Table 3.5: Transect Details

Village Transect	Number of Sampling Points From Which Measurements Were Taken	Total Number of Trees Studied Along Transect
Chidumbwe I	20	80
Chidumbwe II	39	156
Mudzinge	26	104
Principe A	44	176
Principe B	40	160
Mufurudzi II	50	200
Mupedzanhamo	50	200
Zvataida	38	152
Total	307	1228

The frequency, density and cover of species were weighed against the spatial variability of parameters such as extent of cleared land, types of species damaged, species preferences, human population distribution, herbivorous livestock population size, average household size, age of village and appropriate inferences drawn. Such inferences were aided by GIS and correlation analyses in some instances.

3.9.2 Socio-economic Data

Questionnaire surveying and formal interviews

Questionnaire surveying constituted one of the major ways through which quantitative socio-economic and cultural data were collected. The data that were collected through this method related to the relationship between settler farmer livelihoods and the forest and woodland resources that are used by the communities in Mufurudzi resettlement scheme. The collected data included the number of households that were established after resettlement, communal area - resettlement area natural resource sharing arrangements, income levels, stocking rates, livelihood strategies for coping with environmental stresses such as drought and crop failure, tree species used for different purposes, preferred tree and grass species, as well as the perceptions of individuals on the environmental changes that have occurred in the resettlement scheme since the beginning of resettlement. Appendix I shows the questionnaire that was administered in the survey.

Ethnobotanical data on settlers' knowledge, perceptions and practices regarding forest and woodland resource utilization and management were gathered through both questionnaire surveying and formal interviews. The administered questionnaire was tested and validated in Takawira (Forest Dawn farm), another resettlement village, before the survey was conducted. The questionnaire survey was a 'blanket survey' in which a census approach (Wong *et al,* 2001) was adopted to include all the household heads that were present in all the villages found in all the sampled properties (farms). The 'blanket survey' was seen as necessary because of paucity of data. For example, there was no documented information about the actual number of households in each village, making it impossible to sample the respondents randomly or in any other way that would avoid bias. A total of 213 questionnaires were administered in this survey.

Furthermore, government officials who work in the area and community leaders did not have sufficient or updated information about most new households that 'emerged' within the scheme after resettlement. Even though such households were not officially allocated land in the scheme they had to be included in this study because they also rely on the forest and woodland resources that are found in the scheme. In the questionnaire survey, the actual respondents were the heads of households that were found in each of the selected eight villages, including those that had not been officially allocated land within the scheme. The names of the studied villages are given in table 3.5. Statistical Package for Social Scientists (SPSS) was used to analyze patterns and trends exhibited by variables related to use and management of forest and woodland products and livelihoods. SAS, Microsoft Excel and ArcView GIS (version3.2a) packages were used to augment the analysis, to determine patterns and trends of villagers' use of forest and woodland resources, perceptions about the state of the resource base, conservation practices and levels of vulnerability to environmental 'stresses and shocks'.

Interviews and discussions were also held with different categories of key informants, drawn both from the local community and technocrats. Informants from the local community included traditional leaders such as village heads, former VIDCO chairmen, local councillors, members of conservation and grazing committees and traditional healers (locally known as *ngangas*) while the key categories among the technocrats who were interviewed included officials from government departments and ministries (District Development Fund, Chaminuka Rural District Council, Agricultural Research and Extension, Forestry Commission, Department of Natural Resources and former resettlement officers). Some of the questions that were asked during the interviews are listed in Appendix III.

The most viable way of collecting livelihood data was achieved through household vulnerability analysis. This involved the classification of households into five categories, the rich, poor, middle class, female headed and child headed households. A total of forty households were selected, one household in each category for each of the eight villages that were included in the study. Household ranking was done by the villagers themselves.

Interviews were conducted with the sampled households and data were collected about their livelihood portfolios. The questions that were asked during the interviews are shown in Appendix III. Historical accounts were recorded during the interviews.

Participatory rural appraisal

Participatory research methodologies, largely referred to as Participatory Rural Appraisal (PRA) were the mainstay of qualitative data collection. The major PRA methodologies that were employed in this study include informal interviews, historical transects (or use of history forms, Vayda, 1996; or oral history, according to Bryant and Wilson, 1998), participatory (social) mapping (Jackson and Ingles, 1998), group discussions, wealth ranking as well as use of ranking matrices, seasonal diagrams, flow diagrams and geographical transect analyses, all of which were used to elicit historical information about the environmental changes that were observed by the local community, thus enabling the tracing of processes of environmental transformation.

> PRA is a social science technique which places more emphasis on local people being involved in the information analysis and problem solving elements of the process (that is, research)…and recognizes that local people are often better placed than outside researchers to analyze and seek solutions to their problems (Wong *et al,* 2001).

The adoption of PRA was based on the understanding that environmental issues that affect local communities are best understood by drawing insights from local knowledge systems, since these communities often have intimate knowledge (ethno ecological knowledge) about the localized and specific problems that affect them. Participatory approaches to problem identification and solution design yield better results in terms of livelihood improvement (Rapold, 2001). In this context PRA was seen as a useful tool for investigating the evolution of ethnobotanical relationships within the study area. PRA was strongly recommended for vegetation inventory and monitoring in the Indian Joint Forest Management Guide which was developed by Poffenberger *et al* (1992). The trends and patterns derived from the analysis of questionnaire data were used to design the PRA tools that were employed in the thesis. Appendix II shows these tools, most of which were group based.

The participating groups consisted of key informants, key local decision makers and special interest groups in natural resource conservation. In each village participants were drawn from traditional leadership (that is local traditional institutions village heads and elders), village development committee (VIDCO) (where they existed) and members of special interest groups such as grazing and natural resource management committees, where they existed, as well as women and youths. Interest groups consist of people who share particular sets of interests and women are one such a group, though they are:

> often overlooked when forest issues are discussed, in spite of the fact that they are often the most frequent and important users of forest and forest products (Jackson and Ingles, 1998: 19).

Participation in PRA activities, however, was voluntary. The total number of participants in each village was fifteen, consisting of one group of five men, another comprising five women and the other consisting of five youths (two females and two males, or vice versa), and each group was assigned exercises in which they were guided by a facilitator (see Appendix II).

Most of the PRA qualitative data comprised oral traditions and participant's historical accounts. However, there were limitations to PRA methodologies. The main problem related to the use of participatory methodologies is that it is normally difficult to derive quantitative data from them or validate the data (Smith, 1998), yet in some cases such data is fundamental in scientific enquiry. To overcome this problem the qualitative data collected were collated with information derived from secondary data sources and questionnaire surveying to ensure their validation.

The ranking of tree species in order of preference was also undertaken in this research (Dahlberg, 2000). Both matrix and pair-wise ranking methodologies were employed for determining the hierarchical importance of tree species within the local community. Other PRA exercises included participatory mapping and seasonal diagramming (drawing of seasonal calendars). Pair-wise and matrix ranking enabled participants to select the tree species that they preferred to use for specific purposes, as well as those that possess certain desirable attributes. These methodologies provided the basis for assessing the nature of ethno ecological knowledge within the study area. Species ranking also revealed the species which are likely to be compromised or conserved in the event that land needs to be cleared, for instance for agricultural use. In pair-wise ranking the number of times a species was considered as more preferable than its 'competitors' denoted the score of preference for the species, and the species that registered the highest aggregate preference score was considered as the most preferred species. Scores for all villages were summed to yield aggregate scores for the entire survey. The highest possible score per species for any one use for all the eight villages was 192. Participants held discussions during the ranking process.

