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).

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

	Land Area Utilised for Agriculture Km^2			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

*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

A3 Pull out 1

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 (Box5) Whilst this

Box 5

Wealth Index

$$\frac{\text{(no. cows per household*Market price + no. small livestock per household * Market price)}}{\text{Household size}}$$

Cow=TZS 120,000 Goat/Sheep=TZS 35,000 (source: CORDS 2005)

Wealth 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 4,545,000. 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

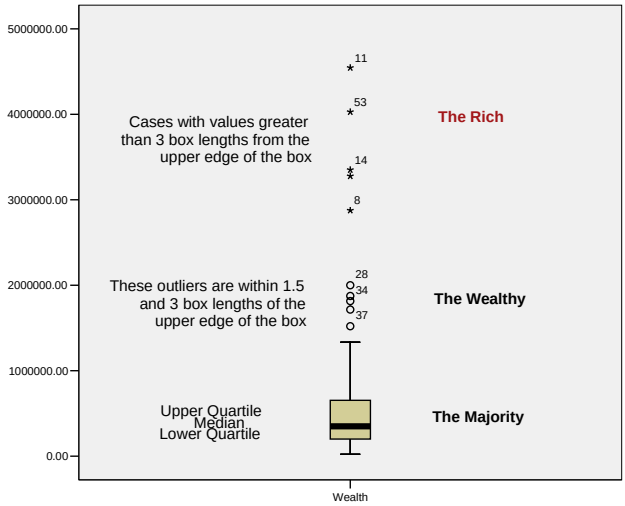

Figure 4.2 A box plot of the original wealth data calculated in Tanzanian Shillings

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

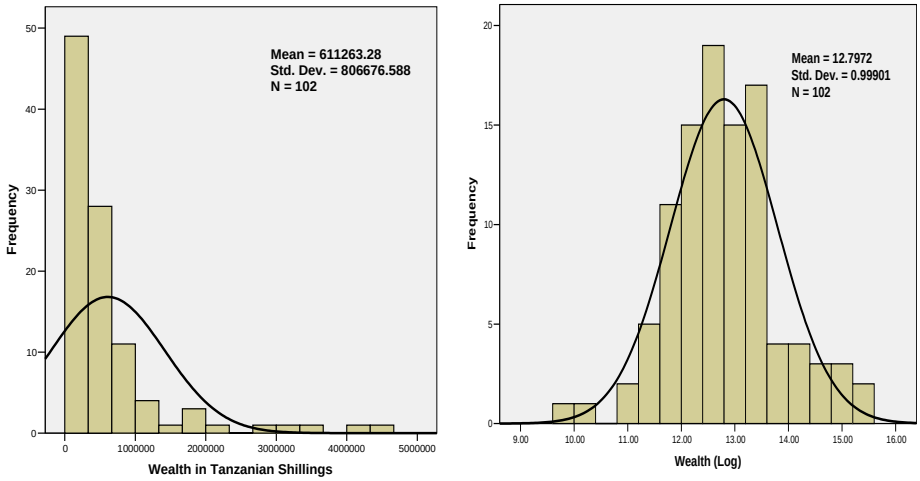

Figure 4.3 Wealth data before and after Log transformation.

upon transformation. Therefore for statistical analysis of the rest of the dataset, non-parametric tests were used.

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

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

Table 5 Descriptive statistics of the livestock herd sizes

	Minimum	Maximum	Mean	Standard 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

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 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 affect their 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).

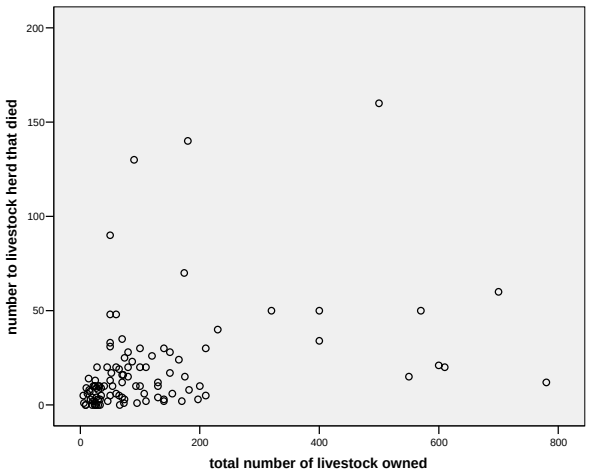

Figure 4.5 Scatter plot to show the relationship between the total number of livestock possessed by each boma and the total number of livestock of each boma that have died within the past year

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.

