A Spatial Analysis of the Drivers of Livelihood and Land Use Change in Maasailand, Tanzania

Environmental Technology MSc Thesis

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Page for declaration of work

Abstract

For centuries a pastoralist lifestyle dependent on transhumance was intrinsic to the Maasai. However, it is becoming increasingly apparent that the Maasai pastoralist system is breaking down. Either as a consequence or as a driver of this phenomenon, land use change, in the form of settled agriculture, is rapidly occurring. This thesis produces a time-series map of the change of area under cultivation over the period 1987-2005 using satellite images processing techniques. The vector output is then combined in a Geographical Information System with data collected from a case-study village and resource locations in the area. A comparison is made between the results that the GIS yields and those of People's Problem Perception Mapping (PPPM). This combination of methodological techniques aims to provide an analytical tool for the production of a comprehensive overview of both human and resource related drivers of livelihood and land use change within the Burko hunting area contained within the Monduli District, Tanzania. This report argues that such an integrated overview of the area, in terms of the problem perception of the community, the recent changes in land use and the actual location and availability of resources, is vital for successful future management strategies whose aim is to encourage sustainable development and maintenance of biodiversity within the area.

The results show that five of the six villages show significant net agricultural expansion during this period. The main driving factors identified by the Maasai are drought, hunger, reduction in herd sizes and observation of other tribes. Socio-political driving factors were not mentioned by the participants but are evident in the visible effects of a history of land alienation, of recent forced sedentarisation and also of the socio-political as well as natural climate during the 1980s which is the decade in which the majority of participants started cultivating.

It is recommended that the Maasai first need to work together on solving their common resource issues, as they would plan cattle movement, in their meetings. Once they have decided what action they are prepared to work together on for the area, they then need to approach the appropriate Government agencies and Non Governmental Organisations (NGOs) for assistance. It is recommended that the NGOs working with the Maasai in this area adopt the PPPM as a way of identifying what resource issues need assistance and what the most appropriate assistance would be. If repeated, PPPM can act as a means of measuring the success of the assistance as perceived by the Maasai. Finally, all the stakeholders involved in the southern area of the Burko Hunting Block need to work together and their respective claims/needs should then be incorporated in the land use zoning plans. One possible solution might be to build upon the use of the GIS system in this thesis, adding in a complete dataset of resource locations.

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This project is a collaborative project between Imperial College London (ICL) and Cullman Hurt Community Wildlife Project (CHCWP). Additional collaborators include the Training Centre for Development Cooperation (MS-TCDC) and the Community Research and Development Services (CORDS). Assistance was also given from the International Livestock Research Institute (ILRI) and the GIS laboratory at the African Wildlife Foundation (AWF) in Nairobi. Several people within deserve a special mention for their contributions to this thesis:

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FORWARD

This project and data are a result primarily of a collaboration between Imperial College London (part of the University of London in the United Kingdom) and Cullman Hurt Community Wildlife Project (CHCWP), the conservation division of Robin Hurt Safaris (T), Ltd. Students of the MSc in Environmental Technology at Imperial College London have formed what is hoped to be a future long-standing, successful alliance with CHCWP. Students volunteer with CHCWP on specific projects to help improve the efficacy of CHCWP whilst, at the same time, satisfying the educational requirements of their MSc course.

The Cullman Hurt Project was founded in 1990 on the conviction that wildlife and its habitat can only be conserved by involving local people and from that involvement they must receive tangible and direct benefits from the wildlife among which they live. The Cullman Hurt Project works with 33 villages throughout Tanzania, all of which are located in and around the hunting areas of Robin Hurt Safaris. Each village which CHCWP participates in has a Benefit programme which delivers funds annually from a 20% surcharge placed on all trophy animals taken by sport hunters who come on safari with Robin Hurt Safaris. CHCWP has been operating for over 13 years in the Burko block (Monduli District) and currently works with 13 villages of which the block is overlapping. While in many ways CHCWP is about wildlife and habitat, it is essentially a "people-focused" organisation which is intimately involved with community development and based on the sustainable utilisation of wildlife.

The idea of this collaboration is to attempt to produce a framework for measuring the effect of the CHCWP benefits as well as to provide a mechanism for village leaders whereby they can consider the resources they need that are critical for their community (taking into account the different requirements of both men and women in Maasai society) but also take into consideration those resources needed by other villages in the immediate area. It is hoped that this new framework will enable village decision makers to incorporate not only the resource requirements at the village level but also those requirements at the wider area level in the decision making process of which projects to spend CHCWP funds on. This will enable the villages within the Burko area to use their funds from CHCWP to more strategically manage their resource requirements.

One of the greatest changes in land use within the area over the past two decades is agricultural expansion. This not only increases conflict between the villages and wildlife (due to crop raiding and also reduced wildlife habitat) but is also causing erosion of roads, silting up of important dams and is undermining the traditional Maasai culture. The driving factors of this land use change were also investigated.

It is hoped that the information contained within this thesis will be disseminated to as many interested organisations as possible and that those organisations will follow the recommendations for the benefit of the Maasai.

The ideas and opinions expressed in this report are those of the author only and do not reflect the views or policies of any of the collaborating or sponsoring agencies involved in this project.

ACRON MS

ArcGIS	Arc GIS version 9 Desktop software			
AWF	African Wildlife Foundation			
CHCWP	Cullman Hurt Community Wildlife Project			
CORDS	Community Research and Development Services			
ENVI	Environment for Visualising Images version 3.6			
	software			
GIS	Geographical Information System			
ICL	Imperial College London			
ILRI	International Livestock Research Institute			
MS-TCDC	Training Centre for Development Cooperation			
PPPM	M People's Problem Perception Mapping			
PRA	Participatory Rural Appraisal			
PVA	Participatory Visual Analysis			
ROI	Region of Interest			
RPM	Risk perception mapping			
RRA	Rapid rural appraisal techniques			
SPSS	Statistical Package for the Social Sciences version 13			
	software			

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Chapter 1 Introduction

1.1 Background and Justification

It is becoming increasingly apparent that the Maasai pastoralist system is breaking down, with settled Maasai pastoralists no longer adhering to traditional resource management methods (Lovett et al. 2001). Either as a consequence or as a driver of this phenomenon, land use change, in the form of settled agriculture, is rapidly occurring. For instance, it has recently been ascertained that the Maasai based in Kenya now derive their main livelihoods not from herding but instead from farming, wildlife tourism and/or leasing of land for cereal cultivation (Thompson and Homewood, 2002). It has been suggested that these new livelihood choices made by the Maasai are not simply a function of potential economic returns (Homewood, 2004; Thompson and Homewood, 2002). Rather, the factors impacting on decisions over land tenure practices and livelihood change will each have their own driving factors, based on historic trends, the current situation and future aspirations of the Maasai community. These livelihood choices might also be impacted by economic changes, population pressure, changing cultural trends (especially within the context of gender and social wealth), poor health and the stochastic nature of the environment. In the context of Maasailand in Tanzania, there is immense political pressure from the government for the Maasai to settle (which has recently been reinforced by the 1999 Land Act and Village Land Act).

These livelihood changes and subsequent land use changes are thought to be having a dramatic impact on local ecology within the Burko area in Tanzania, reducing habitat availability for wildlife. This area is a hunting area which provides important protection for local wildlife through the Cullman and Hurt Community Wildlife Project (CHCWP). CHCWP promotes wildlife conservation through the sustainable utilization of wildlife, delivering economic benefits from Trophy hunting tourism to the local Maasai communities. It has been said that wildlife cannot be separated from the needs and involvement of rural people, or from ambient cultural, political, economic, and biological realities (Tambiah, 1995). If there is to be a viable future for wildlife within the area, the drivers of the change in primary livelihood and land use need to be determined and management strategies adapted to meet the current specific needs of the Maasai and to ensure their active involvement in such strategies.

Current and future research must, therefore, endeavour to understand the complex linkages and interactions between the different driving factors governing Maasai land use. The utility of such information will be greatly increased if the driving factors are defined within the context of the local communities themselves. One way of doing this is to focus at the grassroots level and ask the communities themselves to identify the problems they encounter during livelihood activities, attribute a relative importance value to each problem and discuss the frequency of occurrence of each problem.

Whilst a package of Participatory Rural Appraisal techniques (PRA) would allow for in depth assessment of the livelihoods of the Maasai and the issues surrounding them, these methods sometimes tend to be time consuming (for instance life portraits), spatially limited, hard to quantify and produce statistics from and, ultimately, are often unrepeatable as they are subject to the relationship between the original researcher(s) and the participants. As the Maasai's perception of problems relating to their livelihoods are likely to be influenced by physical, environmental and social factors prevailing at the time of data collection, and as the reason for looking at these problems in depth is to try to find solutions and to in turn measure the impact of these solutions, it is important to use a methodology that is not only easily repeatable but also gives outputs that all the stakeholders concerned, including the communities themselves, can readily understand and use to improve their quality of life and the status of the land. Therefore, this thesis proposes a combination of techniques, some PRA based and some of which will be more scientifically based, and will attempt to address the limitations of PRA whilst maintaining the benefits of the ideology behind it.

Recently, a study by Quinn *et al.* (2003) was published on the feasibility of Risk Mapping as a means of identifying factors that influenced local perceptions of livelihood problems in Tanzania. Quinn *et al*, concluded that the risk mapping method is a "*useful tool for understanding perceptions of risk to livelihoods in semi-arid Tanzania*" (Quinn *et al.* 2003 p118) and that risk perception not only varies according to livelihood strategy and gender roles but also varies according to spatial and temporal availability of key resources such as water.

Therefore, research into the drivers of livelihood change needs to incorporate not only local perceptions but also the corresponding spatial arrangement of the resources within the landscape in order to contribute towards successful sustainable management of common pool resources within the Burko area.

1.2 Aim and Objectives

Aim

The aim of this project is to identify problems that the Maasai Communities of six villages in the Burko area currently experience and associate with different livelihood strategies and to explore the complex linkages between these perceived problems, the available resources within the region and recent land use change.

Objectives:

- 1) To map and quantify the changing extent of land under cultivation in the project area from 1987 to present day.
- To identify the problems that the Maasai community within each of the 6 villages in the project area believe threaten their livelihoods, using People's Problem Perception Mapping.
- 3) To carry out an in-depth case study into perceived problems and land use change within one of the villages and to use this information to verify PPPM as an appropriate methodological tool for the area.
- To create a Geographical Information System highlighting the location of resources within the project area and to display spatially the results from the case study village.
- 5) To determine the factors driving land use change by examination of the relationships between the outputs of the land use mapping, resource mapping, PPPM results and the data collected from the case-study village.
- 6) To make recommendations for NGO interventions

1.3 Scope of the Project

This project combines the use of a Geographical Information System (GIS) of the project area with the outputs of People's Problem Perception Mapping (PPPM) and land use change mapping using satellite images, to provide an analytical tool for the production of a comprehensive overview of both human and resource related drivers of livelihood and land use change within the Burko hunting area contained within the Monduli District, Tanzania. This report argues that such an integrated overview of the area, in terms of the problem perception of the community, the recent changes in land use and the actual location and availability of resources, is vital for successful future management strategies whose aim is to encourage sustainable development and maintenance of biodiversity within the area. The GIS consists of available location points for resource locations (e.g. water points where recorded), social facilities (e.g. schools and dispensaries), crucial transport networks (roads), and the areas in which is designated as the hunting block, as well as a recent time-series of land use change within the villages (gained from visual analysis and processing of satellite imagery).

This report argues that it is important to gain livelihood problem perception information specific to each of the villages as the different spatial locations have different natural and anthropogenic resources which play a role in influencing their perception of livelihood problems. Detailed qualitative and quantitative information has been acquired for a case study village (the village of Arkaria) using PRA techniques and a partial census involving a semi-structured interview of the bomas, in order to provide detailed information as to the driving factors of land use change in the area.

This thesis is structured as follows: Chapter Two considers the received wisdom and public perception of the Maasai before providing a concise history of Maasailand and an overview of land use change in the project area. Chapter Two also includes a brief theoretical summation of the methodologies incorporated within this project as well as a site description of the project area. Chapter Three details the methodologies used and the ways in which they aim to fulfill the aim and objectives of this project as well as the limitations encountered. Chapter Four describes the results of the land use mapping, PPPM and the partial census using the framework of a model developed and outlined in Chapter Three. Chapter Five draws the results together in a discussion of the relationships between different driving factors, drawing on and comparing these results to other research that has been carried out in the area. General limitations are acknowledged and future work is suggested. The conclusion in Chapter Six summarises the project's findings and discusses the implications these could have on future management strategies. Ways in which the methodologies of this project could be used and/or built upon by the Maasai and NGOs/agencies are discussed. Chapter Seven outlines some recommendations for NGO intervention made on the basis of the findings of this thesis.

Chapter 2

DIFFERING PERCEPTIONS & HISTORICAL

CONTEXT

"our culture is a living culture and not a historical one"

Hon. Alhaj Juma A. Kapuya, former Minister of Education and Culture, Maasai in origin (Village Museum, 1998 p19).

2.1 Received wisdom and public perception

The Maasai are one of the few tribes whose name and integrity are globally recognised. However, they have recently been described in every edition of the Sunday Times published globally on the 28th August as, "mammalian bipeds" and "a distracting fraud" by the author A.A.Gill (2005).

Their current image according to Western advertising (tall men in red checked cloths often with spears in one hand and mobile phones in the other) is often used today in commercials for cars, airlines, fashion shoots and in magazines such as Hello! (Gill, 2005). Yet Gill suggests in his newspaper article that this image is false and states that they are "nothing like as utopian as we want to believe".

Often, by saying the word 'Maasai', images are evoked of "tall and slender and handsome, noble savages who looked the part, brave to the point of foolishness, peerless hunters and trackers" (Gill, 2005). This male dominated, coffee-table book image is, according to Dorothy Hodgson (an anthropologist who lived and worked with the Maasai), a legacy left by the British colonial administration who manipulated perceptions of ethnic and gender identity of the Maasai (Box 1).

Box 1

"being Maasai was configured as a masculine category – 'real' Maasai were pastoralists, warriors, and nomads, all of which were perceived as male pursuits. This static, andocentric image of Maasai ethnic identity persists today..." (Hodgson, 2001 p130)

In fact, they are a people adapting to a westernized paradigm of the modern world. Gill's main complaints seemed to be that the Maasai hire lawyers for legal advice about land alienation, that they wear fabricated tartan cloth from China and that, above all, they *"think it is beneath them to do any work but herd cattle"*.

This last perception could almost have been voiced by the Tanzanian national government which purportedly share a common misconception that pastoralists are "*problem people who choose to evade rather than participate in the process of national development*" (Homewood and Rogers, 1991, p 67). From research by anthropologists who have actually lived and spent time with the Maasai, it is apparent that the Maasai's inclination to participate is not the problem, rather it is the lack of appropriately prepared mechanisms that would enable them to do so.

Perhaps our understanding of the Maasai; their livelihoods, their land use and the ways in which these have changed lies not in misconception and theoretical debate but, instead, with the Maasai themselves. Dorothy Hodgson, a cultural anthropologist, said that she, "*listened carefully as people* [the Maasai] *discussed their problems, debated their development priorities*" and realised that they had challenged her "preconceptions about their needs and desires" (Hodgson, 2001 p.3).

2.2 The history of the Maasai

2.2.1 Origins of the Maa people

The Maasai are known as "Iltung' ana loo ngishu", people of cattle. Traditionally, they practice transhumance between different grazing pastures for their cattle according to season, searching for fodder and water (Mapinduzi *et al.* 2003).

Their origins are debatable as the Maa people have only an oral history (Njoolay and Loning'o, 1998). It has only recently been acknowledged by academics that the other Maa-speaking groups, whose livelihood strategies are based around hunting or farming, are linked to and are a part of the Maasai pastoralist system (Homewood and Rogers, 1991). The Maasai themselves believe that God (their God) created three classes of people: pastoralists, farmers and hunters (Njoolay and Loning'o, 1998). These different tribes were founded by the children of Maa's three wives (see Box 2).

BOX 2

The first person was Maa (sometimes known as Maasindat), who lived at Kerrio and had three wives: Naiterokop, Nasotua, and Nainyiti. Maa gave birth to all Maasai. The first child of his wife Naiterekop was a son named Nagol, who had only one tooth. He was a bit of an outsider, and didn't get along well with others. His parents tried to pull out his one tooth, as he was laughed at, but it was too hard. He moved away, and started the tribe (entipat) called "Illogol Iala" (hard teeth). They are still around these days in Kenya and Tanzania (Morogoro and Ruvu), sometimes called "Likikoine" or "Lmbwa". Naiterekop's second child, Maasai, fathered the Maasai, Purko, Arusha and Irkaputie. Maa's second wife, Nasotua, gave birth to a girl named Simal, who later left and was taken by Somali Dorobos. She gave birth to twins, a boy and a girl, in Somalia. The name "Somalia" comes from her name, "Simal", and is the reason the Somalis speak like Maasai. Finally, Maa's third wife, Nainyiti, gave birth to the Iltengwal, Samburr (Samburu), Ilaikipiak, Iluasinkishu.

Source: Dorothy L. Hodgson (2001) p23

Living memory of the Maasai dates the existence of Maa people as being long established in North Africa by the 1770s (Kimesera, 1998). It is thought that the main migratory period southwards took place between 1776 and the beginning of the colonial era (1850) by which time the Maasai were at the height of their power, with Maasailand covering an area that stretched from central Kenya down to central Tanzania (Arhem, 1985).

However, Maasailand today is a shadow of what it once was (Figure 2.1)



Figure 2.1 Maasailand today (Arhem, 1985 p21)

2.2.2 Maasailand

By the end of the nineteenth century, Maasailand had struggled through a decade of disaster. The bovine outbreak of 1883 and the rinderpest outbreak of 1891 left Maasai herds substantially reduced (Rohde and Hillhorst, 2001). This, combined with a smallpox outbreak in 1892, initiated the process of transformation of Maasai social organization and gender relations. The immediate consequences were: the encouragement of Maasai to marry cultivators, boys to find wage employment and the trading of children for food (Hodgson, 2001). At the same time, the effects of colonial land policies in both Kenya and Tanganyika were being realised (Arhem, 1985); the white settlers and cultivators moved in and the Maasai were forced out. The reduction in Maasai cattle herds led to less grazing in the highlands which, in turn, caused vegetation changes ideal for tsetse infestation. This resulted in a large expanse of previously prime pasture land becoming useless (Rohde and Hillhorst, 2001).

At the end of this dire period for the Maasai, the survivors returned to pastoralism as their primary livelihood with the notable change that they chose to increase their food security by living amongst cultivators with whom they could trade (Hodgson, 2001). The Maasai bartered pastoral products for agricultural products as far back in time as the end of the nineteenth century (Ndagala, 1996).

