Veld Products

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Submitted: 18th of March 2005 to Quentin Gausset and Andreas de Neergaard

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Interdisciplinary Land Use and Natural Resource Management

Abstract

Natural resource management is a contested field and we have learned that interdisciplinarity is essential in order to understand the complexities of academic fields.

We have examined the sustainability of veld products by looking at accessibility to resources over time and the human influence on the environment in Lerala, a village in the Central District of Botswana. The products of interest were firewood, timber, traditional medicine and fruits.

In spite of assumptions in literature and governmental interviews that local management would be unsustainable we discovered that implicit management exist and overall works well in protecting the environment. But we have also identified changes in the environment in forms of increased distance to the firewood and timber and the impact that this have on the least well-off group. For other veld products we have not identified important changes.

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1 Introduction

1.1 Natural Resource Management - a scientific battleground

Natural resource management is an area that is increasingly gaining importance in the media as well as in various academic fields. The area of study is wide and is dealing with important resources that humans are depending on such as oil, natural gas, coal, water (e.g. hydro power), wind or plants. These resources have a great impact on national economies and peoples' livelihoods and it is therefore including research in natural and social sciences.
It is important to note that natural resource management is a scientifically contested field, which is divided into different paradigms of different basic values. Typically, it is possible to divide the debate into two conflicting views: an *eco-centric* point of departure and an *anthropo-centric* one.
The *eco-centric* view considers the environment to have an intrinsic value in itself that must be protected from human activities. Human activities in the ecosystem are seen as unsustainable, and conservation of the environment is therefore an important goal in itself. The *anthropo-centric* view considers human beings to be in the centre, and the environment is seen as instrumental: the environment is a resource and its value is not intrinsic but given by the people using it. Depleting some parts of the ecological system might not be unsustainable if people can substitute the resources.

Within the social sciences, different views of natural resource management exist based on different assumptions about human action and rationality. On one side of the spectre a classic economic theory the Neo-Malthusian idea argues population growth naturally leads to degradation of the natural base, and that the world therefore eventually faces disaster. This thought is closely linked to the "*The Tragedy of the Commons*"- theory by Hardin (1968), which implies that people are "rational beings" (understood as in economic theory) who will destroy nature if not restricted and controlled since humans are bound to optimise own benefits while not caring about nature. Privatisation of property is seen as the only means to motivate people to manage nature sustainably and to avoid anarchy.
On the other side there are theories arguing that common property is positive and believe that privatisation leads to social marginalisation.
Between these two scenarios of tragedies are theories by scholars as Ostrom (2002), who argues that there necessarily must exist a "*Drama of the commons*" due to the fact that natural resource management is linked to politics, but that it not always is a "tragedy". Ostrom does not deny that the environmental and social tragedies occur, but stresses that this should not be taken for granted; each community and its context must be analysed separately.
When analysing natural resource management it is hence crucial to be aware of these different basic assumptions and take a stand regarding this different scientific paradigms of values and assumptions.

The case of Botswana
We were working together 8 students from different countries and backgrounds (5 natural and 3 social scientists) where the value of both the eco-centric and the anthropo-centric views were present in our discussions. We are dealing with natural resource management in a concrete local case - the case of Lerala in the Eastern part of Botswana. Lerala is a village with around 5,000 inhabitants, which was founded in the 1960s and has grown to be a relatively large village with facilities such as electricity, postal services and schools. The village, however, is a traditional village mainly based on cattle industry and agriculture.

We have been dealing with a resource that is important for the local livelihood in Botswana - the "bush" or the "*veld*" products (both timber and non-timber forest products) as it is called in the southern part of Africa.
The veld is widely distributed in Botswana. There exist about 150 species wild food plants and about 150 insects for consumption and/or medicinal use in Botswana. The geographical distributions of veld products vary in the different parts of the country, and local communities from different parts of Botswana are hence not dependent on the same veld products (Atlhopheng *et al.* 1998).
The attention has been drawn to veld products in Lerala by a women's Community Based Organisation (CBO) called Kgetsi ya Tsie (KyT), which is funded by foreign donors. The basic idea has been to encourage commercialisation of veld products and the empowerment of rural women. By the fact that a CBO is based on commercialisation of veld products states the importance of these resources for rural livelihoods.

Before going on our field trip we consulted literature regarding the management of the veld, and came across concerns of depletion of veld products in almost all areas where veld products are an important source of income. The area is semi-arid and is exposed to severe droughts, which some times last for years and can affect the ecological system. Humans are seen to be aggravating these trends in a fragile environment by use of inappropriate harvesting techniques, and conversion of veld areas to e.g. grazing areas for cattle (Atlhopheng *et al.* 1998), which has been leading to depletion of the veld. This is seen as a major problem, ecological loss might also lead to an economic loss of the people depending on the veld and a decreased access to vital resources such as firewood. In some reports, the damaging human activity was seen as a result of privatisation that has been carried out in Botswana since the 1970s, leading to equally inefficient harvest as well as marginalization and poverty (Cullis and Watson, 2004). What was common in the literature, in Botswana newspapers and as well in an interview with a government official in the Agricultural Resources Board was, that we were dealing with a case of unsustainable management. This therefore became our expectation when we went to Lerala. And hence, our approach was to find verification of our hypothesis that the veld was being depleted and groups were marginalised.

1.2 Problem Statement and Definitions

Our objectives for the project work have been to investigate the environmental impacts of the harvesting of some chosen veld products in Lerala. Furthermore we wished to identify social problems connected to local management strategy. These objectives lead to the following research question:

To examine if the local use of firewood, timber, medicinal plants and fruit trees in Lerala is sustainable.

As sustainability is a complex concept, we have defined the concept in terms of social sustainability and environmental sustainability. Our definitions are given below:

1. **Sustainable socio-economic aspect**

The users of the chosen veld products should have at least the same access to the products in the future as they have now. If the access to the products decreases, access to alternatives must increase.

2. **Sustainable environmental aspect:**

The harvesting of the chosen veld products should not exceed the supply of these. A change in the vegetation does not necessarily mean that the harvesting is unsustainable, because we are looking at the function of the resource and not its intrinsic value.

1.3 Delimitations

As the distribution of veld products in Lerala is wide, so are the uses of the individual veld products. We have therefore narrowed our focus to firewood, timber, medicinal plants and fruit trees in our project research. The choice of investigation fell on these products in the belief that these resources were accessible to examine with an interdisciplinary approach.

In the categories of firewood and timber we have limited the focus to the species Mophane (*Colosphermum Mopane*) and Mohudiri (*Combretum apiculatum*) as they were considered the best and most used species. We will not focus on specific medicinal plants but on traditional medicine in general. At last, we focus only on Morula (*Sclerocarya birrea*) of all fruit trees.

We have tried to answer the problem statement with use of a variety of methods discussed in Chapter 3.