Table 6 Average acreage of fields per boma according to wealth

	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*

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

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.

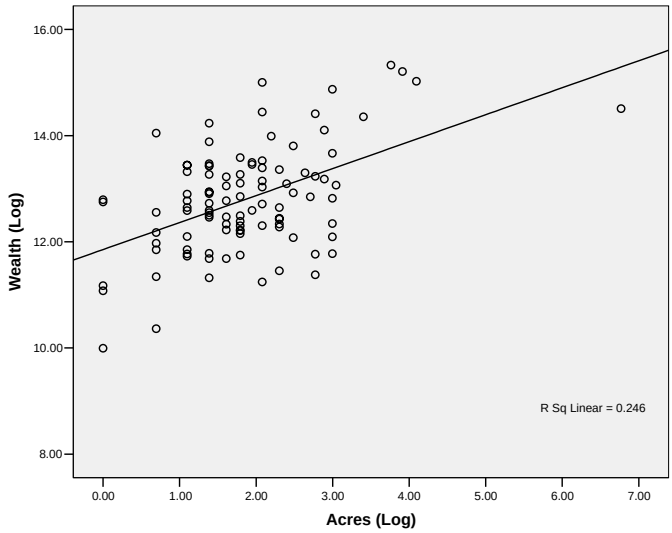

Figure 4.6 Scatter plot to show the relationship between the log transformed acreage and wealth data.

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 Chi^2 test was carried out in order to see whether there was a relationship between wealth of the boma and the cultivation technique they used (APPENDIX D). The Chi^2 value of 4.32 was

Table 7 Methods of cultivation in Arkaria

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

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
Manual	3%	0%	3%
Manual & traction	52%	31%	56%
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.