Participatory mapping provided the means through which the spatial distribution of forest and woodland resources was perceived by participants and yielded information on deforested areas, use rights patterns and resource use conflicts, tracks or routes that are most frequently used for resource tapping, as well as areas that have potential use for forest and woodland resource development. As already explained, information on routes used for resource tapping later proved to be vital in transect analyses.

Whereas data collected through participatory mapping bore spatial relevance seasonal calendars provided temporal data and revealed annual cyclical patterns related to the exploitation, use and destruction of forest and woodland resources. Environmental monitoring is the principal means through which subtle changes in the resource base can be detected and the analysis of seasonal calendars is the quintessence of this process. Processes and activities that impact upon forest and woodland resources can be detected by drawing seasonal calendars. As noted by Freudenberger (1994: 43) "seasonal calendars are tools that help to explore changes taking place over the period of a year."

Finally, open (plenary) group discussions, involving all categories of participants, were of primary importance in identifying the key players and decision makers in village resource use and conservation. Though a wide range of PRA research techniques solicited responses from specific categories of participants such as men, women and youths, open group discussions elicited collective responses or consensus on issues of concern from the entire spectrum of the community. In each of the surveyed villages the three afore-mentioned groups were combined to yield 'common pools' of participants whose responses to a selection of open-ended questions on forest and woodland resource use and conservation were noted. Participants were given time to debate among themselves before consensus was reached.

Open group discussions also helped to unveil the power struggles and cohesive grass roots alliances that are embedded in local communities, areas of potential conflict and prospects for co-management, as well as local ‘political power houses’. Furthermore, the discussions provided the means for checking the validity of the data collected through other PRA methodologies, as well as those collected through an earlier questionnaire survey. PRA responses were recorded on a Community Based Natural Resource Management (CBNRM) work sheet (field book) by the facilitators. Appendix II shows the field book that was used.

3.10 CONCLUSION

Mufurudzi resettlement scheme exhibits a complex and dynamically variable bio-physical and socio-economic environment. This complexity partly stems from land resettlement. The variations exhibited by both the bio-physical and the socio-economic landscapes made it necessary to adopt an integrated research approach in this thesis, comprising a range of ‘orthodox ecological science’ and ‘environmental transformation’ approaches to environmental analysis.

CHAPTER 4

STATE OF FOREST AND WOODLAND RESOURCES IN MUFURUDZI

4.1 INTRODUCTION

This chapter examines the state of forest and woodland resources in Mufurudzi. The chapter argues that the state of the forest and woodland resource base does not only vary geographically but also in complexity and refutes the popular notion that resettlement always leads to environmental degradation and loss of forest and woodland resources. What makes the case of Mufurudzi interesting is that even though there has been notable land cover changes within the scheme, there is no widespread devastation of forest and woodland resources as would be expected in an area that has been settled for more than 25 years. The complexity exhibited in patterns of forest and woodland resource distribution is evident at two levels, namely the macro and micro levels. Whereas the former was based on air photo interpretation (API) and satellite imagery, the latter is based on transect analyses. In macro level analysis large-scale vegetation cover changes were detected in the prefecture by comparing aerial photographs and satellite images for different dates. Both the 1981 and 1986 aerial photographs, as well as the 1996 SPOT (10 x 10 m) and 2001 Landsat images were used in the analysis.

Micro level patterns, which are discussed later in this chapter, are a reflection of the micro-level spatial dynamics that characterize forest and woodland resources within selected parts of Mufurudzi resettlement scheme. Apart from revealing these patterns, transect analyses also provided the means by which a detailed tree resource inventory was undertaken within the sampled farms. Tree resource inventorying constituted the basis for determining the diversity of the tree species, as well as the status and abundance of resources derived from them, all of which are key to the contemporary production and extraction economies of the resettled community.

The results of the analysis indicate that there is considerable geographical diversity in the state of forest and woodland resources in Mufurudzi. Apart from loss of forest and woodland resources through clearing of land for agriculture there appears to be no other significant loss of forest and woodland resources in the scheme. While this paints a generally positive picture about the scheme, at the micro level the results reveal that in some places there is pressure on tree resources and tree resource damage and loss are taking place, even in those areas where large-scale land cover changes appear to be inconspicuous or non-existent.

This chapter is structured as follows: Section 4.2 deals with the macro temporal and spatial changes of land cover, including the conversion of woodland into farmland, and section 4.3 describes the micro level patterns, while section 4.4 examines tree species diversity as well as the forest resource inventory of Mufurudzi on the basis of the characteristics of the vegetation that is found along defined transects.

4.2 MACRO SPATIAL VARIABILITY OF FOREST AND WOODLAND COVER IN MUFURUDZI

Figure 4.1 and table 4.1 provide a summary of the landscapes that have emerged in Mufurudzi since 1981. At the macro level, three categories of large-scale land cover landscapes have been revealed:

a) areas where resettlement has led to forest clearing due to opening of new fields