The German colonial administration tried to restrict the Maasai to the southern end of their land in the arid Maasai-steppe whilst retaining the more fertile and less arid land in the north for white settlers (Arhem, 1985). However, the Germans were defeated in the First World War and Tanganyika was handed over to be administered by the British. The British created the first Maasai reserve in 1926. Tanganyikan Maasailand and the Maasai's grazing rights were protected. However, this was short-lived. More cynical academics suggest that the "protection" was a farce in itself (see Box 3).

Lyall (1973:12) cited in Mvungi and Mwakyembe (1996:75)

During the late1930s-1950s, the centre of Tanganyikan Maasailand became a target for large-scale land alienations (Arhem, 1985). In the 1950s, the borders of the Maasai District were further restricted to allow for the influx of Il-Arusa cultivators,

Box 3

[&]quot;one cannot escape the conclusion that the Land Ordinance was an exercise in cynicism, appearing to grant rights to the African population over their land while vesting complete legal control in the colonial administration... The provisions were deliberately made as vague and ambiguous as possible so that any further shift of policy could be readily justified legally by a reinterpretation of the statute"

encouraged by colonial expansion programmes (Hodgson, 2001; Arhem, 1985). Compensation was given in the form of the Masai Development Plan which was promised would bring economic modernization to the Maasai through the provision of improved services, especially water resources and the eradication of the tsetse fly (Arhem, 1985). By 1955 that programme had failed.

Tanganyika was made independent in 1961, inspiring the continuation of colonial style land policy; acquisition of pastoral lands, more intensive land use practices put in place and compensation to the pastoralists in the form of extension services, often of little use to the pastoralists themselves (Arhem, 1985). This style of governance prevailed due to the Government's synthesis of pastoral people as "problem people", people that wanted nothing to do with national development (Homewood and Rogers, 1991 and see Box4).

Box 4

"The growing attitude of laziness connected with famine relief is distressing [sic]; were the concept of building a better country in which to live through hard work more prevalent, these troubles which have taken up so much of our time would never have arisen"

Water Officer to Provincial Commissioner, Northern Province, 15th June 1961 (cited in Hodgson 2001).

Dorothy Hodgson, in her book "Once Intrepid Warriors" (2001), commented that by the eve of Independence the Maasai had seen 50 years of development and yet they were by far the worse off for it, with the effects of drought increased by land alienation which reduced the dry-season grazing grounds and water points available. What new water points had been built had caused clustering of livestock and degradation within the immediate vicinity of the water points.

Implemented in the name of socialism by the single party state, headed by Dr Julius Nyerere, was one of the most renowned land policies of the Tanzanian government; the 1973 villigization programme. This aimed to resettle the entire Tanzanian rural population into co-operative villages (Rohde and Hillhorst, 2001). In Maasailand this meant that thousands of people were compulsorily relocated from their transhumant lifestyles to sedentary, nucleated villages. The implementation of this policy was often achieved by force. It has been said that, "*The concept of village stands in this context for a political and administrative unit imposed upon the pastoralists by the state*" (Arhem, 1985 p45).

The 'village' also refers to the land surrounding the village office. Boundaries are being mapped currently.

By 1976, approximately 31% of the Maasai population in the Monduli district had been resettled (Arhem, 1985). Far from providing development and modernisation benefits, this upheaval led to population pressure on land that, in the past, had only been found ecologically sustainable if it had been left fallow for long periods. Furthermore, the sedentarisation of the pastoralists, combined with decreasing herd sizes, led to an increasing dependence of the Maasai on grain (Arhem, 1985).

The aftermath of the villigization programme in the 1980s became a period of economic crisis (Ndagala, 1996; Sundet, 1996). The pioneering of mechanized agriculture was encouraged within the semi-arid Ardai plains. In reality, this meant pastoral dispossession and agricultural colonization of parts of what remained of Maasailand. Pioneer settlement, increasing cultivation and livestock numbers and deforestation led to problems still in evidence today of soil erosion, declining fertility of the land and overgrazing (Rohde and Hillhorst, 2001). However, livestock numbers were counterbalanced by the resurgence of disease. During the period after villigization, the Tanzanian Government had supported animal health infrastructure, providing facilities such as dips, which had the effect of lowering the animals' resistance to disease (Hodgson, 2001). However, due to the economic crisis, most government support was withdrawn with dire consequences, namely impoverishment in the form of decline of per capita cattle holdings, for the Maasai (Nelson, 2000; Ndagala, 1996). Economic differentiation among the Maasai has increased ever since (Arhem, 1985).

2.3 Land use and livelihood change

The Maasai pastoralists who inhabit the Ardai plains and the surrounding area still practise transhumance, although the majority of women, children and the elderly stay settled in the dry season whilst the men move the cattle to better pastures (source: data from this project). Together with this change in the traditional transhumance lifestyle, smallholder cropping in the area has increased. In order to ensure food security, the Maasai have had to consider the adoption of non-traditional means of livelihoods. It would appear in the Monduli district that this has resulted in the cultivation of marginal semi-arid lands with limited agricultural potential (Nelson, 2000).

The Maasai's increasing dependence on agricultural foods as food security and risk insurance (Arhem, 1985) meant that they could no longer acquire grain in larger quantities by the traditional means of bartering, especially as the value of grain increased faster than that of livestock (Ndagala, 1996). Pastoralists then turned to rainfed cultivation which enabled them to not only grow their own food (thereby preserving their meager herd sizes), but also enabled them, should there be an excess, to sell the surplus and restock their herds (Ndagala, 1996). The adoption of this rainfed subsistence farming by the Maasai can, according to Arhem, a historian (1985), be traced back as far as the 1960s and early 1970s.

Rohde and Hillhorst in their 2001 paper on environmental change in Lake Manyara area note that by far the most obvious land-use change in this part of Maasailand has been the increase in rainfed maize cultivation. They name agriculture and the run-off from cultivated fields during storms as one of the factors causing extensive gully erosion in the area. Mapinduzi *et al* (2003) noted during research into the use of Maasai ecological knowledge that the Maasai range scouts blamed crop cultivation for causing the erosion of grazing lands.

Sydney Kwiyamba's detailed article for *The Guardian* this year (2005) elaborated on the changing livelihoods in the Maasai plains. She attributed the change of livelihood strategies of pastoralists to the ecological stresses currently affecting their land (long periods of droughts and extensification of smallholder crop cultivation) and the change in tenure rights from communal to private ownership. These, in turn, had degraded the pastoralists' ability to retain their sustainable mobile livestock economies. The major shift in livelihood strategies of the pastoralists has, according to Kwiyamba, been to transgress from pastoralism to agro-pastoralism or, for the younger generation, to migrate to urban areas to seek paid employment.

Traditionally within Maasai society, agriculture was considered a desecration of the land on which cattle fed (Hodgson, 2001; Arhem, 1985). The question of why a society that, traditionally, was so adamantly against agriculture, has learnt how to till the land, is key to understanding the drivers of recent livelihood and land use change in Maasailand.

2.4 Maasai men and women: Their respective domestic roles.

Received wisdom of Maasai culture tends to be static and andocentric, the word 'Maasai' evoking for many an amalgamation of pastoralists, warriors and nomads (Hodgson,

2001) yet this is but one part of traditional Maasai life. It is true that men do herd livestock and that the warrior age group (Morani) carry spears. However, men have many more roles than just herding livestock. They have to treat diseased/sickly livestock, build houses, find food for the family, engage in the purchase and selling of livestock, weed the family fields, attend both political meetings and those concerning pasture management, provide enough income to cover school fees/equipment, fence the boma and, if they are elders, provide advice for the younger men. Women also have many livelihood roles not directly related to cattle, such as collecting firewood and water (see Plate 1), cooking for the family, repairing the houses, weeding the fields, making jewelry as well as bearing overall responsibility for taking care of the family (source: data from this project). Therefore, whilst cattle traditionally fulfilled the everyday needs of the Maasai (Arhem, 1985) current Maasai life is dependent on a variety of other resources.



Plate 1. Maasai women returning to Nanja Sub Village from collecting firewood (source: author)

2.5 The Maasai and the Il-Arusa

To the uninformed observer, it is hard to pinpoint any differences between the Maasai and the Il-Arusa (see Plate 2). Often, the only difference in appearance is that Il-Arusa have stained teeth whereas those of the Maasai are white. They both speak Maa. Both wear the same colorful patterned cloths. Both have the traditional holes in their ears. The Maasai traditionally are known to be cattle focused whereas the Il-Arusa are known for their specialization in cultivation. Today, due to the increase in small-holder cropping by the Maasai, at first glance it is difficult to see any difference between the two groups. Both cultivate and both often own livestock. The Il-Arusa practise the same ceremonies as the Maasai, including circumcision, with often only minor deviations, especially with regard to dowries and traditional dishes eaten at ceremonies (Kambainei, 1998). In the Ardai Plains the two groups live interspersed. If asked directly, the Il-Arusa will say they are Maasai but the pure Maasai will tell you which bomas are Il-Arusa (source: information from this project).



Plate 2. An Il-Arusa woman and a Maasai woman (source: author)

2.6 Methodological Foundations

2.6.1 Risk perception mapping

Risk perception mapping requires data on the types and relative importance of problems perceived by individual people in village communities. It puts the onus on local communities to identify problems, priorities and improvements –the problems are thought of as perceptions of risk.

The methodology was first published by Kevin Smith (International Rescue Committee, New York), Christopher B. Barrett and Paul Box in 2000, in the Journal *World Development*. They wanted to create a "systematic but simple approach to classifying and ordering sources of risk faced by subject population". They used risk mapping to examine pastoral communities in the arid and semi-arid areas of Ethiopia and Kenya. They believed that by "distinguishing between incidence and severity of subjective risk perceptions, this method enhances understanding of the nature and variation or risks faced within a population".

In 2001 the methodology was referred to in a report on common pool resource management in semi-arid Tanzania. The authors of this report (Lovett et al.) went on to use the risk perception methodology to examine variation in local perceptions of risk in semi-arid Tanzania. Their use of the methodology was a wider application than Smith et al (2000) because they included agro-pastoral and agricultural communities. Specifically, they were testing the hypothesis that people's perceptions of problems depends not only on the environmental conditions in which they live but also on their social situation. They carried out the process in 12 villages in 6 districts across Tanzania. For each problem identified, an incidence index (I) and a severity index (S) was calculated to produce a risk map. They concluded that risk perception varied according to heterogeneity of the resources in the area, variations in livelihood strategy and gender roles. They indicated that "Development projects that seek to improve the livelihoods of poor rural communities need to recognise the factors influencing the ways in which people perceive their problems. Many projects implemented in the past have failed because they have not addressed the needs identified by the target communities themselves". They then devised a calculation for a "risk index" which takes account of both I and S, RI=I/S. The RI increases with the overall risk associated with each problem.

2.6.1.1 Use of the terms "risk" and "problem"

Quinn *et al.* in their 2003 paper defined risk in terms of the problems faced by respondents when providing for themselves and their families. They asked respondents across semi-arid Tanzania to identify and rank their "problems". The terminology used in Quinn *et al's* study is slightly misleading as "risk" is usually defined as encountering hazards or taking chances. They based their methodology on that of Smith *et al.* (2000) who defined risk as "*exposure to potentially unfavorable circumstances, or the possibility of incurring nontrivial loss…something undesirable*". Smith *et al's* definition of risk suggests what the layman would normally call a problem. Indeed, Quinn *et al* when collecting data from respondents had to ask the respondents in terms of "the problems that they faced" (p113). A "problem" can account for both certainty and uncertainty whereas "risk" can only account for uncertainty. Therefore, within this project the "risk perception mapping" technique has been used as the basis for the creation of a new and, perhaps, more appropriate technique for analysing livelihoods; People's Problem Perception Mapping.

2.6.2 RRA and PRA

Rapid Rural Appraisal techniques (RRA) evolved as a collective of data collection techniques in the late 1970s and 1980s. RRA techniques were developed to meet a number of demands including an increasing demand for ways of collecting information of the driving factors causing accelerating rural change (especially following the Green Revolution) and to incorporate recognition into the questionnaire methodology of interviewer and participant bias (Chambers 2004). RRA also provide a mechanism for triangulation. By using different techniques and a range of informants in a range of places, the researcher is able to "cross-check" information collected in order to get closer to the truth via successive approximations.

By the middle of the 1980s, Participatory Rural Appraisal began to develop. The distinction between PRA and RRA is that "an RRA is intended for learning by outsiders. A PRA is intended to enable local people to conduct their own analysis, and often to plan and take actions". (Chambers, 1992 p13) Uptake of it was rapid especially because it enabled data collection and more importantly articulation of local knowledge (Mosse, 1994). PRA was finally acknowledged as a type of RRA in 1987 at the Khon Kaen International Conference (Chambers, 1994). PRA is seen as a 'theory' of enabling empowerment of local communities whereas RRA focuses upon gathering data and knowledge as cheaply, quickly and effectively as possible (Baker and

Mwadsley, 2005). However, during the early 1990s, concerns were raised as to how unbiased data from PRA could be when the information produced was necessarily influenced by the gender and wealth of the respondents. Concern was also raised over the lack of acknowledgement of the limitations of the methodology (Mosse, 1994). It has since been suggested that PRA should be combined with other techniques of data collection to overcome the weaknesses it reputedly has and that a successful marriage of techniques is that of PRA and GIS (Mapedza *et al.*, 2003)

2.6.3 Satellite remote sensing and GIS as a tool for monitoring land use change

Remote sensing provides a promising technique for monitoring land use change temporally at large spatial scales with imagery available from the time that the first earth resource satellites were launched over three decades ago. Whereas traditional methodologies for assessing land use change provide data for often localised areas (normally in the form of aerial surveys, comparison of maps of the area or of groundcontrol point photographs), they are inadequate as a means of analysing the spatial patterns of land use change over a large area. In the case of the Monduli district, Tanzania, such material is rare and if available, hard to access. Satellite remote sensing, however, allows frequent and quickly accessible/continual monitoring of land use over large areas with data easily accessible to individuals and organisations via the World Wide Web.

Digital change detection, the process by which change of an object or phenomena is observed from satellite images taken at different times (Singh, 1989), is increasingly being used to observe changes in vegetation patterns over a large spatial extent. There are many diverse methods of analyzing land cover change using satellite imagery but many of these require images from the same sensor at different dates (Bergen *et al.* 2005) and depend on the features of the sensor itself. This can be a problem when wanting to conduct a time-series analysis starting prior to the 1990s as there were only a few sensors in operation and their coverage is extremely limited before this decade. Common methods include vegetation indexes and classification (Serneels *et al.* 2001). A classification is when the remote sensing software uses the spectral information in the image to define different types of land use. However, these techniques are reliant on good knowledge of remote sensing software and can be very time consuming. Ultimately, in trying to link PRA, remote sensing and GIS, it is hoped that a methodology could be developed that anyone with a basic understanding of computers

could use if given some basic instruction. A far less technical approach but comparably time efficient to the refining process of a classification (if only interested in change in one type of land use) would be to digitally 'trace' agricultural areas, creating vectors which can be added into a GIS system and further analysed in the context of other resources.

Whilst GIS offers the advantage of adding a spatial dimension to data, it also, in the form of participatory GIS, can inform communities in spatial decision-making (Abbott *et al.* 1998). For the most part, uptake of GIS in the PRA and RRA fields has been slow, mainly due to the expense and the perceived complex nature of the technology otherwise defined as its 'elitist and anti-democratic nature' (Ghose, 2001 p142.). However, there have been some explorations into this 'grey' area. For instance, a paper published in 2003 on forestry land cover change using GIS and participatory mapping, showed that there no longer needs to be a divide between scientific data (that gleaned from remote sensing) and human information (gained from interviews). The researchers successfully integrated participatory mapping outputs into their previously constructed forestry GIS finding that the participatory mapping revealed detail undetectable using aerial photo analysis alone (Mapaedza *et al.* 2003). It has also been used successfully to combine 'official' spatially-referenced data with indigenous geographical knowledge to produce risk maps for impacts on communities of landmines in North-West Cambodia (Williams and Dunn, 2003).

Therefore, it is of mutual benefit for the stakeholders involved to ascertain the driving factors of agricultural expansion, the resource problems and conflicts within the area as perceived by its inhabitants and solutions which can help make agriculture in the area more sustainable. Only by integrating PRA methods with GIS and satellite image processing outputs can such a synopsis be possible. The thesis trials this theory, examining in detail the combination of the outputs from the different techniques, focusing on changing land use in one village and providing a comprehensive overview for the southern part of the Burko hunting block, taking into account the resource problems of six villages within the area.

2.7 The project area

2.7.1 Location

The Burko hunting block, which contains the six villages this project focuses on, is located in the Monduli District, (part of the Sepeko Ward, in the Kisongo Division) just west of Arusha in Tanzania, in the continent of Africa. As can be seen from the Burko hunting area incept in Figure 2.2, the six villages are all located in the southern area of the Burko block, at different altitudes. Nanja Sub Village is a sub village of the village of Mti Mmoja but for the purposes of this thesis will be referred to as just a 'village'.

The villages are a result of the 1970s villigization programme. The village of Lendikinya was established in 1974 and at the time consisted of all the villages in the project area. It has only been recently (1999-2000) that Lendikinya has been carved up and Mti Mmoja, Arkaria and Arkatan have become separate villages in their own right.



Figure 2.2. A location map to show the Burko Hunting Block (bottom right insert) and the 6 villages within the project area, with relevance to the location of the hunting block in Tanzania and the content of Africa

All of the villages have at least one main dirt road which links them with the Arusha-Manyara tarred main road (apart from Mti Mmoja which lies alongside the tarred road). More detailed information for each village can be found in figure 2.3.



Figure 2.3 Village fact files surrounding a map of the project area based on a Landsat 200TM satellite image spatial subset. (Data source: CORDS 2005)

2.7.2 Natural Environment

The area lies in the rain shadow of Mount Meru. What little rainfall the area receives (a range of 700mm-1200mm) is mostly in the form of bimodal relief rainfall with the "short rains" in November-January and the "heavy rains" during March-May (CORDS, 2005). The climate is described as 'semi-arid' (Mwalyosi, 1998). Most of the villages consist partly or totally of the Maasai plains with some villages incorporating parts of the Monduli Highlands. Geologically, the Monduli Highlands are of volcanic origin. These mountains are covered by sub-humid montane forests ecosystems which are the traditional dry-season grazing reserve. They are also designated as wildlife protection areas (Mapinduzi *et al.* 2003). Vegetation in the area varies according to altitude with the plains at the lower altitudes consisting of short grasses, acacia trees, shrubs and also agriculture (the majority cultivate maize and beans). The vegetation of the higher altitudes consists of dense woodland although there are patches of cleared areas for agriculture and settlements.