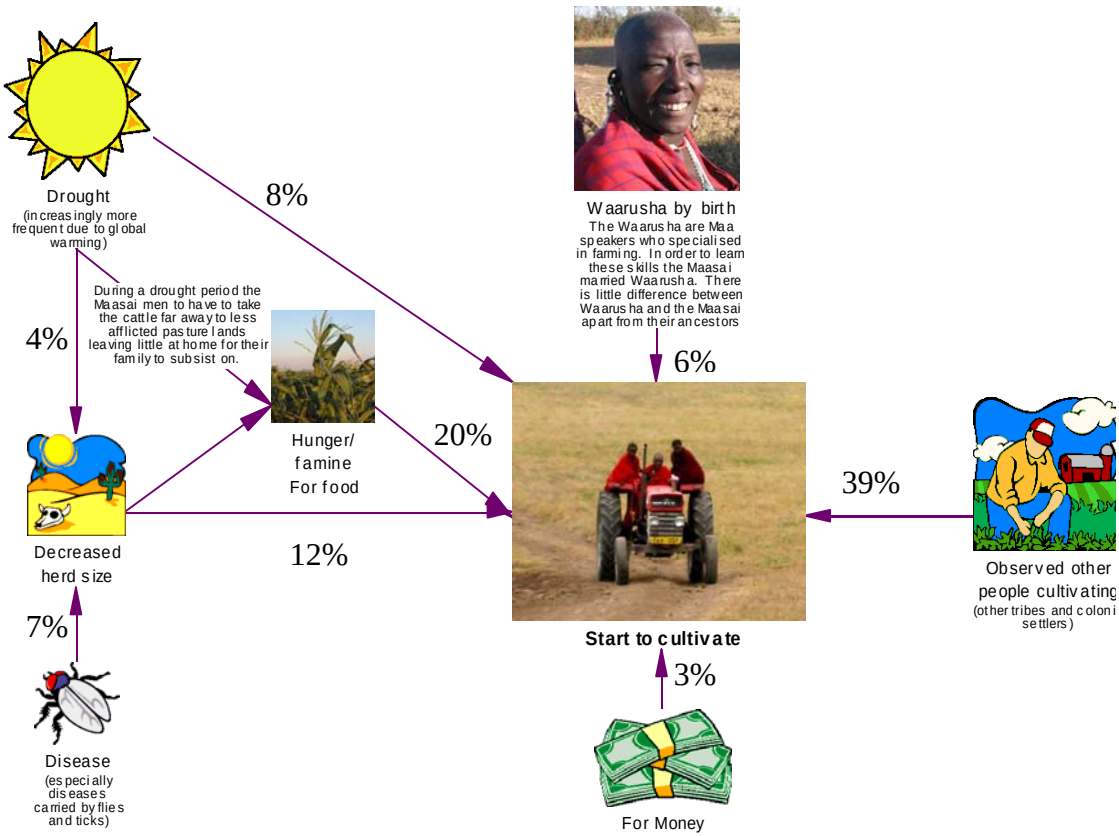

Figure 4.7 A flow diagram to show the reasons cited by the participants as to why they first started cultivating. (3% participants gave no reason)

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,

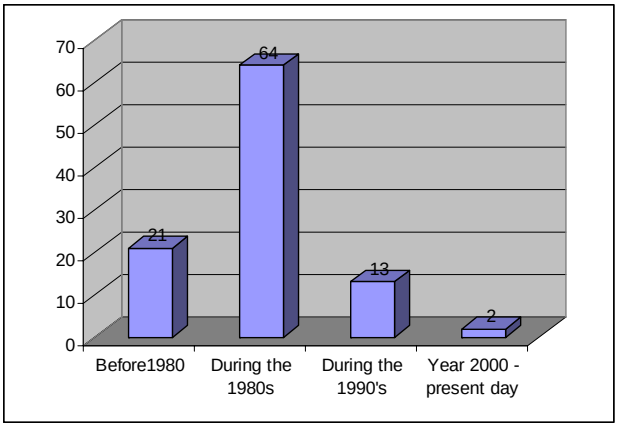

Figure 4.10 Year of commencement of cultivation (2 participants did not give answers)

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.

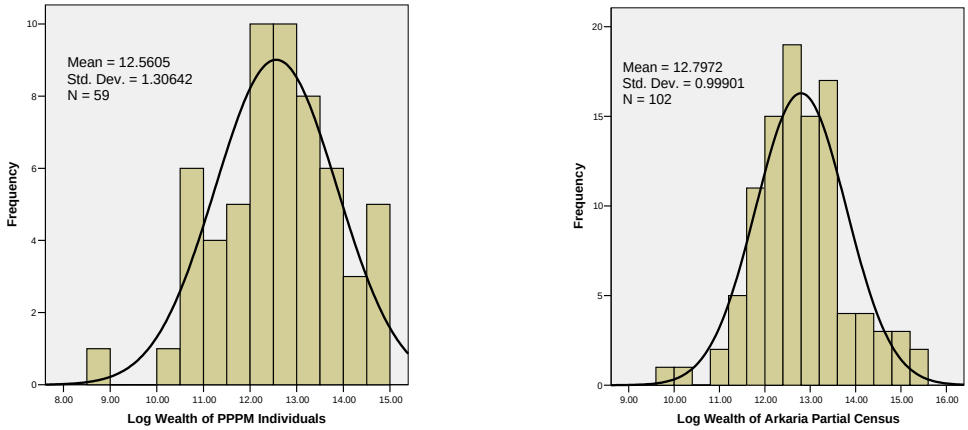

Figure 4.11 The similar wealth distributions: Left is the histogram of the wealth of the project area (60 individuals from the PPPM data although one person did not give their household size so has no associated wealth value) and right is the histogram of Arkaria's wealth (from the partial census data).

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.

Table 10 Average acreage of fields per boma according to wealth

	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

*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.

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)

	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%

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).

A3 pull out of risk and problem maps here.

As can be seen, the individual data for the problem map (Figure 4.12) shows a similar 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 especially evident when comparing Figure 4.12 and Figure

Table 12 A summary of the positioning of problems according to the type of capital asset

Capital Asset	Category	Problem maps (This project)	Risk map from Smith et al. (2000)	Risk map from Quinn *et al.* (2003)
NATURAL	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.
	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
	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
FINANCIAL	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.
	Finance, Markets, Money 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.
HUMAN	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.
SOCIAL	Health care, transport, education, development support	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	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.	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 and a high severity value of approximately 1.75.
	FLA, GMM, security, church, VO & WR	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 importance to the grinding mill machine.	Access to shops and having to relocate were identified with very low I 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.	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 S=1.35). Church, FLA, GMM, VO, WR and security were not identified.