With accessibility to the products as the key word, we have been examining the utility of the products and we have analysed a concrete social problem: the distance to the resource and the rules for management.

In order to assess the environmental sustainability, we have tried to estimate the quantity of veld resources available and quantity of resources used when numbers were accessible. Furthermore, we have assessed the impact of harvesting methods on the environment.

2 Change of Focus

Because the situation in Lerala was rather different from what we had expected before arriving there, our focus in our project and the way we applied our methods, have changed since our synopsis. Regarding the social problematic, we were not able to identify any specific group being especially dependent on veld products, since it turned out that almost the whole village was engaged in this work. We therefore had to change our definition to assess access in general.

Our definition of socio-economic sustainability in our synopsis was "*If the concerned group can rely on veld products despite changes of the environment of the veld, we consider the group sustainable*". This question was obviously biased since we did not start out with asking the simple question if there were any problems at all but just assumed there to be some. The definition turned out not to be compatible with the actual complexity of the situation, since we realized that there was no yes-no answer regarding coping with environmental problems. In stead it was a matter of the degree of succeeding in mitigating problems stemming from changes in the environment. We therefore had to change our focus and examine more complex factors influencing accessibility, such as human strategies and innovations.

Our definition of environmental sustainability did not change significantly in our research. However, our methods of examining the sustainability changed as new results came up.

Our point of departure was to find a collection gradient away from the village. We expected to find a greater collection near the village and decrease away from the village (Figure 2.1) and from this gradient calculate the pressure of the resources close to the village. However, we did not observe such a gradient. The village is surrounded by the agricultural fields. At the end of the fields there are fences and afterwards follows the grazing areas and cattle posts. People collects at there own fields, around their cattle posts or at any good spot they find.

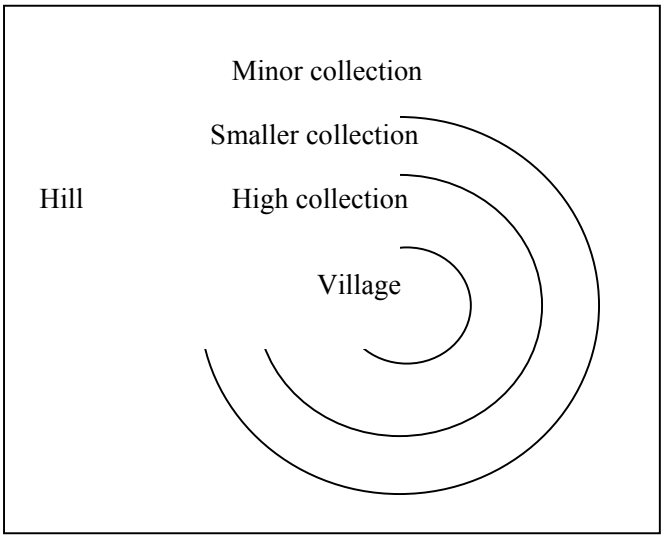


Figure 2.1 The expected collection gradient away from the village.

We then wanted to see if there were any effects of collection of veld products and grazing, and tried to find 4 different categories, see Figure 2.2. We would compare these areas by making sample plots in each area and compare the results.

No firewood & timber collection + No grazing	Firewood & timber collection + No grazing
No firewood & timber collection + Grazing	Firewood & timber collection + Grazing

Figure 2.2 The expected 4 different areas.

However, also in this case, we used days and thoughts, but we did not find these areas, as there apparently did not exist areas with or without collection and with or without grazing. So, in addition to that the people collect everywhere, also the cattle grass everywhere in the veld.

We ended up examining the sustainability by using the method of estimating the supply of wood from the veld and compare it with the demand from the villagers.

Furthermore, we changed our focus of products to examine. Originally we wanted to examine Phane worms as this was the most important veld product in Lerala; from the data of our questionnaire, 94% collects or buys Phane worms. Phane is a larval stage of the moth *Gonimbrasea belina,* which is enjoyed as a delicacy and is hosted by the Mophane tree (Atlhopheng *et al*. 1998). This year there was no harvest of Phane worm in Lerala due to drought, and we then expected not to be able to measure and observe the environmental factors of the supply and harvest and therefore not make an interdisciplinary examination of Phane. However, we realized after returning from the field, that the analyses of natural resources are more complex than just observing harvesting methods, and that we could have examined the environmental aspects of Phane with social scientific methods and literature search.

3 Methodology

In Appendix 5 results from our Problem Ranking, Matrix Ranking, Community Mapping and examples of Sample Plots in Appendix 3 are shown.

3.1 Questionnaire

The questionnaires were used in a joint effort with all SLUSE students in Lerala on the first day and contained general questions regarding people's livelihood strategies. The questionnaire was especially useful to get quantitative, statistical overview of the inhabitants of Lerala.
We were testing it in the University of Gaborone, however, we experienced that it would have been valuable to test it in Lerala also before using it for all the 119 households. Some of the questions were irrelevant in local context of Lerala such at the questions about collecting, buying or selling "Mosata flesh" because almost nobody in Lerala knew about this product. Also the questions about selling firewood or timber to KyT were irrelevant because KyT does not buy these products. Furthermore, in the questions about selling and buying Morula we asked about the fruits and they are usually not traded but the Morula beer is. and this was not captured in this question. Some other unclear questions were the questions about using and trading timber because the time range was not specified. Some informants answered according to the last year and other answered for a longer time range.
After getting to know the society of Lerala we also realized that we should have added more questions. One question that would have been useful to have in the questionnaire was what sources of fuel the households used for cooking. We asked if they had a donkey cart, but missed out on the households that had a car or van. Importantly, we also missed out how many people use their network to use other peoples' (relatives, friends) carts.

3.2 Interviews

Interviews were carried out with 45 informants. Most informants were chosen randomly when we were walking around the village with a translator, and when we had the informants' accept, we carried out the interview according to an interview guide. Some interviews were carried out while we followed the collectors in their work. We had short and structured interviews which changed according to our changing focus. We had more open interviews, where some had the character of being life stories. Carrying out interviews of different lengths (from 10 minutes to more than one hour) was fruitful and gave many insights. It was, however, difficult to assess whether these insights could be regarded as general trends, since it is difficult to evaluate how representative the interviews are. Another problem was, as previously mentioned, that we were biased in our ways of posing questions. In our interviews we focused on explicit rules regarding management, which actually seems to have a very small importance in the context of Lerala. We did not examine implicit rules (e.g. the harvesting techniques see section 4.1.2.2), and we thereby missed out on a crucial issue, since we only realized the problem after the field trip.

3.3 Problem Ranking

Problem Ranking we used in the beginning of the field work to get an overview of the problems that the villagers associated with the veld. The exercise worked well in the sense that it opened our eyes to another local perception of the veld, than what we had expected. Problems that were ranked were for instance problems like dangers of the veld (snakes, rapists), and not – as expected- marginalization because of privatization, conflicts over resource management etc.