b) areas where former arable land has reverted to woodland, and

c) areas in which the extent of woodland cover has remained largely unchanged

Figure 4.1: Land Cover Changes in Mufurudzi

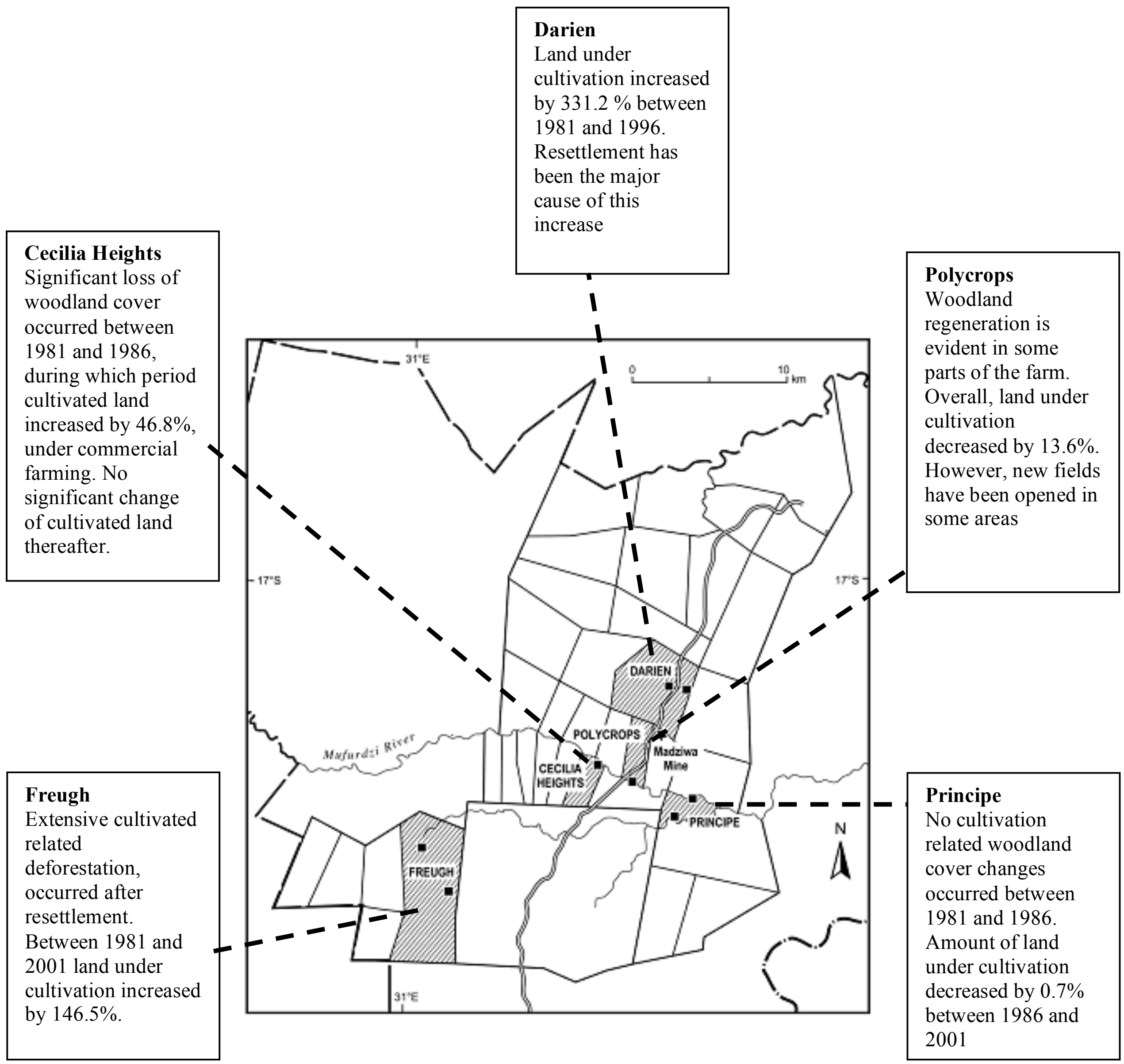


Table 4.1: Landscapes That Have Emerged in Mufurudzi Since 1981 and 1986

Section	Name of Sampled Farm	Village(s) Found in the Farm	Year When Village Was Founded	Prevalent Agricultural Practices Undertaken	Forest and Woodland Cover Change Between 1981 and 2001
I	Darien	Mudzinge	1981	Dry-land farming with cultivation on 4.8 ha holdings and extensive livestock farming	Widespread and extensive deforestation due to clearance of land for cultivation. The land under cultivation increased by 331.2% between 1981 and 2001. Resettlement has been the main cause of this increase.
		Zvataida	1981		
	Polycrops	Mupedzanhamo	1981	As above	Part of the land reverted to woodland after resettlement. Between 1986 and 2001 the amount of land under cultivation decreased by2.4%.
II	Cecilia Heights	Mufurudzi Village II	1994	As above	Significant loss of woodland cover has taken place between 1981 and 1986, during which the amount of cultivated land increased by 46.8%. The increase resulted from commercial farming activities prior to resettlement. There was no significant increase of cultivated land between 1986 and 2001.
	Principe	Principe A	1993	Land used as noted above Intensive farming involving irrigation on 1ha holdings	No significant cultivation related loss of woodland cover took place between 1981 and 1986. The amount of cultivated land decreased by 0.7% between 1986 and 1996. Resettlement did not contribute much to wholesale clearing of land before 1996.
		Principe B	1993		
III	Freugh	Chidumbwe I	1982	Dry-land cultivation on 4.8 ha holdings and extensive livestock farming	Extensive deforestation due to clearing of land for cultivation. Between 1981 and 2001 the amount of land under cultivation increased by 146.6%. This increase largely resulted from resettlement.
		Chidumbwe II	1982		

4.2.1 Areas Where Extensive Loss of Forest Cover Has Occurred

As shown in table 4.1 the most notable land cover changes that occurred in resettled farms are those that occurred where new fields were opened after resettlement, especially between 1981 and 1986. Examples of such farms are Darien and Freugh. In both Darien and Freugh, following the setting up of new villages, new fields had to be opened in areas which were previously used for ranching while existing fields had to be extended to accommodate the relatively large number of land reform beneficiaries who were resettled on these farms (figures 4.2 and 4.3). This led to considerable clearing of woodlands in both farms during the early stages of resettlement, particularly between 1981 and 1986. Land clearing was most conspicuous around villages such as Mudzinge and Zvataida (Darien), as well as Chidumbwe I and Chidumbwe II (Freugh), as shown in figures 4.2 and 4.3, where large a number of households were resettled.

Figure 4.2: Changes in spatial extend of cultivated land in Darien (1981-2001)

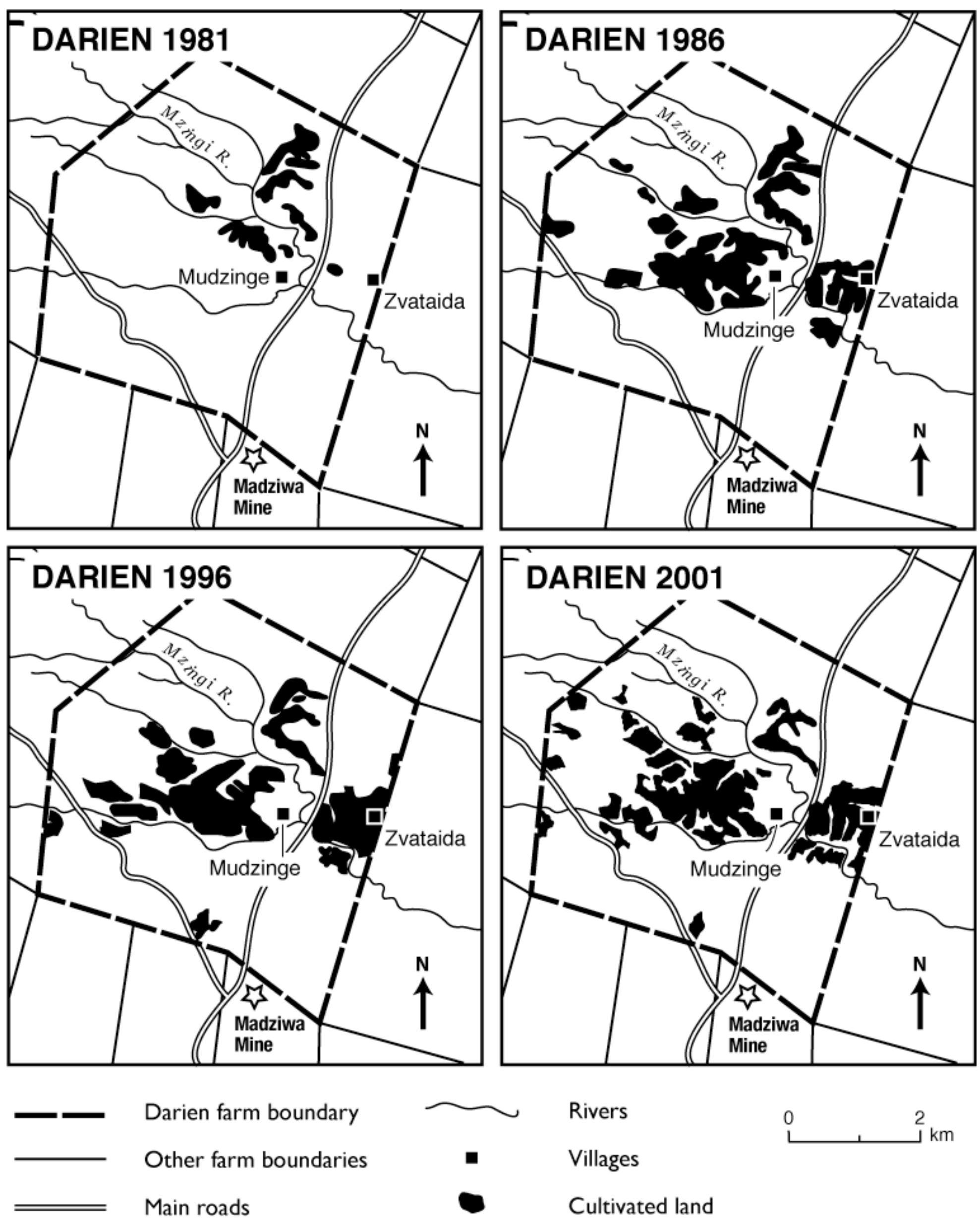
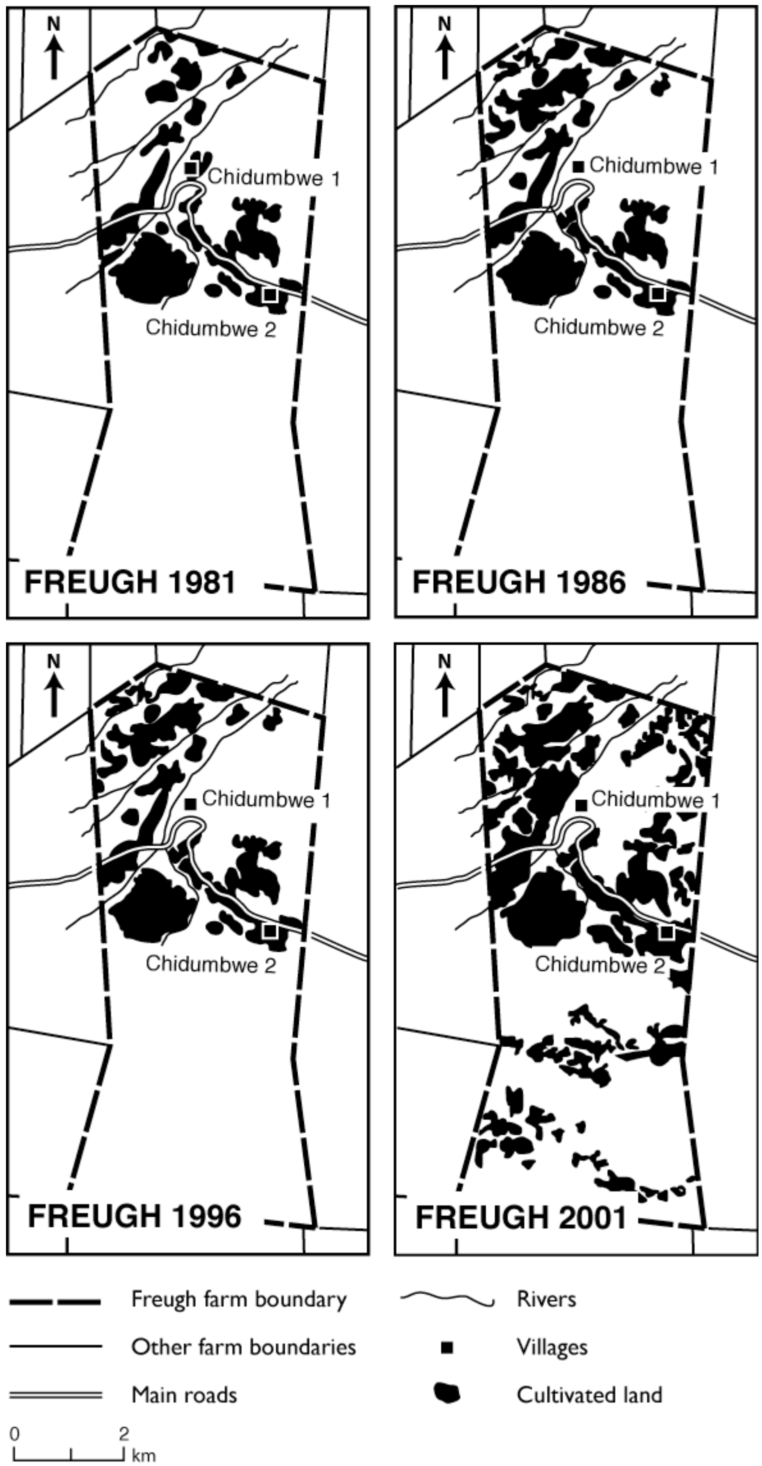