Sources of water in the area are mostly man made. There are a few natural springs but the majority of the population rely upon small dams (patches of land dug out before the rains) and rainwater harvesting. Some people travel by foot (often for 4 to 12+ hours) to the bigger dams, especially during the dry season when the smaller dams dry up, such as Soiminen, Monduli Juu. Many women have donkeys to help them bring back the required water. There are a few water taps in the area. One such tap in the area is located within the Tanzania Military Academy area, south of the Arusha-Manyara road. During the dry season the majority of the population have to supplement their water supplies by buying water from trucks that come from Arusha, Duka Bovu and Monduli at 200-500tsh per 20L depending on the distance of their tank from the tarred road (source of all data: this project). This expense is hard to meet for those with little or no regular cash income.

2.7.3. Current land use and related issues

The land is still used and managed according to the Maasai pastoralist traditions. Annually the livestock routes and pastures are debated and finalised. There are strict rules as to which pastures can be used for grazing and which must lie fallow in order to ensure regeneration of the fodder. Due to the limited number of water sources and grazing lands in the dry season, these areas act as foci for livestock disease transmission, especially those diseases passed on by insect and bacterial vectors.

Agriculture is the other major form of land use in the area. The majority of the Maasai practice smallholder cultivation of maize and beans. As yet there are only a few cases of extensive commercial farming in the area. Stakeholders in the area are concerned that the recent appearance of extensive gullies (Plate 3) is a result of agriculture on land that is geologically and climatically unsuitable.



Plate 3 Extensive gully erosion in Arkaria. (source: author)

2.7.4 Case study village: Arkaria

Arkaria, formerly part of Lendikinya was registered as a village in 2000. It consists of the main village area and two sub villages; Oloodulolkaria and Ormaroroy with a total population of 1766 people, 838 men, 928 women (CORDS 2005). Its altitude varies from 1409m in the southern part to 1791m in the northern part (source: data from this project)

The southern part of Arkaria consists of a flat grass plain, used for grazing livestock. It also contains a depression known locally as Nancha. Nancha was formerly a water reservoir until the 1970s when it stopped retaining water due to siltation and infiltration sheer (CORDS 2005).

The middle part of the village was formerly bush land but has been cleared for agriculture. The northern part of the village is located in the Monduli Highlands and is covered in a dense forest ("Entim Ormong'l) providing a source of building materials, firewood, medicinal herbs and grazing during the dry season (CORDS 2005).

CHAPTER 3

METHODOLOGY

The methodology used in this thesis is based upon the ideology of Participatory Rural Appraisal (PRA). It is hoped that this methodology could be repeated by lay persons if they were to receive the right instruction and have access to the relevant equipment/ software. Furthermore, it is quite possible for the outputs from this thesis to be used as the basis for a resource management and monitoring tool by any of the stakeholders. In the context of resource and land usage, the key stakeholders are the Maasai communities, CHCWP, government agencies and NGOs assisting/providing delivery of key services.

Part of the methodology employed in this thesis (PPPM) was also used to ensure that the data collection exercise benefited the participating communities by demonstrating to the Maasai a technique that they could employ in their own meetings about resource and land related problems. The preliminary findings of the fieldwork were presented to, and were well received by, the Maasai. Of particular note was that the attendees expressed their gratitude to the research team for enabling them, in their own words: "to see our problems with a new eye", this confirming the value of the PRA ideology.

The methodology used in this thesis incorporates a range of techniques including a partial census, People's Problem Perception Mapping (PPPPM) and Participatory Visual Analysis (PVA). The data obtained through these sources was combined with a Geographical Information System (GIS) that incorporated field vector layers created via digitization and shape layers based on data collected from the partial census as well as the spatial distribution of resources (partly data from CHCWP and partly data collected in this project).

Figure 3.1 overleaf is a model that demonstrates (in a simplified form) how the techniques (triangles) are used to gain information and data on Maasai livelihood strategy drivers and the adopted strategies (rectangles).



Figure 3.1 A model of the data capture techniques used in this project.

3.1 Land use change

To estimate land use change in the form of agricultural expansion, three georectified satellite images acquired by Landsat sensors were used (Table 1) taken in the years 1987, 2000 and 2005. The images have a resolution of 30m per pixel. All of the images were

	1987 (25 th ebruary)	2000 (21 st ebruary)	2005 (12 th March)
Sensor	TM Landsat 5	ETM+ Landsat 7	ETM+ Landsat 7
Path	168	168	168
Row	062	062	062
Cloud	A few wispy clouds	None	Extensive heavy clouds
contamination			especially over Lepurko
over project area			

Table 1 Details of the satellite images used

taken just after the 'short rains' which explains why water and moisture in the ground can be seen. Although Landsat 5 and 7 are different instruments, the first five bands of ETM are identical to those on Landsat 5 and have the same spatial resolution (Lillesand *et al* 2004). This makes it easy to cross compare the images. The bands vary spectrally with Band 1 (blue), band 2 (green), band 3 (red) band 4 (reflective infrared)
and band 5(mid infrared). Band 3 is one of the most important bands for vegetation discrimination. Band 4 is extremely responsive to the amount of vegetation biomass on the image and Band 2 corresponds to green reflectance of healthy vegetation (Jensen 2000). These three bands were used to form a colour composite in ENVI of each of the satellite images.

Originally, the land within the project area covered in fields was to be mapped by running a supervised classification in the Environment for Visualising Images version 3.6 software (ENVI). However, after several attempts this methodology was aborted because the outputs were too inaccurate to use; the spectral classes were not differentiating between agricultural fields and other land uses and did not appear to improve substantially when training data was added to guide the classification.

Instead, the methodology actually employed in this thesis was based upon visual interpretation and digitisation of fields. This was developed for each village by creating a vector layer of the fields in each satellite image using the Regions of Interest Tool in ENVI and converting the ROI output into a vector layer (Figure 3.2).



Figure 3.2 The process of mapping agricultural land use

3.1.1 Limitations with using satellite data

Ideally, ASTER data would have been used which has 15m pixel resolution (compared to 30m resolution of Landsat TM imagery). Unfortunately, the study area lies in a 'data gap'. The only images readily available were the Landsat TM 1987 image, the 2000 image and the 2005 image. Due to satellite damage, the 2005 image had to be reprocessed with corrections for data gaps. The missing image pixels were replaced

with estimated values, derived from the 2000 image by the United States Geological Survey (USGS).

Whilst image processing techniques such as running a classification or a vegetation index can produce very accurate results of land use based on spectral information, they are vulnerable to contamination of the image, especially cloud contamination. Both the 1987 and the 2005 image have cloud contamination over the project area that is too extensive to accurately correct for.

3.1.2 Limitations of the digitisation method

Physical inspection of the areas included within village boundaries determined by Monduli District Council (MDC) suggested that they might not be wholly appropriate. For instance, in Arkaria, a whole sub village according to the MDC boundaries is actually located in Lendikinya. Therefore, for the purposes of this project, where possible, a combination of local knowledge and the boundaries contained within the GIS have been used to work out the spatial area of each village.

Visual interpretation can result in errors. It is possible that areas of shadow/water could have been mistaken for agricultural fields especially as in terms of shadow, cloud contamination can generate geometric shapes that resemble fields but are actually shadow. Further, because the images were acquired by the sensor just after the rainy season, there is a lot of moisture visible in them which, because of its dark colour when displayed, can be mistaken for cultivated land. These mistakes can be corrected for if validating the image from the ground but only the 2005 image could be validated by ground verification (locations of fields, water resources and different types of vegetation) and this in itself can only be a rough validation because the image was taken in March 2005 and validation occurred in July 2005. Consequently, accurate visual image interpretation is critical to the reliability of the results.

3.2 GIS

A GIS was compiled from data already collected by CHCWP (roads, contour lines, location of schools and villages, drainage features, estimates of village boundaries and the boundary of the Burko hunting block), data collected in the field (locations of bomas interviewed in the Arkaria partial census, grinding mill machines, kiosks, small

dams, dispensaries, village offices, chairmen's bomas and GPS control points for different types of vegetation) and the spatial subsets of the satellite images.

3.3 Partial Census

A partial census in the form of a semi-structured interview of the bomas in Arkaria was undertaken in order to collect information on a range of topics relevant not only to this project but also useful for our collaborators (a copy of the questions asked is attached in APPENDIX B).

The fieldwork was carried out over a period of three weeks in June 2005. Prior to this project, there was no map of Arkaria showing the location of bomas, nor were there any accurate records. Therefore, random sampling could not be conducted. Instead, it was decided that within the time frame dedicated to the data collection, the research team (the author and two Maa translators, 1 male, 1 female) would interview as many bomas as possible and ensure that both sub-villages and a range of elevations were covered. The chairman of Arkaria informed us that there were approximately 180 bomas in Arkaria. Participants representing 102 bomas (see figure 3.3) were interviewed. Of these, 8 participants represented bomas situated in the most inaccessible parts of the sub villages and, for this reason, we interviewed them at the kiosks in central Arkaria. The remainder of participants, the majority, were interviewed in their respective bomas. Although at a later stage we did conduct interviews in these participants' sub villages, we were able to avoid interviewing the same boma twice as the translators remembered the family names of people they had already interviewed.

Taking the Chairman's figure of 180 bomas in Arkaria as an accurate total, the partial census covered 56% of the number of bomas in Arkaria, which should render the statistics representative of the population with a good sample size. As can be seen from figure 3.3, the partial census covered the majority of the inhabited areas within Arkaria. It must be noted that, in the absence of an official census, the estimate of 180 bomas lacks official ratification. 1,515 people were accounted for within the 102 bomas interviewed. According to the CORDS (2005) socio-economic profile for Arkaria, the total population is estimated to be 1,766. Therefore, this indicates that the census results are viable for 86% of the population of Arkaria.



Figure 3.3 A map to show the location of all the bomas questioned in the partial census.

Approximately two thirds of participants were women as the field work could only be carried out during the day because of the risk of attack from wild animals after dark. We tended only to be able to question men if there had been a nearby political meeting or if we managed to meet them before they had taken out the livestock to graze in the morning.

3.3.1 Limitations of the partial census

For the majority of the fieldwork the research team had no access to a vehicle, so our progress was hampered by the time it took to walk to each and between each boma. Furthermore, we only had one Global Positioning System (GPS) so had to retrace our steps many times to collect the boma locations. Had we had more regular access to a vehicle and another GPS we would have managed to carry out a full census within the time spent in the field. However, whilst this is a limitation to the data collection, in many ways, because members of the community saw us walking every day from the boma we stayed in we became part of 'village life' after only a few days.

There were a few incidences when, after we had explained why we were carrying out the questioning and who we were collaborating with, participants asked what material goods they would get in return. This was because a researcher in the area the previous year had given a small gift, a cloth or some maize in return for the participants' time. Usually, once we had explained that, ultimately, the answers they gave would be used by the NGOs who collaborated in this project to help them, participants agreed to answer the questions.

3.4 Participatory Visual Analysis

Three PRA techniques were carried out during the months field work.

3.4.1 Participant Observation

This is "the process of collecting data from observations made during the course of participating $i t e e e a \square e t$ " (Robson and Willis, 1997). This technique did not take up any extra time but did act as a triangulation tool. Information gained chatting over lunch reaffirmed that the answers gained from the interviews in the partial census were given freely and were not restricted. If an answer to one of the questions in the partial census was a little different or provided new knowledge, we later pursued this with extra questions. Had the research team not stayed for the duration of the field work in a local boma in Arkaria, we would not have had the respect we did have shown to us from the community and the answers to our questions might not have been so forthcoming or full of information. As it was, many of the participants could see the long term benefit of taking the time to answer our questions.

The situation was further helped as the two translators were both true Maasai and educated and the female translator's family were from Mti Mmoja. This, after the

initial period of scepticism at seeing a white person in Maasailand had worn off, won us instant trust and honest answers.

3.4.2 Photo-visual analysis

This was conducted with the Chairman of Arkaria with the purpose of eliciting information that would add context to the statistical findings of the partial census. The Chairman was given a disposable camera and asked to use half of the film to take photographs of places/things that had changed dramatically and also of places/things that had not changed at all. The other half of the film was allocated for his own personal use.

Initially, it had been planned to give out 6 disposable cameras to people in the different sub villages. However, the Maasai are very suspicious of any photographic equipment as the common belief is that the white person takes a picture and then makes thousands of dollars from that picture. Also, apart from mobile phones, there is really very little electrical equipment in Maasailand. The camera was politely declined by two men with suspicious eyes before it was decided to abandon the technique. However, the Chairman was more than happy to carry out the exercise. He had many photographs on the wall of his meeting house from white people who had visited in the past and so had no fear of the camera. He dispatched one of his sons off to various places to take the photographs. The discussion we had once the photographs were developed was extremely interesting and rewarding. This technique worked very well with the Chairman as it drew into conversation issues surrounding resource management in the area that all other methods of data collection had not managed to reveal.

3.4.3 GIS Participatory Mapping

The aim of this method was twofold. Firstly, it was hoped it would verify resource locations in the area and highlight any that possibly had not been noted through other collection methods. Secondly, it was to give the Maasai a chance to look at the GIS of the area and to see for the first time a view of their land that a bird might see. Their grasp of spatial understanding of the image was excellent as was their understanding of the GPS when we explained what it was to them (which we did at the majority of bomas). The participant was given an A2 sheet of paper and many different coloured



Plate 4 RRA, participatory mapping with a young Moran

felt tips. The technique worked well because a young Moran did the first map (Plate 4) and then later we were chatting to the Chairman about it and he said that he and his friends could do better. So then he had a competition with one of his friends and we got another 2 maps. One was composed by a man directing one of our research team members to draw what he described. Interestingly, this gave by far the most accurate map of the ones that the data collection team compiled. Combined, the 3 maps provide very detailed information of Arkaria.

3. People's Problem Perception Mapping

This methodology is built on the basis of Smith *et al's* Participatory Risk Mapping (2000). Whilst the theory behind it is beautifully simplistic yet effective: to get populations to classify and order the sources of risk they face, it lacks a crucial feature of understanding risks; it lacks the temporal component of risk. What is more, as explained in Chapter Two, the definitions used for risk are somewhat theoretical when in practice it was found that participants understood 'risks' to mean 'problems'.

People's Problem Perception Mapping is therefore based on the concept of participants identifying and ordering problems encountered when trying to provide for themselves and their families. At the same time as ordering the problems according to the most important through to the least important, participants were asked to assign each problem a frequency of occurrence.

3. .1 Pilot Study

A pilot of the methodology was carried out in Mti Mmoja and from this pilot study a guiding categorised list of problems was constructed. The organisation of the categories followed the theme of capital assets as used by Quinn *et al* (2003) in their application of Risk Perception Mapping. We found that the methodology agreed upon and outlined below worked well. Modifications to the methodology were therefore small, consisting of deleting a few questions from the individual PPPM semi-structured interview (due to excessive time taken to complete) and working out a priority for discussion topics with the groups after they had finished the identification and ordering exercise.

3. .2 Group work

For each village, we arranged with the village chairman in advance for him to agree a day on which a group of men and a group of women would be ready to participate in the process. Where possible we asked that the group be a minimum of 7 people and a maximum of 15 people (any more people and the ability to discuss and debate different issues is lost) (see Table 2 for numbers of participants).

Village	Group Gender	No. Participants	Location of meeting
Mti Mmoja	Male	6	Chairman's house
Mti Mmoja	Female	9	Church
Arkaria	Male	11	Under meeting tree
Arkaria	Female	9	Under meeting tree
Lepurko	Male	9	In a disused house in NSV
Lepurko	Female	10	At a boma
Lendikinya	Male	12	In temporary village office
Lendikinya	Female	28	Outside of church
			(hence the high turnout)
Arkatan	Male	12	In the primary school
Arkatan	Female	15	In the primary school
Nanja Sub Village	Male	6	In the Chairman's boma
Nanja Sub Village	Female	7	Outside, near the chairman's boma

Table 2 Information of location and number of participants in each PPPM group

On the day of the PPPM in the village, we first of all gave an introduction, outlining the purpose of the exercise and what it involved.

Problem Identification:

The group was asked $t e t \Box t e le te \Box a e \Box e t \Box t \Box e t e e \Box e a$ $t e a le t t e le te \Box a e a atte e t a t e le te \Box t t e$ $e e e t \Box \Box t \Box a e a t e t e \Box e a$.

Problem Ordering

The aim of the ordering was to gain an idea of the way in which people perceive the relative importance of each problem they had just identified. We started the process by explaining that *"we would like you all to think about w* $le \square \square t$ ta t $le \square \square lea t$ ta t $le a \square e e all t e t e$ le t t e ale.."

The participants were allowed to rank more than one problem at the same level but only if they asked to do so.

Frequency of occurrence

Participants were asked how often each problem occurred/was encountered. The options were: daily, weekly/monthly, seasonally/yearly and rarely.

Discussion of solutions to the problems identified

The groups were asked what the community had done to try to solve each problem and what they would like to do to solve the problems both in the present and in the future.

Extra information for collaborating NGOs

We also collected information (dependent on how tired the group was) on a range of issues our collaborators were interested in.

3. .3 Individual PPPM exercise

As this methodology is based on RPM, and as RPM had only been carried out on individual participants, it was thought important to test whether the group work would represent what problems individuals in the community face.

Problem identification and ordering:

The PPPM for the individual participants (Table 3) was the same as for the groups

Table 3 Information on the number and gender of individual participants interviewed

Village	Number of	participants	Location of the Majority of the interviews
	Male	Female	
Arkaria	5	5	In participant's bomas
Arkatan	6	4	In participant's bomas
NSV	0*	9	In participant's bomas
Lendikinya	4	6	Under the tree opposite church or in boma
Lepurko	5	6	In participant's bomas
Mti Mmoja	7	3	At the tree, next to the main road

*There was a political meeting at the same time as we were interviewing so no men were available

Extra information

We also asked questions relating to land use change and livestock numbers in order to see whether the trends shown in Arkaria are similar to the area in general. Questions relating to opinions on equal opportunities in development, feelings on women earning money and attitude towards sending Maasai children to school were also asked for the benefit of collaborators (for original questions see APPENDIX C).

The following hypothesises were devised to be tested:

Hypothesis 1: That the group data does represent the problems faced by individuals in the community and is an unbiased process.

Hypothesis 2: That the problems identified by the group would show if the Government's perception that the Maasai have no interest in participating in Tanzania's national development is right that they lack any identification of problems with social assets.

Hypothesis 3: That the PPPM methodology could be repeatable both in terms of the communities' willingness and in the requirements that the methodology does not require specialist training.