A problem was that it was difficult to start the conversation because the respondents at first seemed "blank" to the idea that they should identify problems. This could have been caused by that the respondents normally do not focus on problems. Peters (1994) has for instance stressed the emphasis on harmony in Botswana cultures, and hence the difficulties in mentioning problems. It could also be that the issue was simply not viewed as problematic. This made us ask leading questions to get conversation going in a problem-oriented direction. Our interference in the Problem Ranking seemed to result in informants associating problems to the veld which they did not consider before. Another problem associated with the method was that as more than one informant participated, one person in the group could lead the group, so that many informants ranked the problems in the same way.

3.4 Matrix Ranking

In the last days of our fieldtrip we were introduced to this method, which we found useful in getting a broad view of different uses of the individual species. Furthermore, the species were ranked after importance. A problem associated with this method is the uncertainty if the informants are ranking the species after importance to themselves or after the quality of the species. And again as with the Problem Ranking, one of the informants could influence the whole group of informants in ranking equally the products.

3.5 Community mapping

The idea about the community mapping was to find out where the veld is located and where people are collecting veld products. We had problems with getting information by using this method because the area was big and different informants went different places to collect. This made it difficult to get an overview of the area of collection. We did also follow some collectors in order to examine their personal gathering boundary, but since the area was large we should have followed many different collectors going in different directions to get any exact overview. This would have been time consuming, and we did not assess it to be of first priority.

3.6 Seasonal calendar

A seasonal calendar was made by asking respondents to explain their activities related to the veld during the year. Through this exercise, we got an impression of changing livelihood strategies in different seasons. We only used this exercise to get an overview, but in retrospect, we could have elaborated on this by e.g. looking at how much time was spent and how much income was generated from each strategy.

3.7 Sample plots

We made sample plots in different areas and how we made them is described in Appendix 3.
We found an eroded area (see Section 4.5) and wanted to make sample plots there to use as one of the areas in our theory described in Chapter 2. However, as our theory changed we could not use the data for this purpose. Instead these plots will be used for estimating the supply of firewood.
The next sample plots we made in another area for getting numbers to estimate the supply of firewood and timber. Close to this area we furthermore made plots to investigate number of trees with broken branches to examine if this was caused by natural or human activities.

3.8 Aerial photos

We had hoped to get a digital copy of the aerial photos joint together to one photo of Lerala and the surrounding veld when we were in Lerala. We would have used this photo to put in our GPS points of the different places we went with firewood collectors and made sample plots. The lack of electricity in our meeting hall made it difficult to work on. We know that one supervisor was working on getting the different photos joint together and to correlate it with the GPS coordinates. We did not priority time to do this in the field but it could have been useful to use the aerial photos to identify the area to estimate the supply of firewood and timber. We could furthermore have used aerial photos to compare vegetation changes over a period of time but we did not have photos from the same time of year.

4 Analysis

4.1 Firewood and Timber

Basically every household needs firewood for cooking, heating up water for shower etc. It is a basic resource of energy, and we did not find any real substitutes to it. Several of the respondents had gas in their household but did not have the money to use it. From the data of our questionnaire research, 83 % of the households collect firewood.

From our interviews we observed that the two most frequently used species for both firewood and timber were Mophane (*Colosphermum mopane*) and Mohudiri (*Combretum apiculatum*) because of their desirability compared with other species. Because they are the same two species that reoccur in the two categories, we have chosen to analyze our data from firewood and timber in one chapter.

Mophane was the tree highest ranked in most categories of all 3 of our matrix rankings. And as Lerala is situated in the Mophane savannah of Botswana the abundance of Mophane was high in the surroundings of Lerala village. The Mophane tree is of large importance of the villagers of Lerala because of the multiple uses of the Mophane tree. As mentioned in Chapter 2, the Mophane tree is host of the most important veld product in Lerala, Phane. Hence, the Mophane vegetation is important for the collection of Phane worms. Moreover, Mophane is a tree species very suited for firewood. Informants told us, that the wood does not smoke when burning and it burns for a long time; and that the wood is suitable for timber because it is resistant to termites. Traditional healers used the roots of Mophane for healing. And at last, Mophane leaves were eaten by cattle when no other and better fodder was available.

Mohudiri was also of large abundance in the area of Lerala. The important uses were mainly firewood and timber used for roofs as the wood could bend. Additionally, artefacts and fodder were mentioned as uses in our matrix rankings.

4.1.1 Socio Economic Aspect

4.1.1.1 Local resources management

Access to firewood and timber for the local inhabitants of Lerala depends on several factors and a crucial one is the property regime and the local management. This institution is complicated since it consists of 2 systems: national law (the jurisdiction of the government) and tribal law (the jurisdiction of the local chief, the customs of the local community).
According to the national property regime, access to firewood (as well as other veld products) is restricted in the sense that it is only legal to collect for own use. If someone wants to sell firewood or timber, a permit is needed from a local authority outside the village (a subdivision under the Agricultural Resources Board in the town of Serowe). It is thus an expression of the view that restrictions are needed in order to avoid a "tragedy of the common". During our interviews with Frank Barsch (Agricultural Resources Board), he explained that the law controlling activities in the veld was new and was created after a recent case of commercialization of a medicine plant, Hoodia, by a US pharmaceutical company. The commercialization led to depletion of the plant, and this case was now used to generalize the overall situation in the country.
Our impression in Lerala was that no-one knew about this restriction or that no-one cared about it if

they did know. We heard that the chief had hold a community meeting about this new management strategy of the veld, but in spite of trying hard, we could not find anyone who had participated in the meeting. One informant told us that he believed that the meeting had actually been concerning tourism instead. The Village Development Committee told us that they were against the permit system and there did not seem to be anyone to enforce that rule. Implementation was thus not taking place, and even though the national rule did exist de jure, it did not exist de facto.

According to tribal law or customs, the veld is the land outside the village and outside the cultivated area owned by households. This land is collectively owned ("common land"), and everyone has the right to collect resources in this area. Some informants mentioned that private land did exist but that it was no problem since they were allowed to collect there if they wished to do so.
When we asked for the rules or management strategies for common land, all informants told us that there "were no rules". In the beginning we interpreted this statement as a sign "open access" that might lead to a scenario of a tragedy of the common, however, informants did not mention any opportunistic behaviour of other users and did not mention any conflict over the expected scarce resources. On reflection, we realized that even though there were no explicit rules regarding management of the veld, there were implicit rules taken for granted by the informants. We could tell from observations that many actions did not happen, for instance: No one privatized the land, no-one started big scale commercialization of the products, no-one excluded anyone from collecting what they needed for their household, and no-one burned down and cut down all plants in big areas. Implicit rules did obviously exist, even though we have not heard of any sanctions being tested. We interpreted this as indicating that there have not been any social problems serious enough to trigger this mechanism.