Figure 4.3: Changes in the spatial extend of cultivated land in Freugh (1981-2001)



However, in these farms the initial phase of resettlement was followed by a ‘wave’ of spontaneous resettlement where ‘secondary households’ which had not been legally allocated land resettled themselves, with the help of local politicians. This ‘wave’ of resettlement started in 2000 when large-scale invasions of white commercial farms took place in Zimbabwe. This form of resettlement occurred throughout Mufurudzi and was characterized by the chaotic opening of new fields, the majority of which were small, usually less than 1 hectare. As shown in table 4.2, spontaneous resettlement led to a considerable increase of cultivated land in Freugh than in Darien.

Table 4.2: Changes in Amount of Cultivated Land in Darien and Freugh

Property Name	**Total Amount of Cultivated Land (Ha)**			
	1981	1986	1996	2001
Darien	84.9	284.6	349.9	366.1
Freugh	447.1	540.2	540.2	1102.2

Even though spontaneous resettlement in Mufurudzi has resulted in widespread clearing of farmland, and subsequent destruction of forests and woodlands between 2000 and 2001, such a situation does not always arise. In Kalamate, a village in north-eastern Botswana, for example, API revealed that following spontaneous settlement medium and dense woody vegetation cover increased in some parts of the village, particularly in the middle and eastern parts of the village where areas that were previously occupied by scattered homesteads and fields were abandoned as villagers moved to the western and north-western parts of the village (Dahlberg, 2000). One reason given for the increase in woody vegetation cover is that human population increases in Kalamate have been modest and hence demands for forest and woodland resources have not been excessive. The other reason, however, relates to the increase of the livestock population pressure on pastures. In Kalamate grazing has enhanced the germination of woody species such as *D. cinerea* and *Acacia tortilis*, as well as *Colophospermum mopane.* However, unlike in Kalamate, the areas from which 'secondary households' were moving within Mufurudzi were never abandoned to allow forest regeneration. Furthermore, some of the 'secondary settlers' who opened new fields during the 2000 land invasions came from the adjacent communal areas rather than from within the resettlement area itself.

4.2.2 Areas Where Farmland Has Reverted to Woodland

API and satellite imagery have revealed that in Mufurudzi there are areas where formerly cultivated land has reverted to woodland as noted in table 4.1. Such areas largely comprise arable land which used to be cultivated by former white commercial farmers prior to resettlement. Parts of these areas have been allocated to communal grazing within the resettlement scheme and are a typical example of areas where woodland regeneration has resulted from change of land use. This was primarily the case in central parts of Polycrops, where bush encroachment and woodland regeneration have occurred. In this case, change of landuse is the major factor responsible for woodland regerenation. There appears to be no conflict between settlement and grazing, even though.grazing areas are used as the source of a number of forest and woodland products, including construction poles, lathies, ropes and edible products such as fruit, insects, honey, mushrooms, game meat and other products. The prevalence of woodland regeneration in some parts of Mufurudzi clearly demonstrates that resettlement does not necessarily always lead to the destruction of environmental resources. In these areas it could actually be argued that changes in landuse planning after resettlement has enhanced the resource base from which essential products are tapped. This situation confirms the perceptions that some land reform beneficiaries have about availability of forest and woodland products in Mufurudzi. The questionnaire survey that was conducetd in the scheme revealed that 24% of the household heads believe that forest and woodland products have remained the way they were since their arrival in the scheme, while 18% actually believe these resources have increased.

A similar situation prevails in Kalamate where bush encroachment became widespread after villagers had abandoned their fields (Dahlberg, 2000). Another example has been reported in Kissidougou in Guinea, where the evolution of settlements in savanna grasslands has induced the establishment of woody vegetation cover (Leach and Mearns, 1996). API revealed that since 1952 there has been an increase in forest cover in Kissidougou, showing a general expansion of forest islands that emerged around villages. Contrary to conventional scientific wisdom, the case of Kissidougou demonstrates a situation where settlement induced the improvement of forest cover, as well as its ultimate demise following abandonment of settlement in some cases, for instance at Damania (Leach and Mearns, 1996). Both the Kissidougou case and the case of woodland regeneration in parts of Mufurudzi clearly demonstrate that the process of settlement and the conservation of forest and woodland resources are not always diametrically opposed, indicating that the relationship between resettlement and forest and woodland resources is not always 'antagonistic' as largely portrayed in Neo-Malthusian literature. Woodland regeneration in parts of Mufurudzi is a typical example of how environmental transformation can yield positive results.