3. .4 Presentation of preliminary results from the risk perception mapping to the villages

This was carried out in Arkaria. We invited all 6 village chairmen. Unfortunately, there was a political meeting on the same day so only 3 of the village chairmen were present. The meeting was held in Arkaria and many other male inhabitants attended the meeting. During the meeting the ways in which the villages could use the data in the reports to ask for support from organisations was explained. The research team explained briefly that in the meeting we would discuss the amalgamated results for the area. We discussed in order of importance (gained from the RPM graph) the risks raised by the majority of groups and the solutions that had been mentioned. We tried to draw into the meeting examples of where the villages could work together to try to solve their mutual problems. This meeting was an important part of the methodological process not only because it empowered the participants with

cumulative knowledge for the area and encouraged them to think in a more futuristic way about managing resources and prioritising problems but also, because it enabled the participants to highlight a few discrepancies in what some villages had stated about other villages and what the actual truth was.

3. Methods of data analysis.

Partial census

The data was first inputted into EXCEL and converted into a numerical format. Some of the participants' responses had to be converted to ordinal data. The Statistical Package for the Social Sciences version 13 software was used to analyse relationships between the data. If the data was not normal then only non-parametric tests were carried out. Attempts were made to normalise data and were successful with two datasets.

This data was also inputted into the GIS (which was created using Arc GIS version 9 Desktop software) and was analysed visually within its spatial context.

PPPM

From the data collected the following Indexes were created based on the mathematics outlined in $t \ et \ al \ 2000$): Incidence Index (I) 0=identified by no-one 1=identified by everyone

Severity Index (S) 1=most important 2= least important

From these to indexes, a total Problem Index was created PI=I/S. As it accounts for both the incidence and severity of the problem, as the value of PI rises from 0 to 1, so does the seriousness of the problem.

Frequency was then plotted against the PI

Chapter 4 RESULTS & ANALYSIS

4.1 Land use Change

The GIS (Figure 4.1) image gives a visual indication of the change in the area under cultivation during the period 1987-2005. All of the villages appear visually to have undergone significant net agricultural expansion during the period 1987-2005, except for Lepurko (see 4.1.2). This is verified by the land area data (Table 4).

	Land Area	Utilised for Ag Km ²	griculture	Rate of Annual Increase in Agriculture Km ² /Year		
Village	1987	2000	2005	1987-2000	2000-2005	
Arkaria	3.55	8.41	9.38	0.37	0.19	
Arkatan	1.88	3.20	2.56	0.10		
Lendikinya	2.32	3.01	3.84	0.05	0.17	
Lepurko*	12.93	15.42	10.15	0.19		
Mti Mmoja	1.12	3.84	4.37	0.21	0.11	
Nanja Sub Village	0.56	1.62	3.74	0.08	0.42	

Table 4 The changing extent of agriculture from 1987-2005 in the project area

*see limitations, section 4.1.2 This data is not valid.

The data shows that of the six villages, four of the villages continued to increase the area under cultivation during the period 2000-2005 but two, Arkatan and Lepurko, reduced the areas under cultivation, Lepurko to an area that is less than that cultivated in 1987. Of the four villages that continued to increase the area under cultivation during the later period, two increased that area at a reduced annual rate (Arkaria and Mti Mmoja) and two at an increased annual rate (Lendikinya and Nanja Sub Village).

The GIS image also indicates visually a possible relationship between the spatial locations of road and fields within the majority of villages.

4.1.1 Limitations of the data

This area data can only be used as an approximation of agricultural expansion within each village for a number of reasons, the most important of which is that the current village boundaries are still being formalized by CORDS and the Tanzanian Government. The boundaries used in this project were originally created by Monduli District Council (MDC). Also of note is that, prior to 1999/2000, Lendikinya consisted of Lepurko, Mti Mmoja, Arkaria and Lendikinya (CORDS 2005). Therefore, the expansion of agriculture within the area prior to 2000 cannot be directly attributed to an individual village



Figure 4.1 A map to show agricultural expansion within the project area during the period 1987-2005. The field layers are the output of the ROI ENVI methodology and were imported into the ARC VIEW GIS of the project area.

Lastly, as previously discussed in the limitations of the methods, visual interpretation of the image can result in errors of misinterpretation especially as both the 1987 and 2005 images contain cloud contamination over the project area. Visual analysis suggests that there may be two major faults with the Lepurko data. The first is that the land area under cultivation in 2005 is likely to be severely underestimated because of cloud contamination over areas observed to be under cultivation during 1987 and 2000. Secondly, the large expanse to the northwest on the mountainside recorded as cultivation in 2000 may have been image misinterpretation as the area was not previously farmed and the area, whilst similar in reflectance values to other fields, has a shape more akin to forest than geometric fields. Therefore for the purposes of this project the data for Lepurko can not be considered valid. Visual interpretation of the three satellite images suggests little or no change in area assuming fields still lie in the areas covered by cloud in the 2005 image.

4.2 Partial Census results

102 bomas were interviewed accounting for 86% of Arkaria's population. 75 participants were female and 27 participants were male. The gender of the participants should have little effect on the data as most questions were asked in the context of the boma. The average number of people within a boma in Arkaria was 15 people with a standard deviation of 7 people. The smallest boma contained 5 people and the largest boma, 46 people.

4.2.1 Socio Economic Data

The Wealth index was calculated using the following formula (BoxX) Whilst this Wealth

Box X
Wealth Index
(no. cows per household*Market price + no. small livestock per household * Market price)
Household size
Cow=TZS 120,000 Goat/Sheep=TZS 35,000 (source: CORDS 2005)

Index fails to take into account any cash income from other businesses or monetary wealth stored in the bank, livestock are still very much a wealth and status symbol for the Maasai and therefore, from the data collected, this indicative measure of wealth was devised. The minimum wealth value of the bomas questioned was TZS 21,875 and the maximum TZS 4545,000. This indicates a large disparity in wealth within the Maasai of Arkaria which is apparent on observation of the skewness and the kurtosis values of the data (3.022 and 9.861 respectively). These are both positive indicating some clustering at the lower end of the range and a long tail towards the maximum value. Upon visual analysis it was determined that only a few individuals had very large amounts of wealth (Figure 4.2). The level of wealth that will be used as an indicator of



Figure 4.2 A box plot of the original wealth data calculated in Tanzanian Shillings

the boundary between the majority of the data that clusters around the mean of TZS 611,263 and the long wealthy tail is TZS 800,000. The 'outliers' are not errors in the dataset. It is possible to validate them as good indicators of the wealth of the people within each boma because the interviews in which the data was collected, were for the most part conducted in the participants' bomas. These members of the community had many other indicators within their boma (such as farm machinery, cars/motorbikes, houses built from concrete and iron sheeting roofs and big water tanks for storage of water) that reinforced the accuracy of the livestock numbers we were given at the time. It is also not in the nature of the Maasai to lie about the number of cattle they have.

The wealth data had to be log transformed to allow parametric statistical tests to be carried out (Figure 4.3). Only the wealth data and the acreage data showed a normal distribution



upon transformation. Therefore for statistical analysis of the rest of the dataset, non-

A Pearson's Moment Correlation was carried out on the log transformed wealth and log acreage data to see if there was a linear association between the two variables. The Pearson Correlation was 0.496 (significant at the 0.01 level). Taking into account the sample size (n=102) and that 50% of the variance within the data has been accounted for, it is possible to conclude that there is a positive relationship between the two variables.

These results were also integrated into the GIS. As can be seen when comparing the two maps, the similarities spatially between those with small acreages and low wealth and those with high acreages and high wealth are clearly visible (Figure 4.4).

4.2.2 Livestock herd sizes and losses within the past year

parametric tests were used.

There is a large variation in livestock herd sizes with a range of 5 to 780 animals per boma (Table 5). The average herd size is 121 animals. Herd sizes of small livestock

				Standard
	Minimum	Maximum	Mean	Deviation
Total Herd Size	5	780	121.23	155.895
Cattle (including calves)	0	660	52.92	87.399
Small Livestock (sheep and goats)	0	500	66.28	98.261

Table 5 Descriptive statistics of the livestock herd sizes

tend to be larger than those of cattle as demonstrated by the means. The average cattle herd size is 53 cows as compared to small livestock herds which normally number 66 animals. The large standard deviations reflect the differences in herd sizes

A3 Pull out of the boma acreages and boma wealth maps here.

FIGURE 4.4 and 4.5

between the majority of the participants and the wealthier participants. The Maasai in Arkaria have 4 cattle per capita on average.

On investigation of the relationship between the current herd number and the number that had died this year, the distribution of the data indicated that those bomas with the very large livestock herd sizes had fewer or similar losses which compared to those with the much smaller herd sizes (Figure 4.5). This is contrary to the hypothesis that with increasing herd size would lead to a corresponding increase in the deaths of livestock. This suggests that other factors, possibly wealth for instance, have played a part in lowering the expected dead livestock numbers. Wealth would provide extra resources for the healthy maintenance of livestock and thus effect the mortality rate e.g. antibiotics, veterinary attention and chemicals to remove vectors of disease such as ticks.

The average number of cows per boma that died within the past year was 10. An average of 22 small livestock animals also died within the past year. Considering the results as a proportion of the current total herd size of each boma, assuming no replacement (i.e. no livestock born within the year or sold), 23.10% of the total livestock herd of a boma on average died within the last year. There is little variation of this figure between the cow herds and the small livestock herds (22.69% and 26.64% respectively).



Figure 4.5 Scatter plot to show the relationship between the total number of livestock possessed by each boma and the total number of livestock of each boma that have died within the past year

4.2.3 The current status of cultivation within Arkaria

The acreage data of cultivation shows that all the participants had between 0-60 acres with one outlier having 830 acres (the outlier is actually practising commercial farming retaining only 10% of his harvest for household consumption, the rest of his harvest is used as a source of income). It is interesting to compare the wealthy/majority split in the acreage data (Table 6). The wealthy bomas own an average of 73 acres compared to the majority of bomas that own an average of just 7 acres.

0					
	All	Wealthy	Majority		
Av Acreage per boma	17	73	7		
Minimum Acreage	1	2	1		
Maximum Acreage	870	870	21		
No data	1	0	1*		

Table 6 Average acreage of fields per boma according to wealth

The Wealth Index is verified by the acreage data as their relationship shows (Figure 4.6) a general trend that with increasing acreage there is increasing wealth.



Figure 4.6 Scatter plot to show the relationship between the log transformed acreage and wealth data.

The relationship between wealth and method of cultivation was explored. During data collection it was found that there were three main methods of cultivation (Table 7). As only three participants cultivated using manual labour alone, these participants were combined with the manual and traction method and a Ch² test was carried out in order to see whether there was a relationship between wealth of the boma and the cultivation

^{*}no data was recorded -it is likely the question was missed by accident

	Number of participants using each method
Manual labour only	3
Manual labour and traction (oxen power)	53
Manual labour, traction and machinery (tractors)	46

Table 7 Methods of cultivation in Arkaria

technique they used (APPENDIX D). The Chi^2 value of 4.32 was greater than the critical value at p=0.05 so the null hypothesis was rejected and the alternative hypothesis; that the wealth of the participants is related to the type of cultivation technique their boma uses was accepted. This relationship can also be seen when examining the majority wealthy split (Table 8)

Table 8 Methods of cultivation All Wealthy Majority 3% 3% Manual 0% 52% 31% 56% Manual & traction Manual, traction & machinery 45% 69% 41%

When the participants were asked the reason why they practised cultivation today, all responded by saying that their harvest provides, in differing proportions, food for household consumption and a cash income. It is notable that 35 participants cultivated for household consumption only and that no participant cultivated for income only. As can be seen from the data in Table 9, there is little variation in the responses of the wealthy and those of the majority. The average proportion of harvest used for household consumption was 74% compared to 26% for income with a standard deviation of 7%.

Table 9 Reasons for currently cultivating (all participants questioned cultivate currently)

_		All	Wealthy	Poor
	Consumption	70%	67%	71%
	Income	43%	50%	42%

4.2.4. Exploration of the factors leading to uptake of cultivation.

Whilst all of the participants gave reasons for currently cultivating in terms of income and household consumption, their reasons for first starting to cultivate were very different and varied (Figure 4.7). Over a third of participants commented that they were influenced by others (observation during dry season migration of other tribes and colonial settlers farming). Other important deciding factors were reduced herd sizes (due to disease and/or drought) and food.



Figure 4.7 A flow diagram to show the reasons cited by the participants as to why they first started cultivating. (3% participants gave no reason)

When these reasons are mapped out spatially, certain trends become apparent (Figure 4.8). In the sub-village of Ormaroroy, many of the participants cited the experience of drought as the main reason why they took up cultivaiton. They are living interspersed with Il-Arusa who knew how to farm from birth. It is interesting to draw in the data gained from another question asked which was "how did the respondent learn to cultivate". Within this sub village, of the 15 bomas questioned, 8 participants gave the reason of a form of interaction with the Il-Arusa (marrying Il-Arusa, observing neighbours, being taught by them) and 5 bomas were Il-Arusa and had learnt from elder members of their family. The majority of bomas in central Arkaria were influenced by others. Most participants said that the men had observed Il-Arusa farming whilst herding cattle in the dry season. Other influential sources were the government through government initiatives and also the Ikisongo (through marriage).

At the centre of Arkaria their appears to be a pocket of 4 bomas that started cultivating following significant loss of stock due to disease.

A3 pullout here of reasons for uptake of cultivation and also of year of uptake.

The bomas in the sub village of Oloodololkaria show, on the map, a variety of reasons for starting to cultivate. Approximately half of these bomas (either side of the road) commenced cultivation due to drought/hunger.

Throughout Arkaria bomas that started cultivating often did so due to initial observation of other people. Whilst participants mentioned tribes such as the Chagga, Ikisongo, lltatwa and colonial settlers, as well as the government, the majority said that it was observation of the Il-Arusa, and trading with them for maize, that made them realise the potential for subsistence that cultivation offered.

The driving factors of this livelihood and land use change are further illustrated by the year of commencement of cultivation (Figure 4.9). A large majority of participants started cultivating during the 1980s. As previously mentioned in the literature, this was shortly after the villigization programme had hampered the traditional transhumant pastoral lifestyle, there were also terrible droughts during this period and it was also a time of economic crisis. It is also interesting to observe the spatial distribution of the decades in which different bomas started to cultivate. As can be seen in Figure 4.10,



Figure 4.10 Year of commencement of cultivation (2 participants did not give answers)

those that began cultivating earliest, before the 1980s, were mostly located in Oloodololkaria and in the mainly Il-Arusa sub village, Ormaroroy. The 1980s saw uptake across Arkaria. Commencement by a few bomas during the 1990s or later seemed to occur mainly in central Arkaria and Oloodololkaria. No uptake of cultivation post 1990 occurred in the bomas questioned in Ormaroroy.

4.3 People's Problem Perception Mapping Data

4.3.1 Verification of the PPPM data using the case study partial census data.

At the same time as collecting data to analyse resource problems within the project area, similar socioeconomic data was collected to that in the Arkaria Partial Census. The wealth data of the project area shows a similar distribution to that of Arkaria (Figure 4.11) and therefore verifies the application of the wealth index. The Log means are very similar: 12.56 for PPPM data and 12.80 for the Arkaria data.



Figure 4.11 The similar wealth distributions: Right is the histogram of the wealth of the project area (60 individuals from the PPPM data although one person did not give their household size so has no associated wealth value) and left is the histogram of Arkaria's wealth (from the partial census data).

The current acreages per boma are distinctly smaller for a boma within the project area compared to that of a boma in Arkaria (Table 10). However, this could be because only 60 people, 10 in each village were questioned in the PPPM data. The sample size for this data set compared to the population in the area is too small to allow for anything more than generalisations.

0 0		0
	All Arkaria	All PPPM
Number of participants	102	60
Av Acreage per boma	17	12
Minimum Acreage	1	2
Maximum Acreage	870	55
No data	1	3

Table 10 Average acreage of fields per boma according to wealth

*no data was recorded -it is likely the question was missed by accident

The reasons for currently cultivating and the proportions of harvest used for household consumption and income are nearly identical between the two datasets. The proportions of participants using the three different methodologies also show similar percentages (Table 11). There is a slight 'reversal' between the Arkaria participants and the PPPM participants in the traction and machinery data.

	All Arkaria	All PPPM
Average % harvest used for household consumption	70%	74%
Average % harvest used for income	43%	42%
Manual	3%	3%
Manual & traction	52%	43%
Manual, traction & machinery	45%	52%

Table 11 Reasons for currently cultivating and methods used (all participants questioned cultivate currently accept for one individual in PPPM who is awaiting plot allocation)

A difference in field ownership was noted from information participants gave. A few participants (from Mti Mmoja and Nanja Sub Village) said that they did not own their farm land. Rather, it was in the army area. Currently, the army is restricting the people of Nanja Sub Village to 3 acres per boma (the army is using a large tract of Maasai land south of the Arusha-Manyara tar road. They restrict Maasai use of the land). This differs from the protocol of ownership described residents of Arkaria and many from the other villages. These participants said that they owned their land in the eyes of the village (their community). The land is allocated and/or approved for cultivation by the village leadership and is only allowed to be sold with the approval of the leadership.

4.3.2 People's problem perception mapping: methodological result and overview

Problems identified by the 60 individual participants and the 12 groups (comprising of 134 participants) were grouped into 28 categories of problems. Following the sustainable livelihoods approach and the techniques employed by Quinn *et al* 2003, these were then broadly defined in terms of the capital assets on which livelihoods depend: natural, financial, human and social (APPENDIX E).

Although the methodology used in this project differs from the RPM methodology, the results for the 'problem map' are directly comparable to the 'risk maps' created by Smith et al. (2000) and Quinn *et al.*2003 (Figures 4.12-4.15). By plotting the incidence index against the severity index a problem/risk map is produced. This can then be divided into quarters to represent the relative importance of the problems/risks (Figure 4.16).



distribution of problems across the quartiles to the risk maps (Figures 4.14 and 4.15)

with the notable difference that 2 'problems' appear within the individual problem map at the highest importance end of the 'brought up by many, high importance' quartile. No risks in the risk maps appear to have this positioning. It is notable that these problems are of water. The position of water in the risk maps shows that less of a majority brought up the problem and that they gave it a smaller severity value.

The distribution of problems within the group data problem map (Figure 4.13) is different from the other three graphs in that it contains some problems in the upper right quartile. One might have expected the data to have shown greater similarity to Smith *et al.*'s risk map because their data was from pastoralists rather than agro-pastoralists/mixed farmers. However, its distribution of problems is more akin to those of Quinn *et al.* (2003) due to the large number of problems with an incidence of between 0.2 and 0.5.

Having looked at the overall patterns of distribution, it is interesting to now compare how the positioning of problems related to different capital assets and how the results from this project relate to those of Smith et al. and Quinn *et al* (Table 12).