4.1.1.2 Access to firewood

Access to firewood has changed over the last decades. All respondents agreed on a change because the distance to the veld has grown in the last decades. Elder people could tell how they used to collect firewood near the village. They mentioned that this distance is now between 6-12 km from Lerala, and there is no doubt that distance to areas where dead branches could be collected, is increasing.

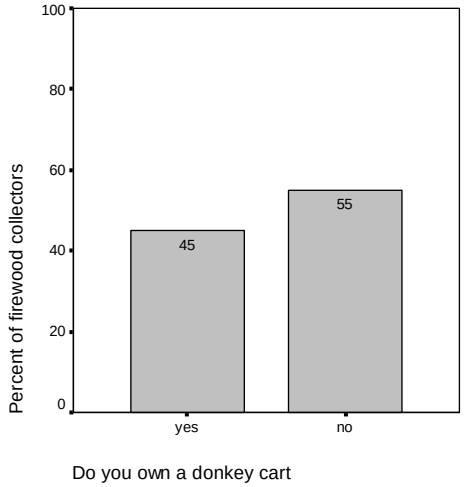


Figure 4.1 Percentage of firewood collectors who own a donkey cart.

People did not agree whether the increasing distance was a problem. Many people did not seem to consider it to be a serious problem since they had donkey carts or could borrow some through networking (friend, a relative or even the headman of the neighbourhood in the village). Figure 4.1 shows that roughly half of the firewood collectors own a donkey cart and this percentage is not included the people who have access to one through networking.

Many people have the option to buy firewood to add to or substitute their own efforts in collecting firewood. This arrangement was unofficial, though, and the commercialization of firewood is small scale.
Others who did not have the same easy access to transportation or money to buy firewood had to walk many kilometres carrying the wood on their heads (women) or in a wheelbarrow or bicycle (men). This of course meant more heavy work as well as time lost. Since peoples' livelihood strategies in Lerala are complex, composed by many different seasonal activities, it is hard to figure out in a cost-benefit manner how large the opportunity cost is for the loss caused by extra labour and time spent on firewood collecting. It could obviously also be the case, that there is no opportunity cost, if people have abundance of time.

From our questionnaire 83 % collect firewood in Lerala and are thus affected by the longer distance to the veld. To get a broad picture of the opportunities for getting firewood, Figure 4.2 shows the interrelations of the groups that buy and collect firewood.

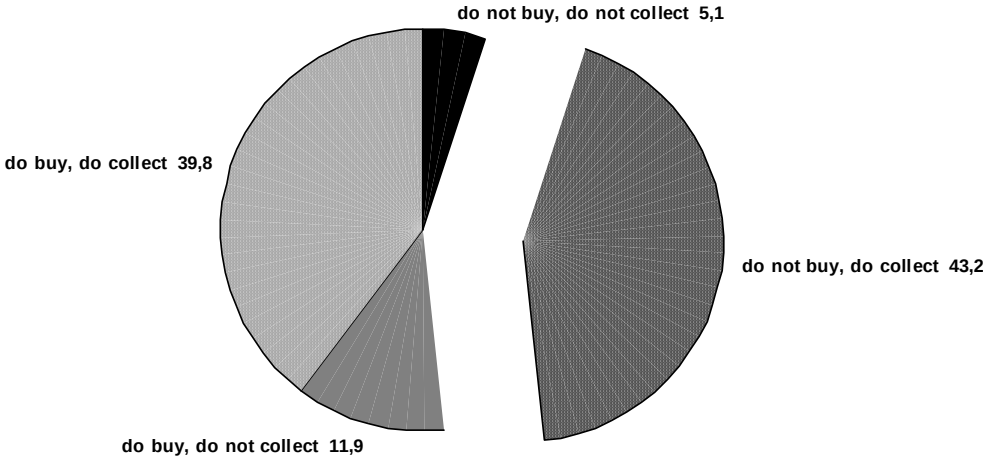


Figure 4.2 The distribution of collection and buying firewood.

It is seen from Figure 4.2 that 40 % can afford to buy firewood sometimes, which means that they can save time and effort going to the veld. 12 % even chose only to buy. The percentage of 43 % is divided in Figure 4.3 into a group which owns a donkey cart (59 %), this group probably do not need to buy. And a group (41 %) without a donkey cart, with apparently no money to buy firewood. This group

makes up 18 % of all the firewood collectors. This group has to walk to the veld and will spend time and effort on this, but most likely many in this group are helped out because of network with relatives and friends.

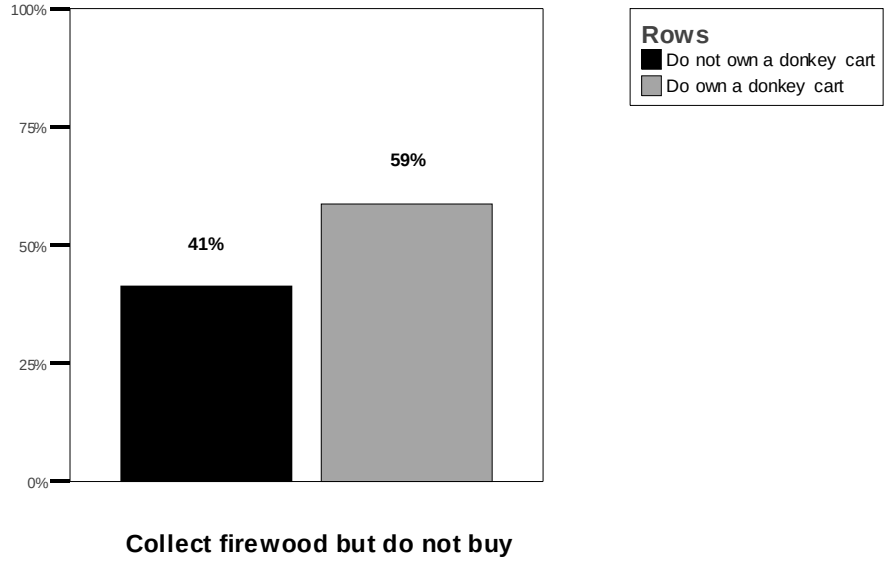


Figure 4.3 Percentage of firewood collectors who collects but do not buy and own a donkey cart.

To predict future scenarios, it is important to know growth of poverty rates over time in order to assess whether or not there is a trend that the last mentioned group of 18 % with few means will increase or decrease.

Only 5% did not collect nor buy firewood (Figure 4.2),which means that it is a very small group which is completely excluded from access (e.g. illness preventing collecting) or does not use firewood. In general it can be said for the time being, that nearly all has access and that a majority of these are able to make up for time related opportunity costs.