4.2.3 Areas Where Forests and Woodlands Have Remained Static

As noted above, there are areas where up to 1996 there had been no significant increases of land cleared for resettlement purposes. Examples of such areas are Mufurudzi II village (Cecilia Heights), Principe A and Principe B (Principe). Though these areas had already been designated for resettlement by the early 1980s the actual resettlement within these areas only took place after 1990. Thus between 1981 and 1986 these areas were used for commercial agriculture by white farmers. After 1996 there was no significant conversion of 'virgin land' to farmland in these areas. This could partly be explained in terms of the reluctance of white commercial farmers to open new fields. Because their farms had already been designated for resettlement the affected white farmers had no incentive to convert additional woodland to new agricultural land under conditions of looming uncertainty. Under these circumstances stability of woodland cover resulted from the fact that the returns of additional land clearing would not justify the costs.

The case of Cecilia Heights is by no means unique. Similar forms of stability were reported in Kalamate (Botswana) and Kissidougou (Guinea), even though such stability was achieved under different circumstances. API revealed that between 1964 and 1988 stability of woodland cover occurred in Kalamate, especially in those areas where homesteads were generally scattered and population densities were low (Dahlberg, 2000). Similarly, in Kissidougou there are a considerable number of forest islands whose spatial extent has remained relatively stable since 1952 (Leach and Mearns, 1996).

From the foregoing discussion it is imperative to note that aerial photographs and satellite images on their own suggest that the clearing of land for agricultural purposes is the most important cause of loss of forest and woodland resources in Mufurudzi, whereas in reality there are other important factors that put pressure on these resources, some of which are not always noticeable at the macro scale. This is because API is only capable of revealing the more conspicuous macro-scale geographically contiguous cleared areas rather than the localized micro changes that are geographically isolated, particularly those that are induced by direct utilization of forest and woodland products.

In summary, at the macro level there are a number of generalizations that can be drawn from the complex distribution of tree resources in Mufurudzi. First, the complexity exhibits both historical and spatial contingency. Historical contingency refers to a situation where the state of a system or environment is at least partially dependent on one or more of its previous states while spatial contingency refers to a situation where the state of the system or the environment at any location in part depends on the state of conditions at other, functionally linked, locations; or on sensitivity to purely local environmental controls or influences (Phillips, 2001). The prevalence of woodland regeneration in areas where cultivated land has changed to grazing land following resettlement is a typical example of historical contingency. On the other hand the extension of cultivated land on the margins of the existing fields is akin to spatial contingency. While useful in revealing macro environmental changes, API is less effective for assessing the more subtle and insidious changes of tree resources which is brought about by selective utilization or damage of trees, thus rendering transect analyses important where tree resource distribution and use patterns at micro-level have to be analyzed.

4.3 MICRO SPATIAL VARIABILITY OF FOREST AND WOODLAND RESOURCES IN MUFURUDZI

This research reveals that complex micro patterns of forest and woodland resource use have emerged in Mufurudzi resettlement scheme. One conspicuous pattern reveals that the distance between the place at which forest products are consumed and the area from which the resources are obtained has an influence on the manner in which the resources are exploited. This situation is prevalent in many areas within Mufurudzi. Transect analyses revealed that tree resources that are near homesteads are subjected to greater pressure than those found in more distant locations. Consequently, tree densities are relatively lower in places that are near homesteads compared to those found in more distant places.

However, such a situation does not necessarily apply throughout Mufurudzi due to a number of factors. As shall be explained in detail later, in Principe A and Principe B villages, as well as in Mudzinge and Zvataida villages, the expected patterns whereby tree densities increase with distance from homesteads were distorted by landscape morphology and the presence of cultural shrines such as gravesites. These factors promote differential tree resource exploitation by inducing variable constraints in the manner in which tree resources are accessed. In some cases landscape morphology and cultural factors exert constraints that make tree resources at distant locations more accessible than those in nearer locations, as discussed below. Another important factor which introduces distortion in tree resource distribution is previous landuse.

4.3.1 Distance Tree-Density Relationship

In all the villages that were surveyed in Mufurudzi resettlement scheme, it has generally been observed that both forest and woodland cover and the size of trees of specific species tend to increase with distance from the homesteads, though deviations from this pattern are evident due to some distortions. Transect analyses revealed that the distance between trees and individual sampling points (an indication of how closely spaced the trees are) and the distance between the sampling points and homesteads are either negatively or weakly correlated. This clearly indicates that within the prefecture trees are relatively more closely spaced in distant locations than in areas that are close to homesteads. In some villages, for example Mufurudzi II (see figure 4.4), tree spacing decreases with increasing distance from the homesteads. In Chidumbwe I, Chidumbwe II, Mufurudzi II and Zvataida negative correlations were recorded between the distance of trees from sampling points and the distance of sampling points from homesteads. In these villages tree density rises sharply with distance from homesteads. This sharp rise in tree densities strongly suggests that anthropogenic pressures have a significant influence on the tree population distribution. This situation is clearly evident in villages such as Mufurudzi II, Zvataida and Chidumbwe I. For instance, as shown in figure 4.5, in Chidumbwe II tree density nearly trebles between the distances of 200m and 500m. Similarly, along Mufurudzi transect (figure 4.6), tree densities generally increase with distance from homesteads. Areas where tree densities are low in distant places are mostly those where resource extraction is generally high due to prevalence of activities such as brick burning. Holding all factors constant, within areas that are relatively close to homesteads, tree resources and NTFPs are more readily harvested than those that are found in more distant locations. This is because it takes significantly less time and effort for resource users to access resources that are found around their homesteads than those sourced from more distant locations. The challenge that CBNRM faces is to optimize resource use so that the time and effort spend sourcing livelihood inputs from forest and woodland products remain minimal.

The above scenario has been revealed in other Zimbabwean resettlement schemes as well. It has generally been demonstrated, for example, that in Zimbabwe the availability of forest and woodland products systematically varies with distance from homesteads (Grundy *et al* 1993). For instance, by examining the spatial effects of fuel and construction wood use in six villages of Mutanda Resettlement Scheme in Manicaland, Zimbabwe, Grundy *et al,* (1993) showed that the number of live trees per hectare is positively correlated with distance moved away from the village, and consequently the costs of wood collection increase with distance from the village.

