with farmers where both grazing and farming co-exist.

2. What are the specific benefits that will arise from improvements in resource use?

Potential benefits are preventing resource degradation, the creation of more productive resource use strategies and more equitable distribution of benefits.

3. What will be the cost, in particular the transactions cost, of improving resource management?

Transactions costs are a key constraint to the effect management of CPR. Negotiation, monitoring and enforcement of natural resource access and utilisation rules are high and may exceed the benefits to be gained from improved management.

4. Under what circumstances will each of the potential solutions to CPR management issues be most appropriate: a shift to private tenure, community based natural resource management, regulation by outside authority or some intermediate position such as the issue of licences for particular aspects of resource use?

The circumstances depend very much on government policy and economic feasibility. If policy is to conserve wildlife through state regulated alienation of land in national parks, then it is equitable to enable communities to benefit from returns to compensate from the loss of natural resources. A shift to private tenure needs to be considered in terms of overall costs and benefits. In the long term benefits may be greater if the resource is left under communal management, particularly if "cascade effects" of displacement due to the sequestering of key resources such as water are taken into consideration. Issuing of licences carried high transactions cost such as monitoring and enforcement.

5. Do the conditions exist for the establishment of 'long enduring CPR institutions' (in the sense of Ostrom 1990)?

This question is dealt with in greater depth in section 9.

6. How can boundaries to a given resource and the membership of the user community be drawn effectively yet equitably, so as to ensure effective management without excluding some users or creating windfall gains to particular individuals or groups?

An indirect answer to the question is that boundaries are problematic in semi-arid Tanzania. Even where boundaries exist they may be difficult to locate on the ground. In the MBOMIPA a problem was caused by lack of knowledge of where the district boundary was. In general villages do not have clear boundaries, and climatic variability means that that natural resource boundaries change with the seasons. Clear boundaries are made by national parks and forest reserves, but these can cut across traditional natural resource use patterns and wild animals do not recognise the national park borders. To answer the question more directly, boundaries can only be drawn effectively if there is a natural boundary to the resource, such as in a water catchment or irrigation scheme. It is difficult to define user groups of resources which change over time, in an often unpredictable way, such as range-land.

9.0 Concluding overview

Common pool resources (CPR) include, land, water, vegetation and wildlife. In Tanzania these resources have traditionally been managed under common property resource management regimes in which there is communal access to the CPR regulated by customary law and practices. This management approach was codified in law by the 1923 Land Ordinance, a land use policy that has recently been replaced. Despite a legal commitment to access to "natural fruits" large areas of semi-arid Tanzania have been alienated from communal control as national parks, game reserves, forest reserves, state ranches and private farms. This has disrupted traditional management systems and

patterns of transhumance that follow marked seasonal changes and periods of drought. Although choice of land use is rooted in political determined policy decisions, the process can be informed through ecological studies and economic analysis. For example a production function approach can be applied to the costs and benefits of national park or commercial farm establishment, and game theory can be used to develop the structure of joint management agreements.

Recent changes in benefit sharing arrangements which distribute incomes from wildlife management, and improved village tenure are attempting to channel resources to village level and stabilise local land management. But how stable are the conditions for the management of common pool resources at village level? Are the conditions for the establishment of long enduring institutions being met (in the sense of Ostrom 1990, Table 10). The survey of villages carried out for this project was designed to evaluate the conditions recognised by Ostrom (Quinn 2000, Quinn 2001c, Table 11).

Table 10. Design Principles Illustrated by Long-enduring CPR Institutions (from Ostrom, 1990)

1. *Clearly defined boundaries*
   Individuals/households who have rights to withdraw resource units must be clearly defined, as must the boundaries of the CPR.

2. *Congruence between appropriation and provision rules and local conditions*
   Appropriation rules restricting time, place, technology and/or quantity of resources units are related to local conditions and provision rules requiring labour, material and/or money.

3. *Collective choice arrangements*
   Those effected by operational rules can participate in modifying them.

4. *Monitoring*
   Active auditing of CPR conditions by monitors accountable to appropriators or are appropriators.

5. *Graduated sanctions*
   Dependent on the seriousness and context set by officials accountable to appropriators or are the appropriators.

6. *Conflict resolution mechanisms*
   Rapid access to low cost local arenas to resolve conflicts.

7. *Minimal recognition of rights to organise*
   Rights to organise institutions are not challenged by external government authorities.

8. *Nested enterprises*
   Only for CPRs that are part of larger systems. Appropriation, provision, monitoring, enforcement, conflict resolution and governance activities are organised in multiple layers of nested enterprises.

Table 11. Design Principles and Institutional Performances (adapted for Tanzanian villages from Ostrom, 1990 pp. 180, taken from Quinn 2001c).