4.1.1.3 Access to timber

The same concerns existed regarding increasing distance to timber and this might be more serious than firewood, since it is heavier and more difficult to transport. Access to a donkey cart (either through networking or money to rent a cart) is therefore essential.
It seemed that the timber is valued highly by the users. Even though the last years have seen a development towards substitution of the resource for building modern houses, timber still seems to gain a cultural value when it is used for traditional houses. It was mentioned by a few respondents that it is preferred by households to have a modern *and* a traditional house, because this is better for kitchens with bonfires and they are used as burial place for children that have passed away too early to be buried at the community graveyard. Apparently modern concrete or brick houses are not seen as suitable for these purposes. From one of our village transect walks we observed that 40% of all houses were traditional houses.

4.1.2 Environmental Aspects

4.1.2.1 Demand – Supply

From or definitions in the introduction we say that the use of veld products in Lerala is sustainable if the harvesting of the veld products does not exceed the supply of these.
More detailed calculations and all assumptions made can be seen in Appendix 4.

Supply of firewood and timber:
The supply can be calculated as:

Supply = growth rate * volume of existing trees

The growth rate is the annual percentage increase of the existing trees. The growth rate varies from different locations, tree species and years. According to Banks *et al*. (1996) an estimate for the southern Africa is 4% per year for savannah trees. We assume this for Mophane and Mohudiri as well, as we do not have this information from these species, despite the fact that Mophane is a slow growing tree and it could be argued that the growth rate should be set lower than 4%. Furthermore, our estimate only includes Mophane and Mohudiri trees.
The volume of existing trees is calculated with assumptions in Appendix 4 and is 1,069,651m^3. The calculations are based on an area between 6 and 12 km from the village which information we got from interviews.

Supply = 0.04 * 1,069,651m^3 = **42,786m^3**

Demand for firewood:
The demand for firewood in Lerala per year can be estimated from:

Demand for firewood = household consumption * number of households

The average household consumption of firewood was estimated by asking different households about their use of firewood, and then by measuring one load of firewood on a 4 wheel donkey cart. This is 7.3 m^3 per year. The population in 2005 is estimated from the Central District Council (2003). The average number of people per household is found from the questionnaire to be 6. The number of households is 1165.

Demand for firewood = 7.3 m^3 * 1,165 = 8,460 m^3

Demand for timber:
The demand for timber in Lerala per year can be estimated from:

Demand for timber = timber per household * number of new households per year

We assume that timber is only used for building new houses and fences. Another assumption is that the use of timber is proportional with the growth rate of the population, this is not realistic for one year but for longer periods this should be adequate. The timber used in a household was counted for 24

households, and the poles were measured for two traditional huts and one fence. This gave 3.5 m^3 timber per household, and the number of new households was estimated to 50.

Demand for timber = 3.5m^3 * 50 = 172m^3

Demand vs. supply
Total demand = Demand for firewood + Demand for timber = **8,632m^3**

Sustainability: Supply ≥ Demand: **42,786m^3** ≥ **8,632m^3**

At present the demand does not exceed the supply.

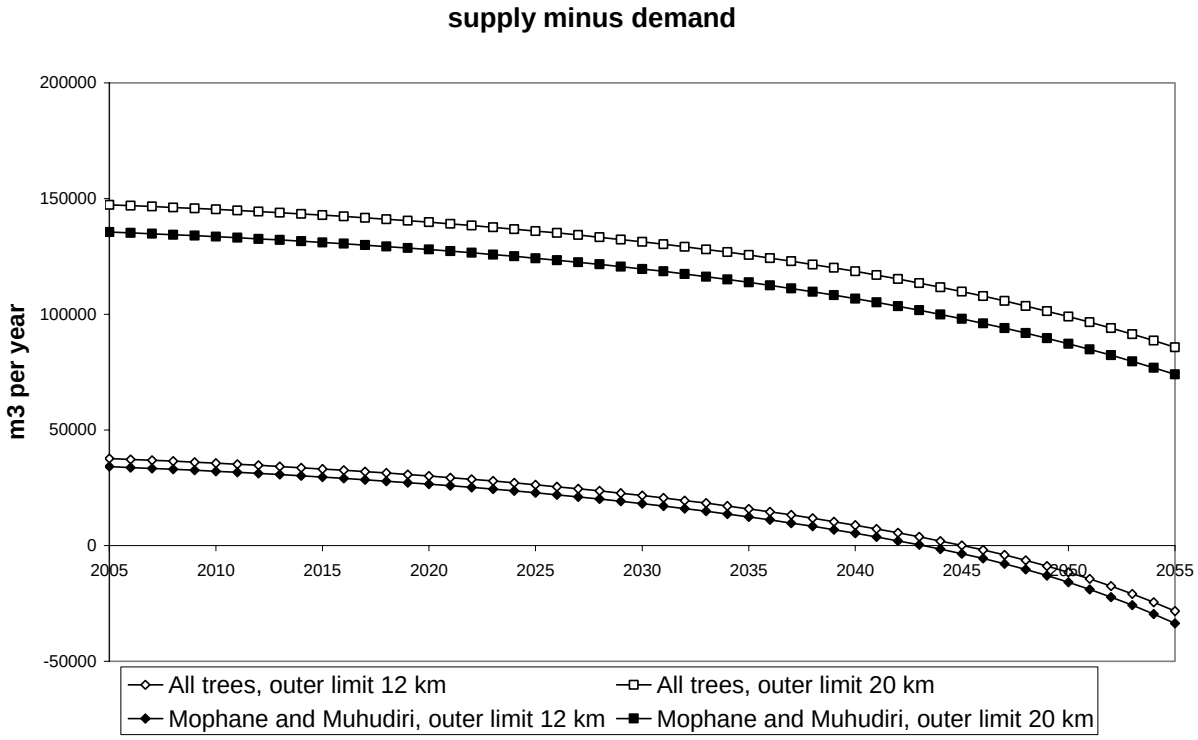


Figure 4.4 The difference between supply and demand for the next 50 years with outer limits of 12 and 20 km, respectively.

In Fure 4.4 is shown the difference between supply and demand over time. The important variables are the population growth and the defined area as we assume that the other variables (consumption per person, plant growth rate and volume of wood per ha) are constant. An assumption is that the veld is now at a maximum biomass and will not increase. It is seen that it will not differ much if people use all trees or only Mophane and Mohudiri, because of their high representation in the veld.

The lower lines in Figure 4.4 show that the demand will exceed supply in 2044 if the population follows the same population growth rate (the population will be 35000) and if the population is only able to use an area with the same boundaries as today. However if most people have transport they will

be able to use a larger area. This could be the scenario of the upper lines showing an area with outer limit of 20 km and then the supply exceeds the supply for an even longer period. But the near future is what is of greatest interests to us, since other factors will influence sustainability in the next decades which is outside the reach of our investigation. Botswana has in other places been going through rapid development, and it is not unlikely that Lerala will see big changes within the next decades. Examples could be increase in the use of gas instead of firewood and changes in agriculture.
If there will be a population of 35000, the village will change and there will be new variables that need to be taken in consideration that we cannot predict. But we can conclude that the demand is not exceeding the supply in the next decade.