Figure 4.4: Relationship Between Tree Spacing and Distance from Homesteads in Mufurudzi II

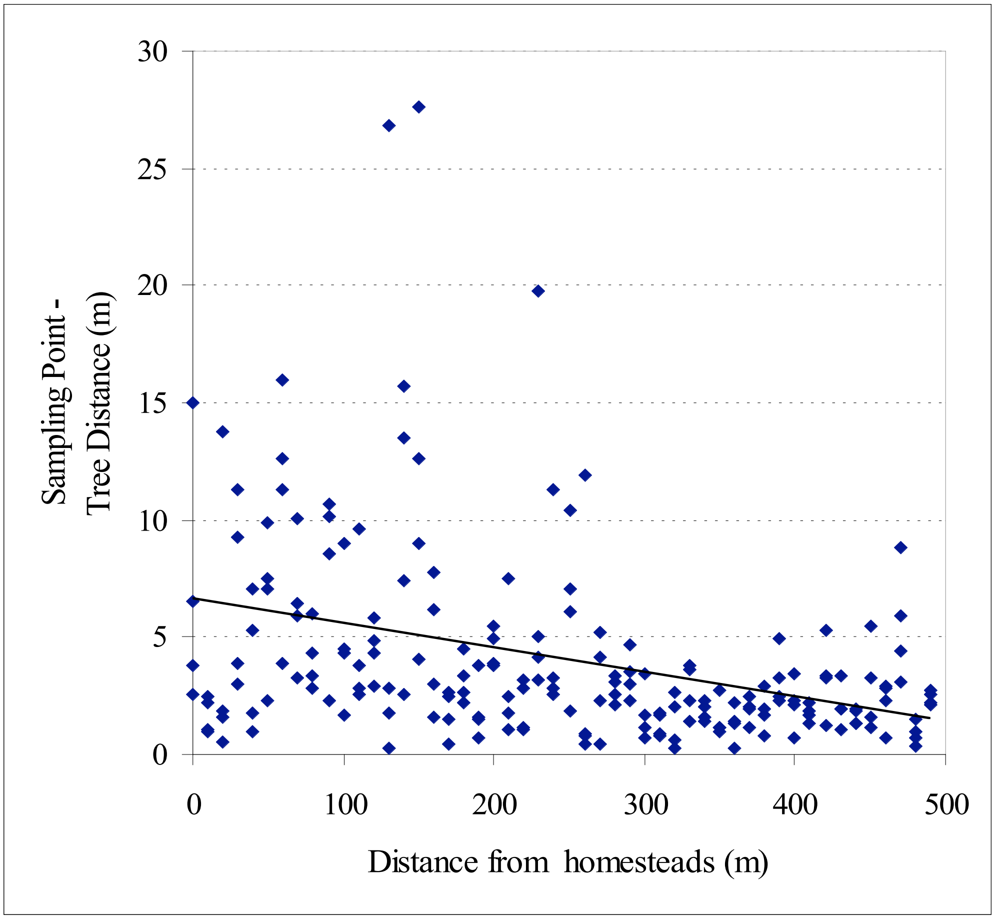


Figure 4.5: Variability of Tree Density in Chidumbwe II Village

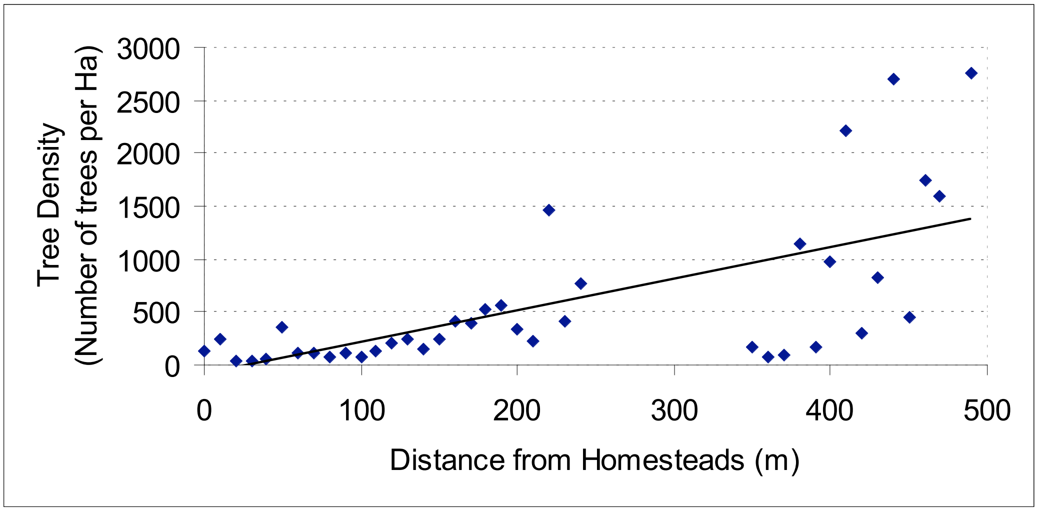
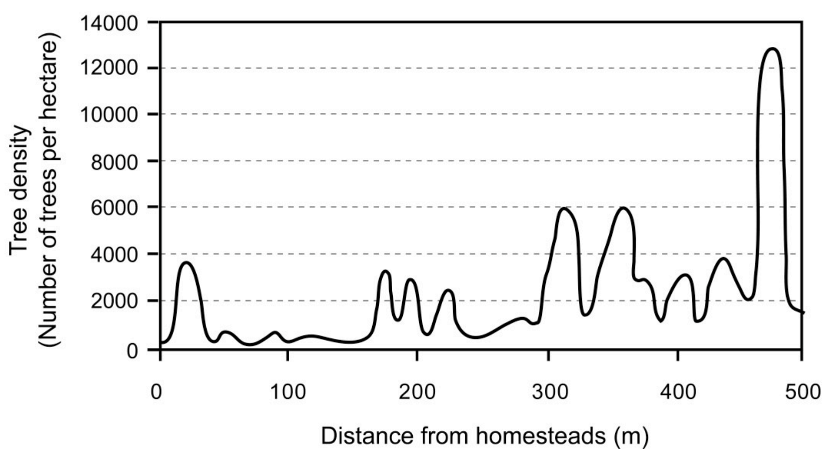


Figure 4.6: Variation in Tree Density Along Mufurudzi II Transect



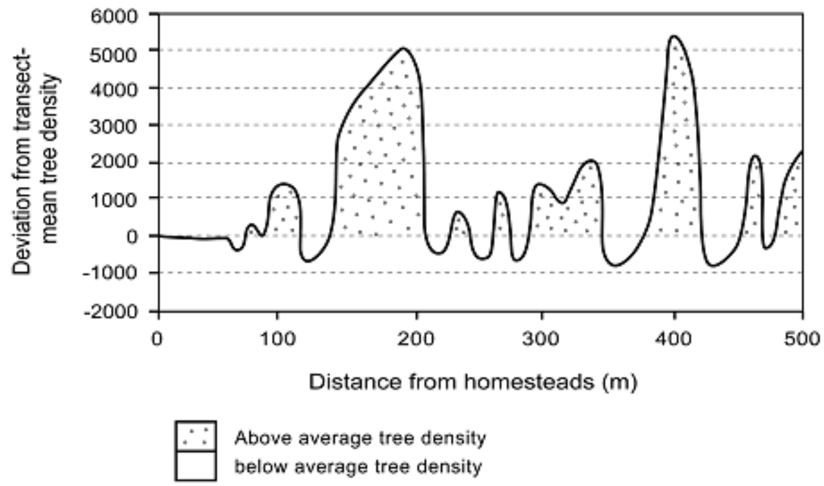
4.3.2 Distortions of the Distance – Tree Density Relationship

There were cases where the manner in which tree resource distribution was unique to particular villages. In some parts of Mufurudzi complex patterns of tree resource distribution have emerged. This is especially the case in villages such as Zvataida (Darien), Mupedzanhamo (Polycrops), Principe A and Principe B where tree density-distance relationships do not exhibit any definite spatial pattern. In these villages morphological, socio-economic and cultural factors have distorted the expected tree density-distance patterns. These factors have created a number of transitional zones within the prefecture, each characterized by different levels of access and tree resource exploitation, as explained below.

- **Landscape morphology and differential accessibility of tree resources**

In villages such as Mupedznhamo (Polycrops), Principe A, Principe B and Mufurudzi II, transect analyses revealed that access to forest and woodland resources is not a function of distance from homesteads alone but of landscape morphology as well. In all these villages tree spacing varies from one location to another at some sampling points along the transects that were surveyed in these villages. At these sampling points the average distance between specific sampling points and the nearest trees in each quarter of the sampling frame (MSSP) exceeded the average distances between sampling points and the nearest trees along the entire transect (MSFT) by more than 2 metres, signifying considerable tree scattering, and low levels of tree densities. In Mupedzanhamo, (see fig 4.7.) for example, the main area from which forest and woodland resources are found is serrated by gullies. The gully that is closest to the homesteads is approximately 67 metres wide and nearly eight metres deep.