For the data from this project, in general, water was the most frequently mentioned problem and consistently given a high ranking by participants, be they individuals or groups. Both sets of participants give water for humans greater importance than water for livestock. Medium to severe problems consist of a mixture of problems from the natural and social assets; education, weather, healthcare and livestock diseases. The individuals give these problems lower incidence than water but the groups give weather and education the same 100% incidence. The least important problems seem to consist of a mixture of financial, human and social capital assets.

Comparison of the individual and group data shows some differentiation in perceptions of the main problems the Maasai in the project area face. The group data shows consistency in the ranking and placement of problems such as education, weather, healthcare and livestock diseases. In the individual data, it is evident that there is less consistency with many problems given lower incidence and higher severity values. This is

	i	TIANTA TA SUITINALY OF TAULUAL	an midners of the set of Group set and the Group set of t	
Capital Asset	Category	Problem maps (This project)	Risk map from Smith et al. (2000)	Risk map from Quinn <i>et al.</i> (2003)
	Water	In both maps water was given the highest severity (approximately 1) and had a very high incidence with nearly all participants bringing it up	Water was given a lower (but still a high value) severity of approximately 1.35. It was brought up by 70% participants	Water was given a lower (but still a high value) severity of approximately 1.30. It was brought up by just 55% participants.
ZAFDa	Weather	70% of the individuals gave it a high S value a little below 1.5 (it must be noted that often participants first said hunger and were then asked to further clarify what caused the hunger e.g. drought). All the groups cited it as a problem but gave it a severity value closer to 1.6	Not identified as a risk	Approximately 25% identified weather and gave it a severity value of 1.4
LAR	Forest, land, livestock disease and wild animals/pests	These were placed in the brought up by few, low importance quarter by individuals and the groups apart from livestock disease which was brought up by 75% groups and given a high S value of a little over 1.5. Wildlife had a low incidence but was given a higher S value by individuals	Land being pasture and wild animals being 'crop dest', these were also in the low severity, low incidence quarter although both were given S values between 1.5-1.6. Forests (access to/destruction of) was not identified.	Forest, pests, land and livestock all had a low incidence. However, land, livestock and pests had higher S values between 1.5-1.6
Η Η Ζ	Veterninary services and agri-inputs	These were both given low S values and low I values by te individuals. The group gave agri-inputs a low I and low S but gave veterinary services approximately S=1.4 with an incidence of 40%	'tools' were given a high importance, S=1.3 but a low incidence of less than 10%. Veterinary services were not identified	Agri -inputs were given a high severity index of approximately 1.45 but a low incidence. Veterinary services were not identified.
ΓΥΓΟΝ	Finance, Markets, Moncy and Poverty	For the individuals finance, markets and money were all within the brought up by few, low importance quarter. Poverty had a low incidence but was given an S value slightly lower than 1.5. The groups placed finance markets and money in roughly the same places but poverty had a higher incidence (0.5) and was given greater importance with a lower S value (1.4)	The only financial category was 'prices' (the price of livestock) which had a low incidence and a severity score of 1.6	Finance and markets were placed in the brought up by few, low importance quarter. Poverty and 'money' were not identified.
$H \supset \underline{N} \land Z$	Disease, population, pressure, pregnancy and work load	Disease, population pressure and work load were all put in the brought up by few, low importance quarter by individuals. They did not identify pregnancy as a problem. The groups similarly identified and positioned population pressure with pregnancy nearby. Workload was given a higher I and a substantially higher S value of 1.35 as was disease which was identified by 40% groups and given a high S value of a little over 1.5	Sickness (human illness) was identified and given a very low incidence (10% participants) but a high importance: S= approximately 1.2. Population pressure, pregnancy and workload were not identified.	Disease was brought up by just over 45% of the participants but given a less important S value of 1.6 Population pressure, pregnancy and work load were not identified. Hunger was identified by 30% participants given an S value of just over 1.5. Food availability had the highest I value (0.75) and a low S value (1.4) Age was also identified with high importance (S is approximately 1.10) but extremely low incidence.
L A L C O S	Health care, transport, education, development support FLA, GMM, security, church, VO & WR	Health care and education were given low S values of 1.55 by individuals. The rest were of low incidence and importance. The groups prioritized education and health care with high incidence and low S values (1.3-1.5). They also gave higher incidence and lower S values than the individuals to transport and development support All were brought up with low incidence (although individuals didn't identify church) but the groups gave higher importance to FLA and the individuals gave higher higher importance to the grinding mill machine.	Clinic was brought up by approximately 40% participants given S value of 1.65. "School" (School fees) and transport had similar S values but lower incidence values. Development support was not identified. Development support was not identified. Access to shops and having to relocate were identified with very low 1 and high S values. Conflict (crime) had S value of 1.35 but a very low incidence. Church, FLA, GMM, VO, WR and security were not identified.	Hospital and transport were identified by 40% participants with low S value of 1.45-1.5. School was given a similar S value but had a lower incidence value. Support had a very low incidence value. Support had a very low incidence value and a high severity value of approximately 1.75. Access to shops, theft of cattle/crops and witchcraft were identified as problems (very low incidence and v. high S values apart from shops which had severity were not identified.

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especially evident when comparing Figure 4.12 and Figure 4.13. Figure 4.12 shows that many problems have been identified and ranked as being very important by less than 20% of the participants ($I \le 0.10$) whilst Figure 4.13 shows a trend within the groups of increasing severity (decreasing importance) with decreasing incidence, indicating greater consistency compared to individuals in their identification and ranking of problems. The individuals were more inclined to think only of their personal and immediate problems. For instance, one participant within the individual data gave wildlife the highest importance ranking. When pressed for further information it was found that his crops had been raided by a bush pig the night before the interview. This example demonstrates the importance of relying on group work to represent the problems of the village for at least that season rather than just for that particular day. When the groups identified wildlife as a problem, they gave it a low importance ranking because in general for their community it was not deemed to be as great a problem as, for instance, the lack of access to water.

The problem index (which combines severity and incidence to form a single score) for the project area is presented in Table 13 Natural and social problems dominate the

		All villages average PI		_			All villages average PI	
	Problem	groups	individuals			Problem	groups	individuals
1	Water humans	0.99	0.92		15	Development support	0.17	0.03
2	Water livestock	0.96	0.85		16	Transport	0.16	0.08
3	Education	0.70	0.19		17	Forest	0.15	0.03
4	Weather	0.65	0.48		18	FLA	0.11	not identified
5	Healthcare	0.58	0.31		19	Markets	0.10	0.05
6	Livestock	0.52	0.15		20	Security	0.10	0.03
7	Poverty	0.35	0.03		21	Agri-inputs	0.09	0.01
8	Veterinary service	0.30	0.04		22	Wildlife	0.09	0.04
9	Disease	0.27	0.07		23	Church	0.09	0.01
10	Land	0.21	0.04		24	Population pressure	0.04	0.03
11	GMM	0.20	0.01		25	Pregnancy	0.04	0.01
12	Finance	0.20	0.03		26	Pests	0.04	not identified
13	Money	0.19	0.09		27	Western religion	0.04	not identified
14	Workload	0.18	0.02		28	Village office	not identified	0.01

Table 13 The problem index data ranked in order of importance according to the average group results

top half (left side) of the table. The relationship between the averaged individual and group PI data was tested and a spearman's correlation coefficient of 0.738 (significant at the 0.01level) indicates that there is a strong correlation. This is further visible when the data is plotted in a scatter plot (Figure 4.17).



Figure 4.17 A scatter plot to show the relationship between the average individual and group PI data

4.3.3. Spatial distribution of the most pressing problems and their frequency

The top six problems for the area appear to be: 1) water for livestock, 2) water for humans, 3)education, 4) weather, 5)healthcare and 6) livestock. However at the village level, the top 6 problems differ (Figure 4.18). For all villages, water for humans appears to be the most important problem. Water for livestock tended to have second ranking of importance apart from in Arkatan where it was in third place as they gave health care the second place.

Lepurko and Arkatan were the only villages to have the same 6 important problems as the average for the area. Arkaria ranked poverty rather than livestock disease in its top 6 as did Nanja Sub Village. Lendikinya ranked money instead of health care and Mti Mmoja ranked disease and forest instead of healthcare and weather.

Water for livestock and humans tended to have a seasonal frequency of occurrence (during the dry season) apart from in Arkaria where it was considered a daily problem. Education tended to be a problem either seasonally or daily (this reflected whether the main complaint was payment of school fees, in which case the problem was the lack of cash available in the dry season, or the distance to school, in which case the problem was daily).

Weather tended to be a problem either weekly/monthly or seasonally. The time of year of data collection might be reflected in this frequency as the onset of the dry season had just begun and people were worrying about where they would get water from later in the season once the dams nearby had dried up.

A3 pull out of bar graphs on image here

Healthcare was given a frequency of occurrence of daily to weekly/monthly. This is partly a factor of distance from the nearest dispensary (Arkaria, Lendikinya and Arkatan do not have their own dispensaries) and partly due to the prevalence of diseases (especially childhood diseases) and malnutrition within the area.

Livestock disease is generally considered to be a problem occurring seasonally (in the dry season when many cattle congregate around a few water points leading to increased spread of disease). Lendikinya viewed the problem as more frequently (weekly-monthly) as they perceived that the disease was causing decreased herd sizes which was in turn reducing people's ability to access basic needs (e.g. to be able to buy water from trucks during the dry season).

4.3.4. Gender issues with reflection of livelihood role

As outlined in Chapter 2, Maasai men and women have very different livelihood roles. This is reflected in the different problem indexes of the groups of each village and in the average PI scores for the area (Table 14.). A general overview of the data (APPENDIX F) shows heterogeneity (as expected) rather than consistency.

As expected, land issues, agri-inputs and livestock diseases are problems identified mostly by men. One might expect, because men deal with the main income, that monetary issues would also be identified by them. However, the monetary problems identified (lack of access to credit, markets and cash income) are actually brought up by the women rather than the men. The men are not very concerned with money, rather they seem to have identified the problem as those services that need the money (saying they are too expensive or it is difficult to find the money for the fees) whereas the women, who have no/little cash income and have the responsibility of the family's well being no matter what the season, identify monetary problems and the need to have greater accessibility to Tanzania's economy.

Transport is brought up mostly by women. The household chores such as collecting firewood, collecting water as well as getting people to hospital and easily getting to market are extremely time-consuming and hard work if transport facilities are not good (the only regular form of transport are the dala dalas going up and down the Arusha-Manyara tar

	All females A	Average	All males Average		
Problem	individuals	groups	individuals	groups	
Water humans	0.92	0.98	0.92	1	
Water livestock	0.88	0.92	0.81	1	
Land	0.03	0.08	0.04	0.35	
Forest	0.05	0.20		0.12	
Weather	0.55	0.72	0.41	0.56	
Pests				0.09	
Wildlife	0.03		0.07	0.18	
Livestock (diseases)	0.09	0.29	0.22	0.72	
Agri-inputs			0.02	0.41	
Veterinary service	0.03		0.04	0.41	
Finance	0.05	0.21			
Markets	0.07	0.23	0.02	0.09	
Money	0.09	0.19	0.1	0.09	
Poverty	0.04	0.28	0.02	0.3	
Workload	0.03	0.28		0.1	
Disease (humans)	0.08	0.13	0.06	0.43	
Population pressure			0.07	0.09	
Pregnancy		0.09	0.02		
Healthcare	0.24	0.60	0.4	0.65	
Transport	0.09	0.28	0.06	0.13	
Forced Land Acquisition				0.22	
Education	0.18	0.62	0.21	0.74	
Development support	0.05	0.29		0.08	
Grinding Mill Machine	0.02	0.31			
Security	0.04	0.20	0.04		
Church		0.18	0.02		
Village office	0.02				
Western religion				0.08	

Table 14 Summary of the problem index data according to gender

road that runs past Arkatan, Mti Mmoja and Nanja Sub Village. All the other roads are dirt roads, often in bad repair and rarely travelled).

It is expected that as women have the role of looking after the family's well-being, they would identify and give high PI values to water for humans, health care and education. With water for humans there is no difference between the men and the women; it is the highest priority for everyone. The men actually consistently give healthcare and education higher PI scores than the women. This could be because men make the decisions for the community and therefore are concerned and perhaps more aware of the issues affecting the different areas and people of the village.

Women actually tended to be more concerned and to give higher PI values to causal factors such as drought/poverty. Different groups of women then identified and gave smaller rankings to social resources such as the lack of a church in the area or lack of development support.

4.3.4.1 A case study of problem identification and importance: Arkatan

Arkatan appears to have the greatest heterogeneity between the genders and is at odds with the general male-female trend as previously discussed. For instance the women of Arkatan appear not to bring up a single financial or human resource problem.

Figure 4.19 is PI frequency map and will be used as a basis for exploring the reasons the Maasai of Arkatan gave for identifying certain problems and according them the frequencies that they did.



Figure 4.19 The problems identified by groups in Arkatan with reference to their problem index value, frequency and gender of group that identified them.

Risks mentioned by both genders

High Importance (High PI scores)

- Water for humans (both sexes gave it a PI of 1). The women say there is a water tap but the water is not clean and there is not enough daily. The men said that they have no place to fetch water from in the dry season. They commented that although they buy water, they cannot buy enough for everyone. Both groups classed this as a seasonal problem.
- Healthcare (men gave it a higher PI score of 0.83 than the women PI=0.67). There is no hospital nearby (they have to go to either Arusha or Monduli). They have to go all the way to Mti Mmoja for the nearest dispensary. If they

become ill during the night there is no method of transport to get them to the hospital and even when there is transport (they are near to the main tar road so can get dala dalas during the day), they don't always have enough money to pay for the journey to hospital. They gave this a daily occurrence frequency.

- Water for livestock –(Men ranked it top along with water for humans. Women gave it a slightly lower PI of 0.82) They have to move the cows far every year in the dry season to find water –Manyara and Kisiminjero. This was given a seasonal frequency of occurrence.
- Weather drought –(Women gave this a higher PI of 0.75 compared to men who gave it a PI of 0.60). There is not enough rain which is causing hunger. The men mentioned the problem with the school, that when the drought sets in, the school's farm fails and the children have nothing to eat at school (the school farms 10 acres for its 330 children). Also the teachers are sometimes not able to teach as they are busy looking for water. Men gave this a seasonal frequency, women gave it a daily frequency.
- Education (Both sexes gave this a PI value of 0.64) The men mentioned the lack of secondary school saying that many of their children are passing their exams but can't go to secondary schools as they can't afford the fees (the secondary schools are boarding schools far away from the project area). Again they also mentioned the problem of lack of teaching in periods of drought when the teachers are looking for water. They mentioned again the problem of providing food for the primary school students. The women would like a classroom for kindergarten children. They also say there is a problem for many people in being able to provide their children with uniform and exercise books. The women gave this a daily frequency of occurrence, the men seasonal.

Risks mentioned by only one gender group

Men

High importance

 Livestock (diseases) –(P=0.75) Lumpy Skin Disease Virus for cows, Trypanosomiasis, CBPP, Anthrax, East Coast Fever and Bovine cerebral Theileriosis. This reduces herd size, increasing poverty and so reduces peoples' ability to access basic needs. This was given a seasonal frequency. • Veterinary service. -(P=0.5). They say that it can be very expensive to vaccinate, sometimes 6,000Tanzanian shillings for a calf. They have to wait until enough people need their cows vaccinated before calling out the vet due to the prohibitive expense. This was given a seasonal frequency.

Lower importance

- Disease (/ill health of humans) –(P=0.37). Women giving birth need to get all the way to Arusha. This was given a daily frequency.
- Markets –(P=0.09) In the rainy season there is an excess of milk but no market for women to sell it at.. This was given a seasonal frequency.
- Agri-inputs (P=0.25) They are using local seeds but they want to use modified seeds e.g. those that are drought resistant but they are prohibitively expensive. This was given a seasonal frequency due to planting season.

Women

High importance

 Development Support –(P=0.25) Women need help to create their own businesses so that women have employment and a cash income. This was given a daily frequency.

Lower importance

- Grinding Mill Machine –(P=0.3) The women have to go all the way to Monduli to use a grinding mill machine. Frequency is daily.
- Transport –(0.19) The main road is very far and the journey to it is hard. Frequency is daily
- Church –(P=0.18) They don't have a church. Frequency is daily.

4.4 Problems analysed in the case study village of Arkaria using the PPPM and partial census data sets

4.4.1 Overview of problems identified and their importance from the PPPM data

The six most important problems identified were 1) water humans, 2) water livestock, 3)healthcare, 4)poverty, 5)education and 6)weather. Access to markets and lack of land for pasture (due to population pressure) also had substantial PI scores. Detailed information about the different problems identified according to gender, discussions reflecting the ability of the group data to represent the problems brought up by
individuals, solutions to the problems that have already been carried out and those identified for the future can be found in Appendix G.

4.4.2 Overview of problems identified from the partial census data

Participants were asked to identify any problems that inhibited any livelihood activities they carried out within Arkaria. All participants mentioned either problems to do with cultivation or livestock keeping. These problems have been mapped spatially (Figure 4.20-4.21). From these maps it is possible to make out some spatial patterns.

Crop production (based on Figure 4.20)

The majority appear to suffer from drought. Wild animals were also commonly identified (in particular bush pigs, porcupines, zebra and buffalo) as a problem. Identification occurred mostly in central Arkaria and the sub village of Ormaroro. These locations appear to be away from the main road and also in higher elevations with bomas located near to the fields.

A few participants from each sub village identified crop pests (mostly insects) and also money for agri-inputs. There also seems to be a case of domestic livestock as a problem in each sub village (participants commented that donkeys, dogs and cows would sometimes browse and destroy crops although owners were very honest and any such situations were resolved and compensation given).

Livestock keeping (based on Figure 4.21)

A large number appear to mention lack of water for livestock as a problem. The other problems identified tend to be area specific. There are a few boams (8) that mention lack of pasture as problem especially in the sub villages of Oloodololkaria and Ormaroro. Wild animals as predators are mentioned mostly within the vicinity of Ormaroro. Access to veterninary service either due to expense or distance (or both) as a problem appears to be located mostly to the north of central Arkaria. A3 pull out of problems encountered in crop production and livestock keeping.

4.4.3 Comparison of the two data sets

Whilst the information from the partial census is specifically related to livelihood production, the majority of the problems identified by the bomas were also identified by the groups in the PPPM exercise (Table 15). As can be seen, a number of problems identified have PI's comparable to the percentage of bomas that indicated the problem e.g. wild animals, weather and pests. Whilst not as many as expected (given the individual PI results) identified lack of water for livestock as a problem, this could because they deal with issues of water security all the time as an intrinsic part of Maasai life, whereas problems such as wild animals are not the 'norm' and so are perceived as a problem. Possibly, this data indicates that individuals will focus on identifying problems related to uncertainty rather than those problems that they are aware of, and believe are almost certain to occur in the future.