4.1.2.2 Harvesting Techniques

Firewood

In terms of sustainability it is important to look at the techniques of harvest. We wanted to see if the harvest was damaging trees so they could not regenerate. We also wanted to se if unsustainable harvesting methods had degraded the area near the village and if this was the reason for the increased distance.
As mentioned previously, implicit rules exist regarding the management of the veld. One implicit rule seemed to be that people are not supposed to break live branches or harvest live trees except for timber. Most people in Lerala said that they only use dead wood for firewood but that some others are breaking of branches. The optimal option is to collect dead branches; they are not so heavy to carry and they are ready to burn.

Figure 4.5 Broken branch

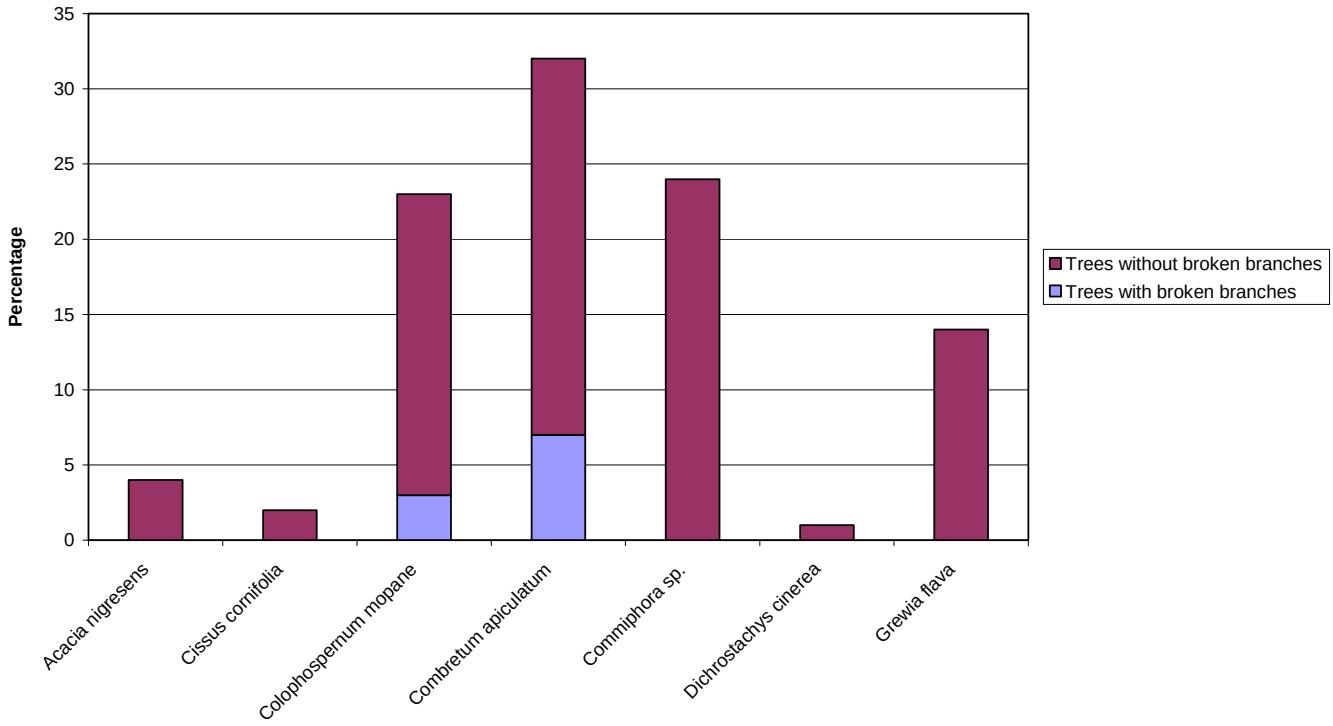


Figure 4.6 Proportion of trees with and with out broken branches.

We did, however, observe that this rule seemed to be trespassed (Figure 4.5), and we saw this as an indicator that changes might occur. If implicit rules are broken, it could be a sign, that people are having difficulties accessing the resource.

One informant blamed cattle or wind for breaking branches on the trees. We cannot prove that cattle do not break branches of trees, but by observing an area of collection of firewood, we found that there were only broken branches on the preferred firewood species (Figure 4.6). From these sample plot observations and the fact that some of our informants said that other people are breaking branches we find it most likely that it is humans that have broken the branches.

Breaking branches of the trees is not necessarily unsustainable because the trees can shoot again. According to our estimation (Figure 4.4) there is enough wood, but breaking branches indicates that there is not enough dead wood in the easiest accessible areas such as near the village and roads. From this observation we can deduce that it is not the harvesting methods that have increased the distance but that population growth leads to increased agricultural cultivation of veld and higher pressure on the easy accessible areas.

Timber

Regarding collection of timber, the main stem is harvested. More informants stated that they only cut down Mophane half, so it can resprout. Mophane has coppicing ability so when the tree is cut down it will resprout and thereby continue the growth (Figure 4.7). However, it will form at lot of new

branches and there will not be left a main stem. Now there will be lots of smaller branches that are usable for firewood but these will not be large enough for timber poles anymore.

4.1.3 Conclusions on Firewood and Timber

Today there does not seem to exist a Tragedy of the Commons in Lerala, because there are no conflicts and the supply exceeds the demand. The local management implies implicit rules of only collecting dead wood, only small scale commercialization and no exclusion of any groups. The majority has access but in different degrees. The harvest is sustainable but there is a decrease of dead wood in the easiest accessible areas.

Population growth leads to increased distance and higher pressure on the easiest accessible areas. In the long term the less well-off people will have higher opportunity costs in collecting firewood or in worst case scenarios exclusion from access.

We are aware that our conclusions are based on estimations. Furthermore these conclusions are only relevant for the next decade as Lerala will undergo changes in the future that are impossible to predict.

Figure 4.7 Coppicing Mophane tree

4.2 Medicinal Plants

We have been analysing the medicinal plants in general even though many individual medicinal plants exist. We are aware of the danger of generalizing, since different medicinal plants are likely to have diverse results when analyzed in depth.
The majority of people in Lerala are involved in traditional medicine. Figure 4.8 shows the involvement in medicinal plants from the data of our questionnaire.