Figure 4.7: Spatial Variability of Tree Spacing in Mupedzanhamo



Whereas the area between the homesteads and this gully is almost bare, the opposite side is fairly densely vegetated, showing that the gully is an impediment to forest and woodland resource users. The second gully, which is approximately 11, 6 metres wide, occurs about 240 metres from the homestead. Besides gullies there are also some rock outcrops, that render a number of locations less accessible to woodland resource users. In Principe A and Principe B the main physical bottlenecks that impede resource accessibility are rivers and hillocks. Consequently, tree populations are higher per unit area around these features compared to other areas. Nevertheless, from the forgoing discussion it can be argued that the complexity exhibited by forest and woodland cover indicates that demand and scarcity of forest and woodland resources in Mufurudzi have not yet reached levels where resource users have to invest time and effort in exploiting those resources that are found in areas of prohibitive terrain, regardless of the scheme having been settled for more than 25 years.

- **Socio-economic influences on tree resource distribution**

Proximity to locations where certain important rural livelihood activities are carried out has also influenced the micro-level distribution of tree resources in Mufurudzi. These activities include farming, gardening and brick moulding, as well as gold panning. Where these activities are undertaken they are often accompanied by tree resource use. Whereas tree clearing is essential for the initial setting up of fields, gardens, brick moulding and panning sites recurrent tree cutting is necessary once these activities become fully operational. For instance, continuous tree cutting around fields and gardens is necessitated by the need to protect crops. The erection and maintenance of fences, including brushwood fences, which is a common practice throughout Mufurudzi, is an example.

Similarly, trees are cut to make way for gold panning or to provide ‘mining props’, building materials for construction of huts and to supply fuel for brick burning. However, gardening and brick moulding are seasonal activities that are carried out in the dry season and are, therefore, normally undertaken in areas where water supply is less erratic and where soils are generally suitable for that purpose. As a result, proximity to a permanent source of water is prioritized. Thus, the choice of site for undertaking these activities is not a mere function of distance from the homesteads alone but also the availability of other essential resources such as suitable soil and adequate water supply. Brick moulding sites and gardens along Zvirungurira river (Mufurudzi II village) and Nyatope river (Mupedzanhamo village) are typical examples of places where tree cover losses have been considerable.

It can be concluded therefore that variability in forest and woodland resource accessibility and proximity to homesteads, fields, gardens and sites of economically viable activities have created multiple entry points from which forest and woodland products are differentially exploited to give rise to differentially degraded woodlands characterized by clumps of trees and patches of bare ground, thereby distorting the expected pattern where tree densities positively correlate with distance from homesteads.

Virtually all transects surveyed in Mufurudzi exhibit tree damage that is consistent with the collection of NTFPs, including worms, medicines, fruit, honey and in some cases latex. In the case of Mufurudzi it would appear the observation that tree resource use patterns differ geographically due to the different strategies adopted by householders to minimize their risk (Clarke and Grundy, 2004) is irrefutable. As noted by Forsyth and Leach (1998) some environmental changes tend to be location specific and are subject to the influence of local conditions. This is particularly the case with habitat conditions such as soil type, drainage, landscape morphology, availability of water and other localized conditions.

- **Relationship between cultural influences and tree resource distribution**

When considering Mufurudzi resettlement scheme as a whole, it could be argued that even though morphological and socio-economic conditions are undoubtedly the most important factors that determine the state of forest and woodland resources and the manner in which these resources are accessed by local communities, there are cultural forces that exert the same influence. In the case of Principe A, Mufurudzi II and Chidumbwe II villages, for example, cultural shrines such as gravesites have led to differential exploitation of tree resources within the woodlands. In these villages tree cover is much denser around community gravesites than in other areas. Tree girths also tend to be higher around the gravesites. For example, along Chidumbwe II transect the community gravesite which is situated some 350m from the homesteads consists of huge trees. The *Syzygium* trees which are found at the gravesite exceed 30cm in diameter, and are much larger than the majority of the trees that are found elsewhere along the surveyed transect. Similarly, the termitaria vegetation in Mufurudzi II comprises trees of considerable girths at the gravesite found between only 35m and 40m from homesteads. Trees at this site have been left intact while the proportion of damaged species is about 59% around the site. Similar patterns of tree resource distributions also occur at a gravesite that is found about 120m from homesteads in Principe A.

There is evidence that local communities in Mufurudzi resettlement scheme prefer to bury their dead in more closed woodlands, a phenomenon that has aided tree conservation around burial sites. Most villagers in these communities generally consider tree cutting or use of woodland products that are found near cultural shrines such as gravesites and sacred groves culturally inappropriate. The villagers generally believe that any form of desecration of burial sites evokes reprisal from the 'living dead' and the spirit world.

However, in all the villages that were surveyed in Mufurudzi resettlement scheme, it can generally be concluded that both forest and woodland cover and the size of trees of specific species tend to increase with increasing distance from the homesteads, though deviations from this pattern are evident due to the distortions that have been discussed above. Transect analyses revealed that there are a number of tree species that receive greater protection from exploitation than others. These include *Kirkia acuminate, Crossopteryx febrifuga*, *Syzygium spp*, *Parinari curatellifolia* and *Pseudolachnostylis maprouneifolia*. Data gathered from the surveyed transects reveals abundant evidence that suggests that these trees are not as widely exploited as other species. The role of these species is discussed in Chapter 5. The population of damaged trees within this category of species is generally low, while there appears to be no relationship between tree size and distance from homesteads.

- **Influence of previous landuses on tree resource distribution**

The state of the vegetation is not necessarily always the reflection of contemporary processes. Alluding to land redistribution in South Africa, Willis (2004) noted that redistributed land is not always natural forest or natural woodland, but some form of land that has already been transformed. Indeed in some parts of Mufurudzi resettlement scheme tree resource distribution is partly a function of historical processes related to landuse change. For instance, at corresponding distances tree population densities in Chidumbwe I are much lower than those found in nearby villages such as Chidumbwe II and Mufurudzi II. At the distance of about 500m from homesteads, for example, tree population densities in Chidumbwe I are only about 1200 per hectare, compared to about 1500 and 4000 per hectare, in Chidumbwe I and Mufurudzi II, respectively. As noted in table 4.3, beyond 500m from homesteads land in Chidumbwe I was once cultivated by previous owners. Today this land is used for grazing and the woodland is in the process of regeneration. This explains the small stature of trees found in the area as well as the reason why trees are more widely spaced than expected.