Problem	Av. Group PI value	% bomas that identified the problem
Wild animals:	0.29	44%
(browsers destroying crops)		
Security	0.30	3%
Wild animals predators attacking livestock		
(and people)		
Lack of water for livestock	1	34%
Weather:	0.58	62%
Drought (lack of water for crops)		
Pests	0.26	14%+3%=17%
(insects + domestic animals)		
Agri inputs	Not identified	11%
(lack of money)		
Veterinary Services	0.34	7%
(expensive/distance)		
Land	0.37	8%
(lack of pasture)		

Table 15 Comparison of PI value with problems identified in the partial census data.

4.4.4 Outline of relevant factors revealed from the photo-visual analysis exercise

Prompted by the photos he had taken, the chairman of Arkaria offered many additional insights into the recent land use and livelihood change in Arkaria.

The first picture he showed me was a picture of a small dam north of his boma which he dug in 2001. As can be seen from the photograph (Plate 6), at the beginning of the dry



Plate 6 A photograph taken by the chairman of Arkaria showing a small dam he dug in 2001 just north of his boma. This dam is used for water for both humans and livestock. Taken in June 2005.

season when the photograph was taken (June 2005) the dam still held water. He also showed me a photograph of a big dam called "Inkamuriak" which dried up in 2002. It was located in the valley where central Arkaria is based. The chairman explained that the water destroyed the base of the dam due to siltation. He then went on to say that in the past, all the dams were constructed in the period during which Edward Sokoine was Prime Minister of the United Republic of Tanzania (1977.1981. Sokoine was a Maasai, from the same district as Arkaria, Monduli. The chairman told me the night of Sokoine's death in 1984, there was heavy rain and so all the dams filled with water, like a river, and so the dams grieved for him. After that, they began to dry and silt up. When discussing a photograph of a maize field, the Chairman said that during his time as Prime Minister, Sokoine had forbidden anyone to cultivate in the valley where central Arkaria currently is. After his death, they started cultivating there. The Chairman himself admitted that it was the cultivation in the valley that was causing terrible gully erosion –he had even taken a photograph of his friend next to one of the worst patches (Plate 7). Apparently when the rainy season comes, fast running water run-off, channelled from the fields runs down what used to be a livestock path and is now a patch of extensive gully erosion.



Plate $\overline{7}$ A photograph taken by the chairman of Arkaria showing extensive gully erosion which has gradually increased in size over time. Before the erosion, this used to be a livestock path. Taken in June 2005.

The last, important piece of information obtained from this exercise was that since 1997, all forest within Arkaria has been classed as protected by the village authorities (ie the Maasai themselves). This was done because they realised that deforestation was increasing as members of the community (suggested as being the Il-Arusa) cut down the trees and sold them. These days, an individual has to pay a tax when he cuts down trees from the forest and he has to get permission. The only tree that is allowed to be cut down without permission is the Acacia tree. Inhabitants are allowed to milk the trees for sap without having to get permission as this does not kill the tree. This information explains why, unlike its neighbouring villages, Arkaria has not extended its cultivated area northwards, into the montane forest.

Chapter DISCUSSION

Due to the complex nature of the way in which the results from the different methods relate to each other, this discussion will follow the structure of the Maasai components in the data capture techniques model (Figure 5.1). The discussion will begin by exploring those current and possible problems raised by the Maasai through the PPPM data and the partial census data. It will then address what resources are actually available in the region and discuss the shortcomings of those resources as mentioned by the Maasai. The different livelihood strategies of the Maasai and the implications of the results regarding the ways in which society is structured around these strategies are then explored. The land use of the main livelihood strategies is then discussed, drawing in results from all of the different techniques used in the methodology and the forms of "other income" are discussed. Finally, there is a summary of the linking relationships between all of these components. Within this context the future of the Maasai in terms of changing resource priorities is discussed and there is an overview of the usefulness of the combination of the techniques employed in this thesis.



Figure 5.1 A model of the data capture techniques used in this project.

.1 Current and future problems



Figure 5.2 Problems component of the data capture techniques model

Although the question asked was : " $d e t e e e a \Box t a t$ $\Box t$ a lte la t $\square ea$ ", and guidance was only given if a participant needed etea 🗆 ea further prompting (which rarely occurred), the problems listed by the residents of Arkaria in the partial census were split between the two main livelihood strategies: crop production and livestock rearing. It was apparent that the problems mentioned by these individuals were focused on problems related to uncertainty, problems they would not necessarily expect to have to deal with on a daily basis or 'out of the ordinary' problems. Those brought up included wild animals, both in the form of browsers destroying crops and in the form of predators attacking livestock. Lack of water for livestock was identified, though only by 34% of the bomas (as opposed to all of the PPPM groups) whereas, drought (lack of water for crops) was brought up by the majority. This difference in identifying water as a problem for crop production but not so much for cattle reflects the traditional lifestyle of the Maasai. It is 'normal' to face problems in finding water for cattle -that is partly why they practised transhumance (and still do move the cattle to dry-season pastures) whereas, the problem of drought and the consequential failure of rainfed cultivation is a relatively new problem for which they have no remedial strategy. The success of their crop is nearly wholly reliant on whether they receive enough rainfall. When the partial census was carried out, it was evident that many crops of maize and beans had failed already. Therefore, it is likely that their consequent concern for the period during the heart of

the dry season (with little or no source of their own grain) was reflected in their response to this question.

Other problems mentioned include pests destroying crops. Surprisingly, a few respondents mentioned that domestic animals, including dogs, were becoming a problem in this respect. This is an interesting demonstration of adaptational behaviour on behalf of the dogs, which are often not fed adequately and so have to look elsewhere for food. The remaining problems were mostly indirectly related to lack of money: Agri-inputs were specifically mentioned in the context of inability to afford seeds, tools and pesticides. Veterinary services were mentioned in terms of problems of distance and/or money. Finally, lack of pasture was mentioned by 8% of the bomas questioned. This was also discussed in the male group meeting, with the Chairman of Arkaria expressing concern over the future of the village as population pressure was gradually causing the land set aside for pasture to become smaller. This, of course, has long term consequences not just for the residents of Arkaria, but also for the other villages in the region as pasture land in Maasailand is a common pool resource for (very much regulated) use by everyone.

These results are interesting when compared with the types of problems mentioned in a study carried out last year by a former ICL MSc student (Table 16). Ryan Tinggal

		Arkaria	% of participants in Tinggal's thesis (2004) that identified the problem	% of participants in this thesis (2005) that identified the problem
Physical	Water	24	72%	44%
	la nd	3	9%	8%
	Forest		0%	0
	Weather	3	9%	62%
	Pests (for live stock and agriculture) Live stock Disease and		0%	61%
	Veterinary Services	15	45%	7%
Financial	Agri-Inputs	2	6 %	11%
	Finance	2	6%	0%
	Income	4	12%	0%

Table 16 Problems relating to livelihoods of the Maasai in Arkaria in 2004 and 2005

(2004) interviewed 70 households across 3 of the villages within this project area (Arkaria, Lepurko and Mti Mmoja). As can be seen from above Tinggal's results show noticeably higher percentages for water livestock problems. The issues surrounding identification of water as a problem have already been discussed and most likely account for the discrepancy. The large difference in participants identifying livestock problems is likely to be a result of the way in which the semi-structured questionnaire

is organised as, prior to this question, there is a detailed question as to whether their livestock had suffered disease this year. Often respondents did not, therefore, reidentify livestock diseases/access to/affordability of veterinary services when asked to identify problems with their key livelihood strategies. The percentages were similar for those participants identifying agri-inputs and land as problems during both 2004 and 2005 indicating these particular problems have not deteriorated but neither have they improved.

The PPPM data addressed both current and future problems as both the groups and individuals were asked to identify the problems they face when trying to provide for themselves and their families both those problems they are facing at the moment and possibly also those problems they might not be experiencing currently but could face at some other point in the year.

When compared to the risk map results from Smith *et al.* (2000) and Quinn *et al.* (2003) the different problem perceptions resulting from different lifestyles and livelihoods as previously discussed become apparent. Quinn *et al*'s research incorporated participants with different livelihoods (Pastoralists, agro-pastoralists and agriculturalists) whereas Smith *et al*'s research focused only on pastoralists. It is therefore very appropriate that of the two risk maps, the problem maps produced from the results of this thesis have a similar distribution to Smith *et al*'s. Whilst the Maasai are now agro - pastoralists their perceptions still very much reflect those of pure pastoralists.

The Chi² test proves that there is a strong correlation between the individual average PI values and the group PI values. Therefore the hypothesis that the group PI values are truly representative of the population in general can be accepted.

The group PI values indicated that water is the most important problem in the project area. It was given consistently high rankings by both genders. Other problems that were consistently perceived and identified by the Maasai to be of major importance now and in the future were: education, weather, healthcare and livestock diseases. These show a strong focus towards problems within the natural and social assets categories. Problems identified, but given the lowest PI values, often tended to be a mixture of gender-specific problems related to financial, human and social capital assets. The spatial variation of the top six problems is also very interesting. From the map annotated with the bar charts of problems identified and their frequencies of occurrence (Figure 4.18), it was possible to see that poverty replaced livestock disease in both Arkaria and Nanja Sub Villages and that Lendikinya identified "money" as being a more important problem than that of healthcare. Whilst Arkatan did not mention financial related issues in its top 6 problems, it was noticeable during group discussion that participants were worried about unemployment. This was the only village that actually talked about "unemployment" it is also the closest village to the main town of Arusha and the rapidly increasing urban sprawl surrounding it.

Mti Mmoja ranked disease and forest instead of healthcare and weather in its top 6 important problems because, as the chairman showed me, by waving a hand and disturbing about 50 flies, the community have serious problems with eye disease. The process of deforestation in the area is of major concern for them because non-Maasai are apparently taking down trees at an alarming rate. This not only increases the journey time Maasai women to have to travel to collect firewood but also the trees being removed are often those that are used in the treatment of eye disease. Although both the women's and men's groups discussed the possibility of replanting trees, they said that there was no point until they had a regular water supply. This is but one example of how many of the problems identified are interlinked and how, for instance, by solving or at least alleviating the human water problem by extending the supply of piped water to the villages, many other problems could be dramatically reduced in severity.

As the lifestyle of the Maasai is very much centred around adapting to the environment in which they live and in creating coping strategies, it would be expected that the problems they identify would reflect their lifestyle and in turn, as governing bodies would have people believe, their lack of interest in financial and social assets. In part, the results do substantiate part of this hypothesis. The majority of "natural asset" problems identified were found within the 10 most important risks. According to the common perception of Tanzanian government agencies, the Maasai do not want to be part of Tanzania's development process. et, the results show that amongst the natural asset problems were also key "social assets" such as education and healthcare and that within the top 15 problems, problems relating to "financial assets" and development support are identified. This indicates that, possibly, it is not that the Maasai don't want to be a part of the development process but rather they have not been given or shown the mechanisms by which they can become involved.

This was further illustrated during the feedback meeting when we discussed the reasons for why education was the most important problem in the project area after water. The Maasai present agreed that one of the main reasons was a lack of a secondary school in the area (the nearest ones being very far away e.g. Monduli where their children have to board –hard both in financial and social terms). The Project Director of CHCWP, who was also present, said that he had heard that there were plans for a government secondary school in the area but that its future location was, as yet, undecided. It was apparent that the Maasai, whose children the school would educate, and the people likely to be most affected by its positioning, had no knowledge at all of this plan. This is characteristic of the lack of communication between different governing bodies, NGOs and the communities themselves. If all the stakeholders in the land in this area are to work together and manage this land in a sustainable way, then the channels of communication must be improved.

Whilst the Maasai lifestyle is still very much centred around cattle, this in no way is an indication that they are averse to social change. Education is a good example, reflected in its important position in the PI for the project area, of how the Maasai have changed their attitude in favour of a Tanzanian socialist development policy is that of education. When the Maasai first came across the notion of education and schools, during the colonial period, many Maasai parents feared it would alienate their children from their family and their culture and despised the notion of it (Hodgson, 2001). et, recently, there has been a complete change in the Maasai attitude towards education. All female respondents questioned in both the PPPM interviews and the Arkaria partial census were in favour of education. Only a few men were not totally supportive of it, stipulating that girls should only attend school up to Standard 4, before marriage, in order that they could read and write for their future husbands. One man in Arkaria refused to let his children go to school, believing it would be of no benefit to them. He was adamant that his children, as he had in his time, would go to school and get beaten and there would be no one at home to look after the livestock. However, such negative respondents are in the minority. The vast majority of respondents believed that, through education, their children could understand the modern world and come back to help their parents and secure a future in the modern world for the Maasai by becoming leaders. As many pointed out, a current major problem experienced by the Maasai is lack of money to afford key social services such as medical care and veterinary care. If their children are educated, the Maasai believe that they will not only bring money back home to help the running of the boma but also that some will become veterinary surgeons and doctors and return home to help alleviate suffering. Although this is very much a parental view, the majority of participants being parents or grandparents, one younger respondent who had just finished primary school in Mti Mmoja remarked that he preferred school to herding livestock as when you see the goats or sheep or the cows, they die all the time. Education will die only when you die"".



.2 Resources available in the pro ect area

Figure 5.3 Resources available section of the data capture model

A complete data set of resource locations for the GIS was not available as had been anticipated. It was only possible to gain a few layers of locational data for social resources such as village boundaries, locations of schools and dispensaries. For Arkaria, the resource profile was updated and improved using the outputs of the participatory mapping to establish locations of waterpoints. Through the use of the GIS of resources combined with discussions from the PPPM group, it has been possible to come up with the following synopsis for the area.

Important social resources within the project area have been identified from the PPPM as: medical facilities, hospitals (there are currently none) and dispensaries (currently 2), educational facilities: found lacking are kindergarten facilities and secondary schools (there are none in the area) and veterinary services (there's a demand for a closer medicine dispensary and dips). Transport networks remain poorly developed, the roads often only maintained in the upcoming months of an election.

Key natural resources such as water, land, forests and wildlife are for the most part in decline. At the time of the field work undertaken for this thesis, the small dams dug by groups of Maasai still retained water in from the rainy season (plate 6) However, once these dry up the population of the area rely on comparatively small numbers of water points. When questioned where they got water from, participants named some of the larger dams in the area (in this context dams are dug out holes, not blocked rivers) including Soiminen (a 4 hour journey for many from Arkaria), Lengibure (20km from Mti Mmoja), Meserani, Enjoroee, Lenkibure, Tanzanian Military Academy, Emainete (Monduli Juu) and Hilala.

The land itself is facing increasing population pressure. A new theory not yet validated is that once people adapt to semi-sedentary cultivation, a population trap will have been 'srpung' (Holmes, 2005). As the Maasai population fills the landscape, they will have to work harder to grow food, increasing their vulnerability to crop failure and famine but yet so immersing themselves in the cultivation and its economy (Figure 5.4) that before long, even if they wanted to return to pastoralism they couldn't.



Figure 5.4 The poverty trap or spiral of environmental degradation (McCown et al. 1994)

Population pressure and agricultural expansion (as demonstrated previously in Chapter 4, Table 4) are not the only pressures on Maasailand. Further encroachment from national parks and the Tanzanian army as well as an increasingly arid climate as global

warming intensifies are also possibilities. Deforestation is still occurring as was voiced by the Mti Mmoja PPPM groups. All of this habitat destruction, increasing human presence and the blockage of wildlife corridors by agriculture is impacting on the ecology of the area. This further reduces the natural resources available to the Maasai because one of the most potentially lucrative sources of income, wildlife, is being marginalized.



.3 Livelihood strategies

Figure 5.5 Livelihood strategy section of the data capture model.

The partial census results show that there are two main livelihood strategies pursued by the Maasai in on their land. These are livestock husbandry and rainfed smallholder cultivation. The livelihood strategy for the younger generation has been increasingly to seek an external source of income. This usually means moving away from their home area. Commonly, the young Korriangas (warriors) work as night watchmen or in the tanzanite mines. Some, through Government sponsorship, attend further education colleges and universities in Tanzania and Kenya. Many seek waged employment in town.

From the partial census it is apparent that all but one of the bomas questioned were engaged in cultivation (one man who was awaiting plot allocation). Cultivation is therefore no longer a temporary expedient as it has been in the past (Hodgson, 2001). Furthermore, not only has the increasing need for grain trapped the Maasai into a sedentary lifestyle, but it has also tied them into the national economy in a very different way from their previous primary livelihood, pastoralism. This change in primary livelihood towards agro-pastoralism along with sedentarisation creates the need for services and permanent resource sources. Whereas, in the past, the transhumance lifestyle enabled the Maasai to walk away from disease, this is no longer an option. For instance, in the past, when nomadic the usual Maasai practice if someone died, whatever the cause, would be to immediately leave the body out for the wild animals and to abandon the boma forever (source: participant observation). In the past, harsh environmental conditions such as drought did not have such immediate and disastrous effects as they do now. The Maasai simply walked away from them. This strategy ensured that they could exploit different sources of water and better grazing land (Homewood and Rogers, 1991). In the past, pastures were left fallow for longer, allowing more permanent regeneration to take place.

Being tied to the economy of the country has inevitably also entailed becoming tied socially. Having recently realised the benefits that education has to offer in terms of becoming integrated into other societies and gaining access to better services, it is nearly every parent's wish in Maasailand that their children be educated to at least primary level. Reasons for this are outlined in APPENDIX H but specifically included the phrase 'bring back development to Maasailand'. This highlights an underlying need for more development support in the area. Increased educational opportunities have produced the disadvantage of an increased workload for Maasai women because, traditionally, young children were formerly used to graze and protect the small livestock. However, once this source of labour is removed (as the children are in school) it falls more often than not on the women to look after the small livestock as well as having to complete all of their other household duties. This was specifically brought up in the PPPM exercises and appears as 'workload' on the graph.

The results show a distinct stratification between the 'majority' of participants and the 'wealthy'. In Arkaria, the wealthy members of the population questioned (16%) own 62% of Arkaria's total cattle holdings (assuming that the livestock data in the CORDS 2005 profile is correct). This small proportion of the community also owns a total of 57% of the small livestock holdings of the village. This economic differentiation has been noted by many academics and has been described by Arhem (1985) on his book on the Maasai of the Ngorogoro. This phenomenon has also been noted by the anthropologist, Dorothy Hodgson (2001), who is quick to warn that whilst many may have romantic notions that the Maasai traditionally practiced homogeneity and communal sharing of wealth, these notion are wrong. She says in her book that records their history, that the Maasai society has always been to some extent stratified. What is worrying is the increasing differentiation between rich and poor. Dorothy

even goes so far as to assert that pure pastoralism *"is now solely the provenance of the very nich and the destitute"* (2001 p173). Ndagala (1996) noted that during the early 1960s, the Maasai had 13 cattle per capita. By the mid 1980s the Ngorongoro Maasai were though to have just 8 cattle per capita. The data from this thesis indicates the current per capita figure for the Arkaria Maasai is 4. Furthermore, it is estimated that a family the equivalent of 6.5 adults needs 21kg milk a day, which requires at least 35 to 40 head of cattle (Mwalyosi, 1998). The partial census results indicate that the average borna size is 15 people in Arkaria and consequently each borna requires approximately 81-92 head of cattle to provide a traditional style of life. et, the average borna in Arkaria has approximately half that herd size of cattle.