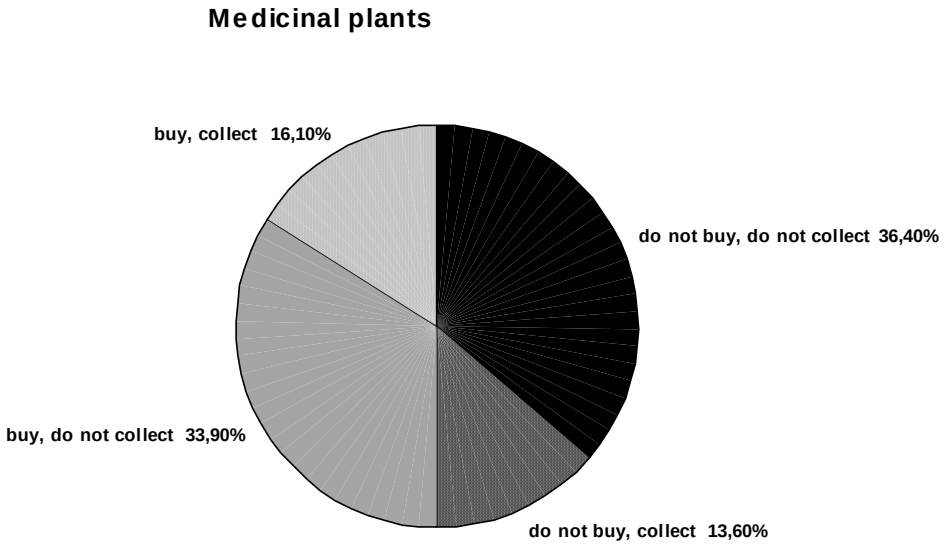


Figure 4.8 The distribution of collection and buying medicine.

4.2.1 Socio Economic Aspect

Our socio-economic sustainability aspect depends on whether people can continue to have access to this product. In our interviews we focused on traditional healers and health clinic staff, because we believed them to be the most informative respondents. This did give insights into the field, however, in retrospect we have realized that it would have been useful to interview consumers of the products, since our results now have a tendency of being based on assumptions more than data.

4.2.1.1 Demand

As can be seen from Figure 4.8, more than half of the population is using traditional medicine (64 %). There is thus a high demand for the products. We did not carry out any direct survey of the demand for medicinal plants over time, which was made difficult, among other things because the churches did not approve of traditional medicine, and people did therefore not talk openly about the topic. Because the issue was sensitive, we did not get into depth with how much and how many different products people use, and neither did we get data on people's preferences regarding the products. The clinic staff informed us that the use of traditional medicine does continue and that some people only use modern medicine in last resort, and there might exist an unofficial demand for the products.

4.2.1.2 Access to Traditional Medicine

As seen from Figure 4.8 around 50% of the consumers buy medicine and do not collect, and we therefore conclude that access is partly depending on traditional healers. According to our interviews with traditional healers, there has been an increase in their number in Lerala. The increase of healers should probably be interpreted as the number being relatively constant, when calculated as traditional healer per person in Lerala. Because of the population expansion within the last decade, the 2 trends (increase in healers + population growth) probably even each other out.

For those who know which plants to collect for medicine, medicine also belong to the common property regime, and there is hence an implicit rule of non-exclusiveness. This means that there is access to the supply. Taboos, however, exist in certain areas, and this functionally works as a counter balance to "open access". A sacred area that can be mentioned is the mountains behind the village that we visited ourselves when we went hiking with a traditional healer who "disappeared" on the way - with the explanation that it was a punishment of the ancestors (the badimo) because he was bringing outsiders to this sacred area. It seems however, that taboos are in a process of change; people we interviewed did in general not agree on which taboos were "real". Since Lerala is in a process of growth and modernization. This might point to a future scenario where constraints build into implicit management might change substantially and maybe even disappear.

Currently, it seems that there is a sufficient supply of access to resources through the traditional healers and the property regime as well as a relatively well-established implicit management strategy of the resource.

4.2.2 Environmental aspect

We carried out interviews with 6 traditional healers in order to investigate whether there have been a depletion of medicinal plants in the area. They all thought that they were harvesting so that the plants could continue the growth and most of them also thought that others were doing that as well. Two of the young healers said that there where a depletion of the resources. The four elder healers on the contrary thought that there were no vegetation changes. Few healers accused each other of destroying the environment because of jealousy and competition.

On a walk with a traditional healer we could observe how he only harvests a part of each plant and only the side roots. Another aspect which indicates that he does not over utilize the veld is that he only collects every third month.

We know that 64% uses traditional medicine but we do not know the quantity of the demand. As the situation is now it seems like the supply of medicine is not decreasing and that it can meet the demand. However KyT have already started a commercialisation of some veld products including medicine. And KyT do not look at the distribution of the trees/plants before starting encouraging the harvest of new products. This makes it difficult (if not impossible) to evaluate if the harvest could lead to a depletion of the veld. A commercialising could lead to a higher pressure on the collected plants even though this does not mean that the harvest will exceeds the supply. We have though not observed a situation as the Hoodia case previously mentioned.

4.2.3 Conclusions on Medicinal Plants

Medicinal plants belong to common property, yet many implicit rules (taboos) constrain access. This means that most collection occurs through healers and this prevents the majority of the people in overexploiting the resources. According to our observations the traditional healers harvest sustainably. After analysing our results we realised that in our research we have only addressed the question of supply in the form of healers and not the question of demand in form of consumers. This only gives the half picture of the accessibility.

4.3 Fruit trees

The fruit tree of focus is Morula (*Sclerocarya birrea*). Figure 4.9 shows the involvement of Morula fruit in Lerala from the data of our questionnaire. Morula is one of the most important veld products in Lerala. Also KyT commercialize Morula as one of their main products.

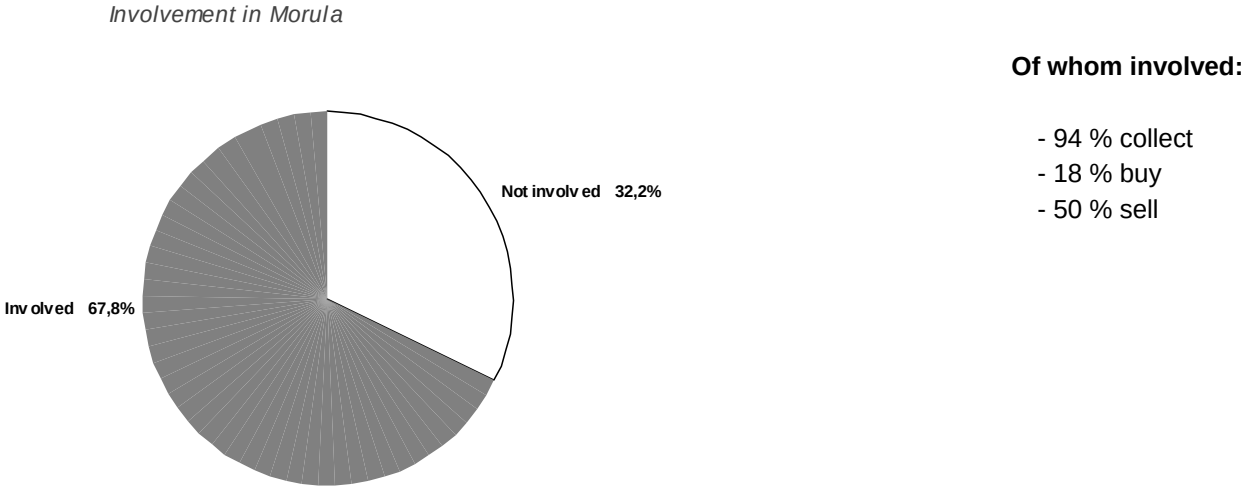


Figure 4.9 Involvement of Morula fruit.