Table 4.3: Characteristics of Chidumbwe I Transect: S17^0 08.446^1 E031^0 31.072^1 – S17^0 08.427^1 E031^0 31.348^1

Zone	**I**	**II**	**III**	**IV**	**V**
Distance from homesteads (m)	0-100	100-200	200-300	300-400	400-500
State of transect zone	Thinly vegetated area in which scattered clumps of trees are interspaced with vast stretches of bare wetland. This zone is separated from the homesteads by an ephemeral stream along which *B. boehmii, J. globiflora, Pseudolachnostylis maprouneifolia* are prevalent, beyond which exists a stretch of land previously occupied by workers' quarters for the former commercial farm. Dominant trees in this zone include an assortment of thorny trees, fruit and medicinal trees that appear to have been deliberately conserved, as well as low value trees such as *Albizia amara*.				Open woodland exhibiting an increase in vegetation density with increasing distance in a zone where land was once used for cropping as evidenced by remnant contour ridges. A wider range of tree diameters exists compared to zones I-IV. The diversity of rare species also increases in a similar way.
Average SP-nearest tree distance (m)	>30	5.07	4.60	4.71	7.43
Tree density (per hectare)♣	0	271	474	452	181
Tree species commonly found along transect and within the vicinity	*Bauhinia thonningii, Gymnosporia buxifolia (Maytenus heterophylla), Albizia amara,*	*Acacia spp., Terminalia sericea, Cassia spp., Brachystegia boehmii , Combretum fragrans, Terminalia stenostachya*	*Cassia spp., Crossopteryx febrifuga, Diospyros kirkii,*	*Terminalia sericea, D. kirkii, B. boehmii, Syzigium spp., Albizia amara, T. stenostachya*	*Sterculia quinqueloba, B. petersiana, D. cinerea, B. boehmii, P. maprouneifolia*

In some parts of Mufurudzi resettlement scheme there are strong indications that species diversity has been influenced by former landuses. In some parts of Darien farm, and the nearby Rataplan farm, land was largely used for ranching and evidence of bush control is still abundant. In order to improve livestock grazing many small trees, as well as undesirable species, were cleared from the land, leaving only those large trees that were suitable for animal shade or fodder supply. In Darien the huge trees, including *Brachystegia spiciformis, Brachystegia boehmii* and *J. globiflora* that dot around the landscape are a relic feature inherited from the woodland that once thrived in the area prior to the introduction of ranching.

In summary, it should be noted, that transect analyses have confirmed the validity of the perception of the resettled farmers that there has been environmental transformation in some parts of Mufurudzi resettlement scheme. Results from the ground surveys that were conducted revealed that both the productive and extractive systems of the local economy, particularly those related to agriculture and use of forest and woodland products, have contributed to this transformation. Considering Mufurudzi as a whole, the demand for agricultural land as well as the utilization of forest and woodland resources to sustain rural livelihood systems have transformed the environment into a landscape that is characterized by a complex string of multiple zones of tree resource cover that are separated by bare patches of ground, each exhibiting different levels of exploitation and human induced pressure, as shown above. Even so, the process of landscape transformation has yielded complex patterns of resource distribution which do not exhibit any evidence of total resource degradation.

Instead the landscape that has emerged depicts enclaves of dense tree cover that are interspaced with belts of exploited resources, which is totally uncharacteristic of degraded environments. The complex spatial patterns exhibited within the vegetation in villages such as Zvataida, Mupedzanhamo, Principe A and Principe B villages clearly indicate that though tree resources are under anthropogenic pressure, outright degradation and over-harvesting take time to occur in properly planned resettlement areas. However, as discussed below, forest and woodland resource utilization is not a random process but a systematic process that is directed to specific plant species, a situation that has significantly impacted upon the relative abundance of some keystone species.

4.4 SPECIES DISTRIBUTION

4.4.1 Relative Abundance of Preferred Tree Species in Mufurudzi Resettlement Area

Micro level spatial variability in species' relative abundance denotes differential access to resources among resource users. Species' relative abundance determines the livelihood options that local communities have at their disposal, as well as the resource management strategies that these communities can adopt to sustain their livelihoods. Whereas both questionnaire surveying and PRA revealed that there are some tree species that play an important role in meeting livelihood needs, transect analyses provided the means by which the actual distribution of the species was assessed.

Table 4.4 shows the frequencies of some of the species that are most preferred for different purposes, as well as *Xeromphis obovata*, a 'problem species', in all the eight villages that were surveyed. The species in the table are the ones that were most highly rated by villagers, who considered them as ideal for specific purposes.

Table 4.4: Relative Abundance of the Most Preferred Species

Livelihood need/ problem	Most preferred species	Zone (Frequency of species at different distances from homestead in metres)					Total	Relative abundance* (expressed as a percentage)
		0-100	101-200	201-300	301-400	400-500		
Construction	*Pericopsis angolensis*	2	2	3	0	2	9	0.73
Fruit	*Diospyros kirkii*	4	11	19	8	7	49	3.99
Wood fuel	*Brachystegia boehmii*	54	52	57	67	77	307	25.00
Shade	*Bauhinia petersiana*	7	7	3	2	4	23	1.87
Artifacts, Carving and curios	*Terminalia sericea*	9	8	13	3	5	38	3.09
Fodder	*Dichrostachys cinerea*	36	29	11	3	3	82	5.68
Multiple use	*Lannea discolor*	2	5	6	1	10	24	1.95
Problem species	*Xeromphis obovata*	30	4	7	10	14	65	29.00

* Relative abundance is the ratio of the species population to the total number of trees and shrubs covered in the survey. The total number of trees and shrubs encountered in the survey was 1228.

However, the actual spatial distribution of the above species is depicted by the relative densities of the species, shown in table 4.5. The higher the relative density values the more available is the species. Tables 4.4 and 4.5 show that *B. boehmii* is clearly the most abundant species, while *Pericopsis angolensis* is a very rare species. The variation in relative densities denotes lack of spatial homogeneity in species distribution.

The importance of a species in the livelihood of the local community can be viewed partly in terms of the manner in which the population of the species changes with increasing distance from the homesteads. For instance, the sharp increase of the population of *B. boehmii* with distance signifies depletion of those members of this species that are closest to the homesteads, a pattern that was also observed in Mutanda Resettlement Scheme by Grundy *et al,* (1993). The population of *Dichrostachys cinerea* on the other hand decreases with distance from homesteads. There are several possible explanations for this pattern.

First, *Dichrostachys cinerea*, a thorny tree, is rarely used for most critical purposes. Besides being an important source of fodder *Dichrostachys cinerea'*s only other important known use is medicinal, though construction poles may be derived from it in areas where building materials are extremely scarce. Second, the seeming distance related decrease of the population of *Dichrostachys cinerea* might simply be explained in terms of the prevalence of other species in the woodland rather than by its mere level of exploitation. Third, the prevalence of *Dichrostachys cinerea* near homesteads might be the result of the dispersal of its seeds by livestock, a process that has been taking place during the past 24 years the scheme has been in existence. *Dichrostachys cinerea* often thrives in overgrazed environments (Dahlberg, 2000).

Even though more research needs to be done on the distribution of *Dichrostachys cinerea* what is already evident is that the species has not yet been widely exploited in areas that are close to homesteads, where it is flourishing, signifying that land reform beneficiaries in Mufurudzi still have other options to resource use, as well as other species to choose from, and are not yet desperate to the extent of using this species for most purposes. However, the relatively high population of *Dichrostachys cinerea* is not unique to parts of Mufurudzi. *Dichrostachys cinerea* is one of the species whose populations were reported to have increased in Kalamate in north-eastern Botswana (Dahlberg, 2000). The other species whose populations were reported to have changed in a similar manner in Kalamate include *Acacia tortilis* and *Colophospermum mopane*.

The main reason cited for this increase is increased grazing, which tends to promote the germination of these species. As shown in table 4.5 above, there are some tree species whose population densities do not seem to change with distance. Among such species are fruit trees like *Diospyros kirkii, Lannea discolor* and *Bauhinia petersiana,* as well as, the problem species *Xeromphis obovata*. *Xeromphis obovata* often occurs in dense thickets and seems to easily invade and colonize devegetated rocky areas. In villages such as Zvataida and Principe A, where *Xeromphis obovata* is proliferating, the species is regarded as obnoxious or a nuisance because it impedes the movement of both people and livestock, and is a threat to the quality of grazing. However, the plant is medicinally important as noted in Appendix IX. Plate 4.1 shows a typical stand of *Xeropmhis obovata* in Zvataida village.

Plate 4.1: A stand of *Xeromphis obovata,* showing almost total absence of other species in the vegetation (Darien Farm)