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≤ 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 as through debate, it is more likely to represent the problems faced by 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

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

		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

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).

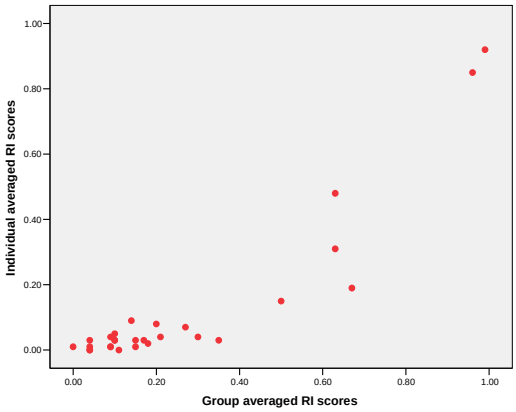

Figure 4.17 A scatter plot to show the relationship between the average individual and group PI data

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 wellbeing 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 road that runs past Arkatan, Mti Mmoja and Nanja Sub Village.

Table 14 Summary of the problem index data according to gender

	All females 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

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.

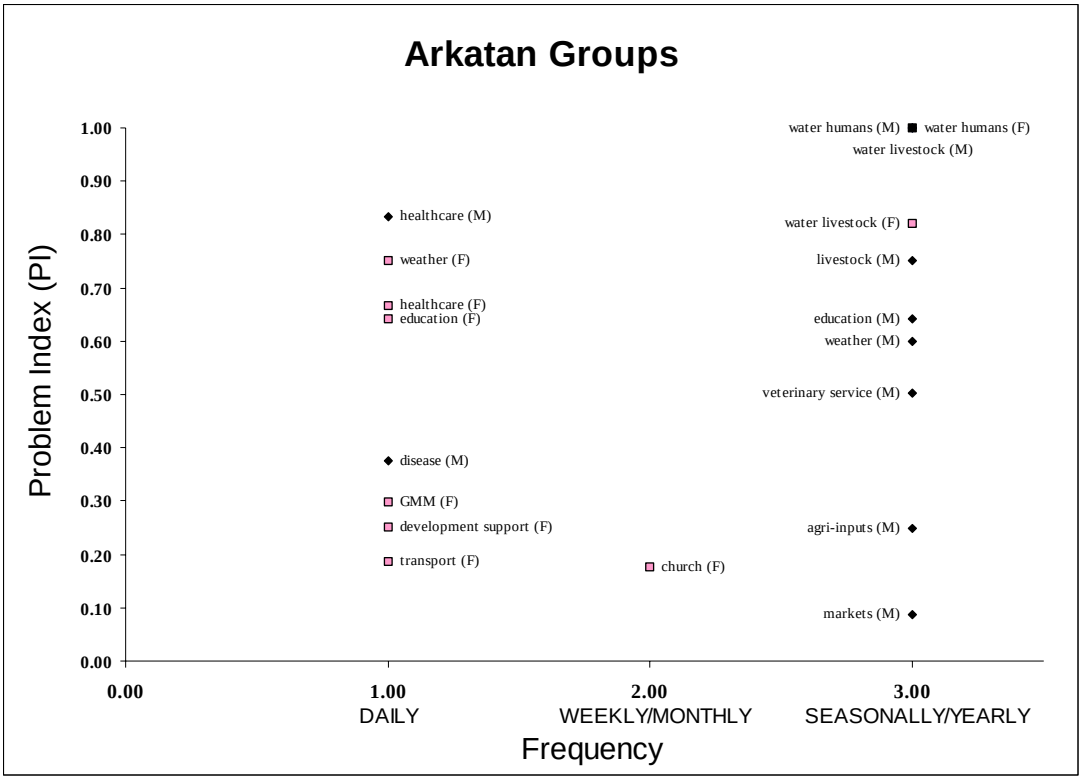

Figure 4.19 The problems identified by groups in Arkatan with reference to their problem index value, frequency and gender of group that identified them.

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

<u>High importance</u>

- 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 bomas (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 be 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.

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

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

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 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

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.

dry 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 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.