Many cite disease and alienation of important dry-season grazing grounds and permanent water sources as the factors driving pastoralism to becoming economic un -sustainable (Hodgson 2001; Mwalyosi, 1998; Homewood and Rogers 1991). Other means of income are needed, hence the livelihood strategy of adaptation to cultivation as these results show. It is the only other means of production, at the time, that the Maasai had come into close contact with (Nelson, 2000). That the decade most people in Arkaria commenced cultivation is the 1980s lends even more validity to the hypothesis that, despite what reasons the Maasai might give, ultimately they were forced to take up cultivation by the socio-economic climate at the time which was reflected in the better price of grain against cattle (Ndagala, 1996). It is also interesting to note that Dorothy Hodgson (2001), who worked in the same area as this thesis is based, says that the main reasons given to her for the uptake of cultivation were either that the cattle had died, or that the people were hungry and that the way in which they were taught how to farm was from the Il-Arusa. Very similar in nature to the results gained from the partial census.

Furthermore, the results showed that there was a relationship between wealth (measured in terms of stock ownership) and cultivated acreage, indicating that cultivation had become nearly as much a part of the pastoral economy as cattle are. From their answers, it was evident that for many families, selling their harvest is the only cash income that they have. By using a proportion of the harvest for household consumption, they do not have to sell their cows for food. Also any income can be used to cover veterinary expenses for the cattle.

The economic sustainability of pastoralism as a livelihood, having been brought into question in the 1980s, was then pushed over the brink of sustainability by a combination of very bad droughts and a notable increase in the population of the Maasai, due to reduced human mortality (Nelson, 2000). When viewed in this context, a new light can be shed on some of the reasons given by the Maasai in this project for starting cultivation. For instance, some of them cited reduction in herd size due to disease. During the 1980s the government removed their veterinary extension services due to the economic climate (Homewood and Rogers, 1996) leaving herds adapted to dips and vaccinations with little protection against very harsh environmental conditions. Many cattle also died from starvation as did people, corresponding with the reasons of drought cited by a large majority of Arkaria's inhabitants.

The problems encountered by people pursuing these different livelihood strategies in Arkaria vary but not greatly. However, their spatial pattern of variance is very interesting. It becomes apparent that the sub village of Ormaroroy is a hot spot for wild life activity both in terms of crop destruction and livestock predation.

The uniting factor between both of these strategies (pastoralism and cultivation) is that they are both vulnerable to drought. There are murmurings from the women of setting up cooperatives to sell jewellery (some already do) and to set up a market for excess milk in the rainy season. Many of the women's groups and individuals said that they want access to development support services, to be taught how to run a business so that they can provide for their family in the dry season. This is a remarkable move away from traditional risk reduction strategies of the Maa group and a tremendous step towards what must appear to them to be a very commercialized world.

.4 Land use



Figure 5.6 Land use section of the data capture model

Excluding Lepurko from the land area data, both the map and the data show significant net agricultural expansion during the period 1987-2005. However, there is additional data available; Dorothy Hodgson (2001) notes that an area of 505.75 acres was farmed in Mti Mmoja in 1992. Incorporating this additional data, Mti Mmoja appears to have had 1.12km² under cultivation in 1987, 2.04km² by 1992, 3.84km² by 2000 and 4.37km²by 2005. This shows a slight decrease in the averaged annual rate of increase during the period 2000-2005. Looking at the area spatially on the GIS, the road and the escarpment inhibit further expansion.

According from the individual background data from the PPPM exercise, the average acreage was 24.3 acres per boma. However, there was differentiation apparnt between those owning less than 10 acres and those owning greater than 50 acres. Hodgson has data for 1992 indicating that on average, a boma in Mti Mmoja farmed 4.4 acres per household. Even though the data I collected is too small a sample size to be used as an exact match, the average from Arkaria, 17 acres can be used and gives a more conservative estimate. This expansion of cultivation at the individual level is phenomenal for a people who in the past have only used cultivation as a temporary livelihood strategy when their cattle numbers were severely decreased (Arhem, 1985)

The use of machinery by a large proportion of the population as a cultivation technique indicates that the cultivation is no longer just a means of subsistence. For

the wealthy it is another form of income. et to date, the Maasai still seem very reluctant to put any inputs into the land. Many do use cow dung collected from the kraal (where the cattle are kept at night) but other than that there was little or no knowledge of pesticides or fertilizers, or indeed much about how different techniques could produce different yields. Many of the groups questioned specified in their suggested solutions that they wanted to know how to make a 3 acre plot produce the yield of a 10 acre plot, that they had heard it was possible. It is not that the Maasai won't consider other methods of cultivaiton, merely they have not been taught anything different. It was apparent from participant observation that to many, the land they cultivate puts a thin barrier between them and starvation. Whilst a reduction in the area farmed does not look too feasible, teaching the Maasai the most suitable techniques for the sustainable cultivation of the area might at least reduce the damage to the land.

In the past, in the era of Soikoine (Prime Minister of Tanzania 1977-1981), the valley of Arkaria was not allowed to be cultivated. It is thought by many of the other villages that Nancha Dam, which dried up during the 1990s after the El Nino rains had passed, silted up because of run-off from the fields in Arkaria. That is except for Mti Mmoja who believe Nanja dried up because their god was angry with them for having built a Manyetta on the bank.

Cultivation and environmental degradation

Currently in Maasailand, cultivation techniques are being adopted with little regard for their long term sustainability. Little is done (mostly due to the lack of knowledge) in the way of soil conservation.

Part of the problem with the current cultivation livelihood strategy is that the Maasai are caught in a 'catch 22' situation, an ecologically destructive situation. They have adopted agricultural practices that require minimal labour requirements (as a large amount of their time is still spent tending to livestock). The success of the harvest is largely dependent on whether enough rain falls in the area. The Maasai are not inclined to invest in improvement of the land because if there is no rain they risk getting no return on their investment. et, by not investing much in the land (e.g., weeds, fertilizers, pesticides, rotational cropping to restore nutrients to the soil) and utilising it for cultivation they are causing permanent destruction of it. Not only is the

minimal soil quality reduced, but the tilling of the land lays the ground vulnerable to sheet rain erosion in the rainy season which can not only can cause the gullies seen in Plates 3 and 7 but also washes away what few nutrients there are in the soil. Should the opposite scenario happen, and the harvest be successful, then the Maasai will invest their returns in cattle (many said this on being questioned as to the usage of their harvest). Increasing numbers of cattle need increasing numbers of herders. However, the children are in school. Do the Maasai end up with a development problem because the children have to stay at home to help take care of the livestock or do the children carry on their education and the burden fall upon the Maasai women who already have many other demands on their time If the chore does fall on the Maasai women, they will be less inclined to put work into the fields and so will minimize the labour put in. And so the cycle begins again (see Figure 5.7).



Figure 5.7 The Monduli Maasai Agricultural Systems Diagram (source: Conroy, 2001)

The Maasai are traditionally used to moving away from problems. Now sedentarised, they cannot just move away and let the environment recover. If they want the land to still be giving them pasture for their cattle in a decades time then they not only have to halt the spread of cultivation (otherwise there will be no pasture land left) but they also have to start cultivating responsibly, investing something into the land so that in the future they can still use it. If they do not start to care for the land they are cultivating then a realistic vision in 10 years time will be Plates 3 and 7 not just in pocketed areas as is the case at the moment, but everywhere. In short, their land will become one of the world's 'badlands'.

Future

As private ownership becomes a day to day reality for the Maasai, it is likely their land will be gradually sold off, so that, in time, the big pasturelands will no longer exist and transhumance livestock husbandry will be but words in a history book. This rather bleak snap shot of the future is based on the reasoning that unless the Maasai continue to retain centralised control of their land, bit by bit, individuals will sell out (there is normally a story in each village of a husband who has drunk away his cows and land). Currently, every participant when asked if they owned the land said "yes". When asked if they had the right to sell said "no" and appeared quite shocked at the suggestion, explaining that they have to get permission from the village council in order to sell their land or to transfer it to someone else. Currently, also, if a family wants a plot of land, they have to first show the village council the plot they would like and await the village council's affirmation. So the present situation is ideal for managing agricultural expansion. The village authority controls where and the amounts of land cultivated (apart from south of the tar road, where the army acts as an authority restricting cultivation). The village authorities need to meet and discuss with agricultural experts how to increase yield without increasing the land area cultivated and how to do so without compromising the future sustainability of their land.

Resource problems identified in the area do not have such an obvious solution. What is more, as they are based on the perceptions of the Maasai, they could change unpredictably. A possible change in perceptions of resource problems could occur if the AIDS epidemic was to hit the Maasai. They have all the ideal exposure features – many Maasai men work in the Tanzanite mines, mines being notorious for the spread of sexually transmitted diseases and HIV (Rugalema, 2004). Most Maasai men (excluding many educated young Maasai men) and Maasai women have heard the story that a Maasai man put a condom in the sun and watched the AIDs virus swim around (this is actually a basic convection current of the lubricant) and are convinced condoms are sent by the Americans, impregnated with the AIDs virus, to wipe out the Maasai. Nothing of course could be further from the truth and in fact this belief will be the ultimate vector of the AIDS epidemic into the Maasai. They have so far escaped an epidemic partly it is thought because all the men are circumcised and this reduces spread of STDs and HIV (New Scientist, 2005) and partly because until recently (the past 5 years in which there is a marked increase in the number of family members leaving home to work in town/the mines) they have had little sexual exposure to other cultures. However, TB is rife still in Maasailand and, normally a good indication of the epidemic outbreak, will disguise the first wave. It could be that the virus has already infected many people. There is of course a three year lag period normally between infection of HIV and signs of AIDS. This will affect perceptions of resource problems in two ways. Firstly, in the longer term, instead of looking at problems resulting from the problem of population pressure, the Maasai will instead face those problems brought on by large numbers of deaths in one section of the population pyramid. The other immediate change is likely to be the rising in priority of healthcare services. Therefore, if used regularly, PPPM might be able to show the changing prioritising of problems before the health problem is acknowledged.

. Validation of the methodology

It was useful to carry out the PVA techniques because the information elicited from them confirmed the findings already gained from the partial census on livelihood strategies in the area. This triangulation is all the more valuable because not only does it reinforce the knowledge gained from the partial census and PPPM exercises, but it also verifies that these methods used, although guided and not totally open exercises, managed to elicit participants' true perceptions.

Chapter CONCLUSION

Visual evidence and the data obtained from the digitization of satellite images indicate significant net agricultural expansion in the project area during the period from 1987 to the present day (2005). Results from the partial census of Arkaria indicate that, whilst the original driving factors for commencement of cultivation were related to, among other factors, drought, present day continuation and even expansion of agriculture is driven by the need of the Maasai to supplement their traditional diet to stave off starvation and malnutrition and, for some, to provide a source of income for the household. Perhaps, the most important driver is the decline of cattle per capita over the past half a century. This has been attributed to a combination of drought, disease and a frail livestock economy compared to the endorsed agricultural economy.

Cultivation techniques are currently being adopted in Maasailand with little regard for their long term sustainability. The Maasai are traditionally used to moving away from problems. Now sedentarised, they cannot just move away and let the environment recover. If they want the land to continue to provide them with pasture for their cattle in future decades, they not only have to halt the accelerating spread of cultivation but they also have to start cultivating responsibly.

Whilst the Maasai of Arkaria appear technically to be agro-pastoralists, it is evident from the PPPM results of the project area that livestock husbandry features most strongly in the problems identified by the majority of the groups whilst agriculture related constraints are brought up by less than half the groups. The PPPM results show clearly the willingness of the Maasai to become part of Tanzania's development process. However this is difficult for them to do if they do not even have ready access to the most basic of human needs: water.

A possible change in perceptions of resource problems could occur if the AIDS epidemic was to hit the Maasai. This would affect perceptions of resource problems in two ways. Firstly, in the longer term, instead of looking at consequences resulting from the problem of population pressure, the Maasai would instead face those problems brought on by large numbers of deaths in one section of the population pyramid. The other likely consequence would be a sudden dramatic increase in the importance of healthcare services to the Maasai. Therefore, if used regularly, PPPM might be able to show the changing prioritisation of problems, indicators of impending social change and, possibly, provide advance warning of impending crisis. The PPPM methodology is recommended in this thesis because, although a guided and not a totally open exercise, it was proven to elicit participants' true perceptions.

The application of the PPPM technique is not restricted to problems associated with livelihoods. It could easily be used as a tool to identify and start the debate on the most pressing of the Maasai's current and future concerns. The most immediate concern has to be land management. The current practices cannot continue a

 $t \square$. Other livelihood strategies will have to be found within the next decade if the ecological integrity of the land is to be sustained.

Hunting tourism is so potentially lucrative that both the hunting company and the Government have a vested interest in the current land management and future development of this area of Maasailand. The Maasai in the southern area of the Burko Hunting Block already have a voice as stakeholders. The hunting company itself and its community liaison NGO (CHCWP) are already working with the Maasai (and have the most longstanding reputation in community wildlife development in Tanzania). It would seem unlikely that Government national development policies would offer tangible benefits to the Maasai in the immediate future. The hunting company, with its enlightened policies of inclusion, would seem to offer an avenue through which the different land management styles and concerns of the stakeholders (the government, the hunting company and the Maasai) could meet at the same level. However, if the Maasai are not actively engaged with the other stakeholders in making decisions about the most appropriate and sustainable use of their land, they will have no choice but to continue to over-exploit their dwindling natural resources (Mwalyosi 1998). This has already proved to have a disastrous effect on the condition of the land. However, it is apparent from the data collected in this project that the choice the Maasai currently face is stark. It is either participation or starvation.

Chapter Recommendations

For the Maasai:

- work hard to enforce within their community, the traditional values of common pool resource land and reinforce traditional authority over the protection of Maasailand as a whole.
- Work together in cooperation rather than as independent villages in the tackling and resolution of common resource problems as outlined in detail for each village in the preliminary findings reports distributed at the preliminary findings meeting.
- Work together to formulate a Development Plan of Action for the area based on the needs of the Maasai community

For NGOs and governmental agencies:

- Whilst a reduction in the area cultivated does not look too feasible, teaching the Maasai the most suitable techniques for the sustainable cultivation of the area might at least reduce the damage to the land.
- The village authority controls the location and the amounts of land cultivated (apart from south of the tar road, where the army acts as an authority restricting cultivation). It would be to the benefit of everyone if a meeting with agricultural experts could be arranged and the dilemma of how to increase yield without increasing the land area cultivated and degrading the land further be discussed. The best locations of fields for minimal environmental impact also need to be investigated and made known.
- The PPPM methodology as outlined in this thesis provides a tool, that is proven to work with the Maasai of this area. It can direct agencies and organisations as to the most important resource issues in the area. The methodology, if used regularly, can also act as monitoring device to measure the success of intervention/assistance.

- When there is a complete locational data set of resources in the area, land use managers and stakeholders should work together to input into the GIS all the information at their disposal. By reassessing the needs and factors of the stakeholders spatially better land management techniques could be developed. The power of the GIS to compute algorithms taking into account distance to nearest hospital, economic status of the household etc and compute cost cover maps should be utilized especially in any decisions regarding resource location. Whilst there was not enough time to develop such a system within the confines of this thesis, it would be strongly recommended that the applications of GIS in the context of the resource and management issues in the southern area of the Burko Hunting Block be utilized.
- The PPPM technique works well with the Maasai in the Burko area. It would be interesting to see whether it worked as effectively with other tribes and people. The potential for it to become a recognised PRA tool is high but more work needs to be done to prove whether it is appropriate in all situations and locations.

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APPENDI A

HOW CORDS WILL USE THE DATA COLLECTED IN THIS PRO ECT

The Research Project on carried out in 6 villages within the southern part of the e et a Burko hunting block in Maasailand, Northern Tanzania (Arkaria, Arkatan, Lendikinya, Lepurko, Mti Mmoja and Megwara Sub-village) by Briony D. Turner of Imperial College London marks a benchmark of its own kind not only to the local communities living in the area but also to the change agents and other stakeholders operating or to operate in the area. The project, which is probably the first of its own kind in the locality, has been very constructive and instrumental since the methodologies employed by the data-collection team were simple and participatory; and above all, the team gave the feedback of the study to the communities reflecting general findings and anticipated possible interventions and solutions in the future. This state of affairs has not only honoured PRA techniques in its real essence but also halted the old phenomenon that: "the Maasai Community has been $e \Box e t e a$ $l \square e e telle t \square al$ all $\Box e \ t \ e \ l$ e e ee t teaea te e le $t e \Box t \Box t \Box a \Box ee a ate t e t e t e a e$ t e a riginated" This phenomenon not only made the Maasai community increase their scepticism towards any foreign individual entering their community but also it was an abuse of PRA techniques at the highest magnitude This project has therefore made great progress in readdressing the balance between information gained from the community and information given back to the community.

We at Community Research and Development Services (CORDS) are pleased that the project by Briony D. Turner has coincided with a time in which CORDS has a number of projects operating or are due to operate in the area. CORDS works in the field of resource tenure, poverty reduction and improving quality of services such as livestock development, education, health and natural resources and utilization. It is expected that the results from this project, will contribute to a more informed process of development, improved planning, implementation and sustainable social services in the area. CORDS has been developing a software databank which entails all village profiles in its area of operation including Monduli, Kiteto and Simanjiro Districts. The data and findings collected by this project are very instrumental in improving and enriching our existing data in the databank. The data and findings are useful to all departments in planning, re-planning, reviewing, monitoring, and evaluation; and in finding new avenues of interventions.

CORDS has a number of departments including Gender, Land Rights, Livestock, and Land Use Plans. The gathered data and information from this project will be used by all these departments during fundraising through project proposals which will also be circulated to interested partners and stakeholders.