Village	CPR	Clear boundaries & Membership	Congruent rules	Collective choice arenas	Monitoring	Graduated sanctions	Conflict resolution mechanisms	Recognised rights to organise	Nested units	Institutional Performance
Kadando	Forests	Weak	Yes	Weak	Weak	No	Weak	Yes	NA	Failure
	Pasture	No	Weak	Weak	Weak	No	No	Yes	NA	Fragile
	Irrigation	Yes	Yes	Yes	Yes	?	Weak	Yes	No	Fragile
Karamba	Forests	Yes	Yes	Weak	Weak	Weak	Yes	Yes	NA	Fragile
	Pasture	Yes	Yes	Weak	Yes	No	Yes	Yes	NA	Fragile
	Irrigation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Robust
	Lake	No	Weak	No	Weak	No	No	Weak	Weak	Failure
Mfereji	Forests	No	Weak	No	Yes	No	Yes	Weak	No	Fragile
	Pasture	No	Yes	No	Yes	No	Yes	Weak	No	Fragile
	Water supply	No	No	No	No	No	Yes	Weak	NA	Fragile
Niatolia	Forests	Yes	Yes	Yes	Yes	?	Yes	Yes	NA	Fragile
	Pasture	No	Weak	Yes	Yes	?	Yes	Yes	NA	Fragile
	Water	No	Yes	Yes	Yes	No	Yes	Yes	NA	Fragile
Sarame	Forests	Yes	Yes	Yes	Yes	Weak	Yes	Yes	NA	Robust
	Pasture	Weak	Yes	Yes	Yes	No	Weak	Yes	NA	Fragile
	Water supply	Weak	Yes	Yes	No	?	Weak	Yes	No	Failure
Kisangaji	Forests	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Robust
	Pasture	Weak	Weak	Yes	Weak	No	Weak	Yes	NA	Fragile
	Irrigation	Yes	Yes	Yes	Yes	Yes	Weak	Yes	No	Generally robust
Kakesio	Forests	No	Weak	No	Weak	No	Weak	Weak	NA	Failure
	Pasture	No	Weak	No	Weak	No	Weak	Weak	No	Failure
	Water supply	No	No	No	Weak	No	Weak	Weak	NA	Failure
Meshili	Forests	Yes	Yes	Yes	Weak	No	Yes	Weak	Yes	Fragile
	Pasture	No	Weak	Weak	Yes	No	Yes	Weak	No	Fragile
	Water supply	Yes	Yes	Yes	Weak	Yes	Yes	Yes	NA	Generally robust
Msosa	Forests	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	Generally robust
	Pasture	Yes	Yes	Yes	Yes	No	Yes	Yes	NA	Generally

Village		Yes Clear boundaries & Membership	Yes Congruent rules	Yes Collective choice arenas	Yes Monitoring	Yes Graduated sanctions	Yes Conflict resolution mechanisms	Yes Recognised rights to organise	Yes Nested units	robust Robust Institutional Performance
	Irrigation CPR									
Isele	Forests	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NA	Robust
	Pasture	No	Yes	Weak	Yes	No	Weak	Yes	NA	Fragile
	Irrigation	Yes	Yes	Yes	Yes	Yes	Weak	Yes	Weak	Generally robust
	Game controlled area	Yes	Yes	Yes	Yes	?	Yes	Yes	Yes	Robust
Bolisa	Forests	Yes	Yes	No	Weak	Yes	Weak	No	NA	Fragile
	Pasture	Yes	Yes	No	Weak	Yes	Weak	No	NA	Fragile
	Water supply	Yes	No	No	No	No	Yes	Yes	NA	Fragile
Bumbuta	Forests	Yes	Yes	Yes	Yes	?	Yes	Yes	NA	Robust
	Pasture	Yes	Weak	Yes	Yes	?	Yes	Yes	NA	Generally robust
	Water supply	Yes	Yes	Yes	Yes	?	Yes	Yes	Yes	Robust

NA Not Applicable
? Information not available

The key points from Table 11 are:

- Water is generally well managed through CPR regimes although institutions can be fragile when there are inadequate conflict resolution mechanisms or nested enterprises to deal with inter-village use of the same resource. Building institutional capacity between villages would serve to improve the robustness of water CPR institutions.
- Information from these villages suggests that many institutions, especially those for forest CPRs, are unable to adequately deal with change. Local population increases and the lack of suitable farmland has put new pressure on CPR institutions that they are not adequately equipped or supported to deal with.
- New CPR institutions can be successful if there is local participation in the design, implementation and monitoring of the CPR and transactions costs are low. However, when a new CPR regime has negative impacts on livelihoods and transactions costs are high then institution failure is likely.
- Pasture CPRs pose the most difficult questions for long-term institutional survival. At present migrant pastoralists graze their cattle on a patchwork of CPR regimes with arbitrary boundaries, that do not reflect the underlying ecological system, and varied operational rules. They are generally not involved in the development and modification of operational rules and as a result conflict between pastoralists and village residents are common. However, the dynamic nature of pasture CPRs and their use means that successful management of any kind is unlikely.

Recent changes towards more village-centred CPR management have shifted the need for research on CPR from establishment of new management systems to maintaining their sustainability by lowering transactions costs, making appropriate decisions as to the type of management regime to apply and the institutional arrangements that are needed when there is conflict. The main benefit that will arise from research on improved CPR management strategies is sustainability and stability. The poor will benefit through continued access to CPR and improved village governance. The move to different potential solutions of CPR management such as a shift to private tenure, community based natural resource management, regulation by outside authority or some intermediate position such as the issue of licenses for particular aspects of resource use will depend on the costs and benefits of each option in each situation. It is research into governance and institutional structures relative to these costs and benefits that is central to sustainable management strategies.

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