CORDS is not only a voluntary organization that empower the pastoral communities in the area but also a full-fledged pastoralist research institution (as its name connotes) that researches and Documents some issues of primary concern. CORDS has established Research, Documentation and Information Unit whose objectives are:

- * To assess status of pastoralism in Northern Tanzania;
- * To examine development interventions and their impact on the patterns of pastoral resource use (water, grazing, browsing, salts, fuel-wood, herds, hunting and gathering) and the structure of property ownership;
- * To assess the impact of development interventions on indigenous social institutions;

Specific research findings are documented and circulated to various actors in development with the intention of informing policy and improving the quality of pastoral development in the region. This unit is further designed to facilitate a process of charting out possibilities for alternative initiatives in pastoral development. This project on $e \ e \ t \ a \ a \ la \ \Box \ e \ a \ e$ will be applied under the same avenues; and it is hoped also that not only will it act as a point of reference for future research but that it will also act as a "stepping stone" enabling researchers to leap further forward and carry on the work from where this project has ended.

Written y Raphael Lengare on behalf of CORDS

HOW MSTCDC WILL USE THE DATA COLLECTED IN THIS PRO ECT:

Alais Morindat –MSTCDC

This thesis will be used and incorporated into MSTCDC's Programme on Reinforcement of Pastoral Civil Society in East Africa. The main structure of the programme is outlined below:

The Programme On Reinforcement of Pastoral Civil Society in East Africa

Programme purpose

The emergence of a vibrant, representative and effective pastoral civil movement capable of articulating and implementing their members' vision of their own development is the overall purpose of the IIED/RECONCILE/MS TCDC regional pastoral programme in East Africa. The Programme is working with pastoral civil society groups to strengthen their capacity to articulate and implement their members' vision of their own development and therefore your study in Arkaria will contribute in many ways to this purpose.

Programme Strategy

The programme is driven by a number of principles:

Providing an enabling environment for self-determination

The core work of the programme is to help create the conditions whereby pastoral people can take charge of their own destiny and engage with the State and other interest groups on a more equal footing. The approach used by the programme is to build the capacity of a coalition of partners to support this process of self-determination without corrupting it (i.e. doing the job in the place of local people).

Constructive partnerships for adding-value

The programme s success rests on RECONCILE and IIED forging effective partnerships with a core group of organisations working on pastoral issues in East Africa. These partnerships will be established with organisations working at two critical levels. First, with on-going development programmes in pastoral areas. Second, with a group of national and regional organisations working with senior policy makers within relevant ministries or donor organisations.

Action-research for informed debate and learning

A key principle of the programme is to encourage and support processes of informed debate among all stakeholders, including pastoral groups, on policy issues relevant to pastoral development in the region. Pastoral livelihood systems in East Africa are highly dynamic as pastoralists seek to adapt to evolving social, political and economic conditions at local, national and regional levels. These changes bring in new "actors" and impact on pastoral society in different ways thus creating internal conditions of change as well. Helping pastoral groups as well as pastoral development projects to follow these trends and understand what they mean for pastoral livelihoods is essential to the future development of pastoral areas, and will be an important component of the programme.

The onus will be on creating the conditions through training and designing appropriate tools. The programme will work with in-country partners to identify how such support might be given within the context of their own projects (e.g. adult literacy training, adapted PRA tools, etc.). In the immediate term research will be carried out in more conventional participatory ways with pastoral groups, and that over time these skills will be progressively transferred.

Finally, documenting the process by which the programme and its partners support civil society empowerment is crucial to informing and contributing to broader debates on the topic within the context of decentralisation and democratisation. An important output of the programme will be to assess whether or not its approach could constitute a "model" for supporting processes of self-determination among other marginal or oppressed civil society groups (e.g. urban squatters, womenheaded households, people with disabilities, etc.).

APPENDI

Template of semi-structured interview conducted in a partial census of Arkaria

1	Informant number	WRITTEN
2	Time of day	Night Day
4		INIGHT Day
3	Gender	F M
4	Environment of oma E.g. mountain plateau	WRITTEN
	Primary livelihood of the head of the household	A CD
	a) pastoralism (no farming at all)	_
	b)agro-pastoralism	Е
	c)mixed tarming	
	d)business	
	e)other	
	For each person in your household, what is their primary livelihood activity	WRITTEN
	If different, list different livelihoods	
	What proportion of the produce from everyone's work goes towards household consumption	FRACTION
	(fraction)	
	Household size (those living permanently in the boma and also those away studying but that come	NUM ER
	home in holidays)	
	Livestock numbers:	NUM ERS
	Cows (including oxen)	
	Small livestock	
	Donkeys	
	Chicken	
	Other	
10	Have any of your herds suffered disease in the past year or N	Y or N
11	If then which disease(s)	WRITTEN
12	Were you able to treat it or N	Y or N
13	If NOT then why not	WRITTEN
14	How many died	NUM ER
1	I and area cultivated (acres)	NUM FR
1	Land area cultivated (actes)	MAP CPS
1	Every 10 participants GPS field locations	WAI GIS
1	Reason for sulfivation	
1	Reason for curry anone concerning (each)	A C (EPACTIONI)
	a) income generation (cash)	C (FRACTION)
	b) household consumption	DE
	d) state a large daire	
	a) pot totad	
1	c) not stated	X/F A D
1	when did you start cultivating	I LAN W/DITT'ENI
1		WDITTEN
20	How did you learn	WRITTEN
21	Status of the land you are cultivating	A C
	a)rented	
	b)owned	
	c)communal	
	(NA if not cultivating)	
22	Have you sold any land N	YN
23	When did you sell it	YEAR
24	Who to -is it a villager or someone that lives outside the village (if tribe mentioned note down)	WRITTEN
2	Land preparation (how they are farming)	A C
	a)manual (own hands)	
	b)traction (using animals)	
	c)machinery	
2	How many family members have moved away in the past 5 years	NUM ER
2	If so when and why (if for jobs, what jobs)	WRITTEN
2	Do they send money to the household	Y or N
2	Does it cover	A or
	a) lot of your expenses or	
	b) just provide a little cash for spending	
30	Have there been any constraints on your production abilities (livestock or farming) since the rainy	WRITTEN
	season last year. If so what	
31	Did you move your cattle away from the village area after last year's rainy season? Y. N.	Y or N
51	(August to December _the period after the rains)	1 01 11
32	If	МАР
32	Do you think man and woman are gotting their actual ant actuality in development	W/DITTEN
33	Could you donn't a the role of monoral the role of monoral in real in the role of monoral in the role of monoral the role of monoral in t	WALLEN W/DITTIEN
34	Could you describe the role of men and the role of women in your household	WKITTEN:
3	Have you noticed any changes in these roles	WKITTEN

APPENDI C

Template of the RPM semi-structured interview conducted with 10 individuals in each village

1.	Informant number	WRITTEN
1. 1a	Time of day	WRITTEN
2	Village	WRITTEN
3	Gender	FM
4	Age	NUM ER
	Environment you are questioning in -if not their boma get a description of how far away it is from	WRITTEN
	current location and which compass direction	
	If M: Primary livelihood before marriage	A C D
	a) here the second	F
	b)agro-nastoralism	2
	c)mixed farming	
	d)business	
	e)other	
	If M: Current Primary livelihood	A C D
	IF W: Primary livelihood of your head of household since you were married	
	a) pastoralism (no farming at all)	E
	b)agro-pastoralism	
	c)mixed farming	
	d)business	
	e)other	
	Household size (count those living permanently in the boma and also those away studying but that come home in holidays)	NUM ER
	Livestock numbers of the head of your household	NUM ERS
	Cows (including oxen and calves)	
	Small livestock	
	Donkeys	
	Chicken	
40	Other	
10	Land area cultivated (acres)	NUM ER
11	Ask if would be ok to GPS location (call Briony to do GPS)	MAP GPS
12	Reason for cultivation:	Α
	a) income generation (cash)	C (FRACTION
	b) household consumption	DE
	c) both equally or if a fraction, state	
	d) stake a land claim	
12	e) not stated	VEAD
13	When did you start cultivating	YEAK
14	Why did you start cultivating	WRITTEN
	How did you learn	WRITTEN
1	a)rented	A C
	b)awaed	
	c)communal	
	(NA if not cultivating)	
1	Have you sold any land N	Y N
1	When did you sell it	YEAR
1	Who to -is it a villager or someone that lives outside the village (if tribe mentioned note down)	WRITTEN
20	Land preparation (how they are farming)	A C
	a)manual (own hands)	
	b)traction (using animals)	
	c)machinery	
21	How many family members have moved away to your knowledge	NUM ER
22	If so when and why (if for jobs, what jobs)	WRITTEN
3	Do they send money to the household	Y or N
ıt ⁴	Does it cover	A or
	a) lot of your expenses or	
	b) just provide a little cash for spending	
2	Have there been any constraints on your production abilities (livestock or farming) since the rainy season	WRITTEN
-	last year if so, what	W/DI/T*T'I?NT
2	Do you think men and women are getting their equal opportunity in development	WEITTEN
4	IT MAAN. What are your reeings when your when is earning money If WOMAN. If you care each what if any affacts had to a your life	WRITTEN
1	IT WOWLATN. IT YOU CATH CASH, WHAT, IT ANY, ATTECTS HAS IT HAD ON YOUT THE	1

APPENDIX D

Chi² Calculation

 $\mathrm{H}_0\,$: the wealth of the participants is not related to the type of cultivation technique their boma uses

 $\mathrm{H}_1\,$: the wealth of the participants is related to the type of cultivation technique their boma uses

Actual values	Wealthy	Majority	Total
Machinery	11	35	46
ther	5	51	56
Total	16	86	102

expected values	Wealthy	Majority	Total
Machinery	7.2	38.8	46
ther	8.8	47.2	56
Total	16	86	102

chi ² statistic	Wealthy	Majority
Machinery	2	0.37
ther	1.64	0.31

Chi²=4.32

DF=1

P=0.05

Critical Value=3.841


APP NDIX inal categories of risks for PPPM exercises

Type of		
resources	Category	Details
	water humans	access to (clean) water sources
	water livestock	access to water sources for livestock
	land	availability of land for agriculture/pasture/building
	foroat	materials
	TOTES	droughts/not enough _often root cause of
natural	weather	famine/hunger
	nests	destruction of crons by insects/caternillars
	wildlife	destruction of crons/livestock by wildlife
	Wilding	disease -decreased herd sizes -often result in
		lack of building materials/food/potential cash
	livestock	income
		access to mechanical equipment/availability of
	agri-inputs	seeds
	votorinory	availability/high cost of medicines and cost of
	services	issues but check is not due to bad transportation
	finance	access to credit
financial	markets	Access to markets to sell produce
	That Nets	Lack of cash (especially during the cultivation
	Money	period) for food/building materials
		lack of livestock and ability to bring in an
		income/food to cover the basic needs of the
	poverty	household
		human diseases -ill health (if malnutrition try to
	disease	famine etc)
	population	not enough land for increasing population/causal
human	pressure	factor of erosion
nundn		reduces ability of women to carry out expected
	Pregnancy	workload
		often brought up by women -impossible to do
		everything they are meant to but also due to
	workload	looking after livestock
	· · · · · · · · · · · · · · · · · · ·	Access to health care services -
	health care	dispensary/hospital
		Access to transportation especially roads (and
	transport	the need for bridges in the wet season)
	Forced land	Lond foreibly taken from villages by the ermy
		Access to school/navment of fees/navment of
		necessary equipment/provision of
		teachers/provision of classrooms and teachers
	education	houses/access to further education
social	Development	Access to development support -advice on how
5001ai	support	to start up businesses adult literacy classes etc
	grinding mill	
	machine	Access to a grinning mill machine
		for women, being raped/being beaten by men) -
	security	reduces ability to carry out work load
	church	lack of church building
	village office	lack of village office building
		influence on culture/risk (according to Maasai
		belief) of Pentecost praying activities bringing
	western religion	bad luck

APPENDI F

Summary of gender PIs and their frequencies of occurrence for each village

		Lendikir	squor g roups	-		Ankataı	s dnorß t	- 1		Mti Mmojá	sd norg :			Ankaria gro	sdn	• •		Lepurko g	sdnoz	• •		NS V grot	sdi	• •
	Male PI	F	Female PI R I	F	Male PI	F	Female PI RI	F	Male PI	F	Femal e PI R I	F	Male PI	F	emal e P I RI	F	Male PI	F	Femal e P I RI	F	Male PI	F F	emal e 1 R I	F
water hum ans	1.00	3.00	1.00	3.00	1.00	3.00	1.00	3.00	1.00	2.00	0.91	3.00	1.00	1.00	1.00	2.00	1.00	3.00	1.00	3.00	1.00	3.00	1.00	3.00
water livest ock	1.00	3.00	1.00	3.00	1.00	3.00	0.82	3.00	1.00	2.00	16.0	3.00	1.00	1.00	1.00	2.00	1.00	3.00	0.83	3.00	1.00	3.00	1.00	3.00
land									0.33	2.00			0.37	3.00					0.08	3.00	0.35	00.1		
forest weather	0.51	100	0 63	1 00	0.60	0,00	75	001	0.12	3.00	0.21	1.00	0 5 0	3 00	0.60	00 0	0 5 0	00 1	0.19	200	63 0	00	62.0	8
pests	ţ	0.00	40.0		00-ia	8	2.0	00.1	22.0	0017	0	00.7	0.09	3.00		2	2	00.1		0	*	00.5	40.0	00-1
wildlife	0.17	3.00		_									0.19	1.00										
livestock	0.87	1.00	0.38	2.00	0.75	3.00			1.00	1.00	0.25	4.00	0.69	2.00			0.60	3.00	0.26	2.00	0.56	3.00		
agri-inputs	0.30	3.00			0.25	3.00				ĺ	ĺ	╞	ĺ	ĺ										
vetinary service	0.41	1.00		_	0.50	3.00							0.46	2.00			0.36	3.00		-	0.33	3.00		
fi nance			0.19	1.00																			0.23	1.00
markets					0.09	3.00									0.23	2.00								
m oney	0.09	1.00	0.18	1.00																			0.21	1.00
poverty	0.34	3.00		ſ				Ī	0.28	3.00	0.38	1.00	0.27	1.00	0.50	1.00				1			0.41	1.00
workl oad	0.10	3.00									0.50	1.00							0.36	1.00				
discase	0.46			1.00	0.37	1.00			0.44	1.00	0.13	2.00	0.46	2.00										
population pressure											000	1 00								-	0.09	00.1		
pregnancy								I			60.0	4.00				t				t				T
healthcare	9. 0 19. 1	1.00	0.50	1.00	0.83	8.1	0.67	1.00					0.71	1.00	0.67	1.00	0.63	2.00	0.42	2.00	0.53	3.00	0.40	1.00
transport	c1.0	3.00	0.20	00.1			61.0	1.00	00.00	00 0									(F. 7)	00.1		00		
FLA education	0.87	1.00	0.69	1.00	0.64	3.00	0.64	1.00	0.20	2:00 1:00	0.77	1.00	0.79	3.00	0.53	5.00	0.67	1.00	0.67	00 1	0.60	00.1	0.5.0	00
developm ent support	_			_			0.25	1.00					0.08	1.00					0.33	1.00				
GMM			0.32	1.00			0.30	1.00				┢											0.30	1.00
Security											0.20	2.00			0.20	1.00								
Church				_			0.18	2.00															0.18	2.00
Village office Western mission									000	001										7				
Western religion									0.08	1.00									ĺ	1	Į			٦
$PI \cdot 0 = I_0$	West		ortan	ر س	ے۔ اا	iohes	timp	Orta	nce								Ĭ							
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APPENDI G

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- Poverty the men gave poverty a low importance value (S=1.82) because poverty is not a problem for the majority whereas women ranked poverty as S=1, the highest importance value, because they see poverty as a problem that causes other problems.
- Education –Men focused on financial requirements, saying that they need help in sponsoring children for further education and also discussed the lack of ability for some to pay for school equipment due to the effects of livestock disease (reducing herd size and therefore possible capital). They also mentioned concern over an NGO only supporting girls, not boys in secondary education (however further information has revealed that girls are often not allowed to go into secondary education as they are expected to stay at home and be married). Women highlighted the issue of long distance for some children in Arkaria to travel to get to the primary school, especially with regard to their security on the way to school (attack from wild animals).

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• Weather - drought which leads to famine. It was brought up by both genders but men ranked it as low as possible because they said it was something they couldn't control. Woman gave it a higher ranking, following their logic that like poverty, it was a problem that caused other problems (malnutrition, hence ill health, decreased herd sizes, hence poverty etc)

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Men

High importance

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- Pests- particularly pests that destroy their crops as they start to grow

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- Accessibility to markets -- in terms of transport and in terms of access to in a business sense.
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Lower importance

• Finance –lack of access to credit is preventing them from starting up their own businesses.

3. Discussion of Individuals' PPPM results:

As with the groups, water for humans and water for livestock were deemed the most important problems (mainly to do with lack of access to free water, especially once the harvested rainwater in small dams and in tanks, has run out) and were brought up by all 10 participants. 90% of participants brought up healthcare (S=1.4) as an important problem (mostly problems related to distance to nearest dispensary and especially distance to hospital –common complaint is that people die on the way to hospital) and 70% brought up weather (drought, S=1.43) as an important problem (mostly because it causes famine).

Transport was brought up by 40% (people said accessibility by car is impossible in the rainy season and lack of decent roads causes problems with getting to hospital and to markets) but it was given a lower importance (S=1.72).

Wildlife (crop raiding especially by wild pig –brought up by one man and one woman), security (problem of attack by wild animals –brought up by one woman) and population pressure (brought up by one man), although only cited by a few of the participants, were given higher importance (S for all=1.67) than other problems cited such as workload for women, lack of development support especially for women, lack of pastures available due to increasing population, problems with there being not enough classrooms in school or teachers houses, livestock diseases and human diseases (TB, malaria and diabetes).

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What they would like to see done: accessibility especially during the dry season for both livestock and humans is limited –some families are buying water, but many cannot afford to throughout the dry season or indeed, at all. The majority of the women would like a tap built so that if the rains fail they will still have access to water. The men are looking for sponsorship for the repairing and construction of new dams.

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What they would like to see done-the women suggested that better roads needed to be built in order to increase accessibility to and from the village. The current roads become unusable in the rainy season and it is costly and hard work to repair them after the rainy season has finished

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APPENDI H

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Figure 4.4 Comparison between the distribution of wealth and the distribution of acreage in Arkaria (data from the partial census)



Figure 4.18. A map to show each village 5 top 6 problems (in rank order -1 being most important, 6 being least important) as well as the average frequency with which the village inhabitants say they occur.



Figure4.20 A map to show the problems related to crop production in Arkaria (based on data collected from the partial census)





Figure 4.8 A map to show the reasons why the Maasai of Arkaria started to cultivate in relation to the sub villages within Arkaria.



Figure 4.9. A map to show the spatial distribution of the decade of cultivation of each boma that was questioned in the partial census in Arkaria.