The participants in our Matrix Rankings listed uses of Morula as food, medicine, alcohol, artefacts, oil and fodder, and in most of these categories the tree was highly ranked. Also the income from Morula and the availability were ranked high, and a walk in the village could confirm the large abundance of the tree. Because of the high collection of Morula fruits, we expected a high exploitation and a possible overexploitation of the fruits.

4.3.1 Socio Economic Aspect

The main uses of Morula in Lerala were the fruits for making oil and beer. The fruits collected for making oil were mostly collected by KyT members as the oil was made at KyT and fruits for brewing beer were collected by both members and non-members.

The Morula beer brewing is a process of fruit meat and water left in the sun for a few days. As only water is added no costs are involved in the beer brewing. Squeezing the fruit to extract the meat is time consuming, however, the time and effort in brewing Morula beer is manageable. The income from selling Morula beer was roughly 1 Pula for 1 glass of beer. This could make an income in the seasons of about 50-60 Pula a day, sometimes 100 Pula. When drawing a seasonal calendar, respondents indicated that Morula beer is an important element in the local livelihood strategy that creates income to the household.

Morula trees were as the only veld product we observed, cultivated in households. Some KyT members have received Morula trees to cultivate in private property. The trees were in a high abundance in households, in the village, in the fields and in the veld. This means that they are present on both private

and common property. For the common property we assume that previously mentioned implicit rules apply, but we did not ask about collecting on private property so we do not know these rules. However, the high abundance illustrates an easy access in both regimes and access seems to be sustainable there is no problem of long distance to the resource and no middle men on the market as was the case with the medicinal plants.

4.4 Environmental Aspects

An average Morula tree produces 36.550 fruits annually which is 550 kg and correlates with around 170 L of beer (Shackleton 2002). The seeds of Morula can be either male or female; so both male and female trees occur, where only the female trees produce fruit. The trees are not sensitive to environmental factors as they can grow in most soils and even in periods of drought the trees produce fruits and young trees survive. Only frost might damage young Morula trees (Mateke 1998).

The Morula trees inside Lerala were old and the trees get very old. Despite the cutting down of Morula for artifacts, mostly fruits are collected which is not killing the tree. Also, the fruits get ripen after a few days after falling from the tree so they are not collected while sitting on the branches.

Though, the production manager of KYT thought there existed a depletion of Morula fruits. Her statement was build on that non-members are harvesting unsustainably by collecting all fruits from the same tree and cutting down Morula trees for chairs. However, her opinion might not be objective as she was promoting KyT as a sustainable organization of collecting veld products.

Mostly old Morula trees were seen, hence for a future scenario we did a village transect walk to ask the inhabitants about the distribution of young Morula trees inside Lerala village. Half of the informants had not seen young Morula trees inside the village whereas many stated the young trees to be found in the lands and near KyT (close to the hill) because young Morula trees inside Lerala get eaten by donkeys and goats that go about in the village. So, the picture was not clear, also because a Morula seedling grow to a height of more than 2 m in one year, which could be a reason for not observing small Morula trees.

4.4.1 Conclusions on fruit trees

As it is now, the abundance of Morula trees is high and consumers have easy access to the resource. However, in the long term the picture is complex whether the access will be maintained or decrease if young Morula trees do not have the ability to grow inside the village where donkeys and goats go about in large numbers. The great quantity of Morula in the private fields outside the village is likely to continue and we cannot see a reason why the amount will decrease in the veld either, as the production of fruits per tree is high. We did not observe any social conflicts in relation to the use of resources.

4.5 Case study: Eroded area

We went to an area where an informant harvests timber for selling. It was an area around 8 km from Lerala village, and it was impossible to see from the main road. This was like a desert of 10 ha in the middle of the dense Mophane savannah. The area was characterized by reddish grey sandy soil, where the red topsoil had eroded away and some broad and low stems sticking up the bare area (Figure 4.10). The erosion had taken place because of no plant cover in the area. With no plant cover, the raindrops hit the soil harder and wash away the topsoil. We observed a cliff at the edge of the area where the water had run off and broken off the soil. Furthermore, when the cover is gone the soil gets exposed to higher temperatures, which can lead to desertification. And a change in vegetation results in changes of the hydrology of the soil.

Figure 4.10 Eroded area

The few trees left were dead in the top, which could have been caused by a disease or stress due to low supply of water. They are soon to die out as the soil dries out, because the water cannot infiltrate the soil. The trees left were growing in water lanes from the flow of erosion. New seedlings or grass where only to be found in cow pats and in the edge off the deserted area close to the dense Mophane vegetation. However, the seedlings in the cow pats will never grow into the soil. And the plantation which is boarding up to the eroded area will not be able to spread into the eroded area as the topsoil is gone.

The eroded area contended a high amount of salts. We took soil samples from the eroded area and from the dense Mophane vegetation. The results showed an increased salinization of the eroded area. As the plant cover disappears, the transpiration from the trees disappears and the precipitation exceeds the usage capacity of the soil. In the beginning this causes the groundwater table to rise because the water that before was transpirated to the atmosphere now remains in the soil. The groundwater always

contains some degree of salinization, particularly in Botswana where the high evaporation and low rainfall leads to very limited downward movement of water. As salts move with water; when the water table raises it carries dissolved salts towards the upper layers of the soil and thereby makes these saline. The saline layers remains after the water table has lowered again. The salinization process continues because the soil has low infiltration of rainwater, and when the soil furthermore is uncovered; the water evaporates from bare areas and transport salts from the lower soil layers to the upper soil layers. The salinization makes the soil infertile so no new trees can grow in the area.
We found several large stumps in the area, and we did find newly cut trees around the eroded area. It could therefore be a sign of desertification of the area because of unsustainable harvesting methods.

In order to carry out triangulation of methods, we also interviewed a local informant. We brought an elder firewood collector to this area, and she informed us that the area is called Makgabo and that it had been like that since she was young. Another informant confirmed this. According to these informants, this eroded area is not due to local harvesting of Mophane for timber. They said that they only harvest dead trees in the area, and demonstrated that rather big tree trunks could be broken when they were dead. Since several dead/dying tree trunks were found in the eroded area, people went there to break these trees. This is important because the causal relationship explained by the respondents differed from our own observations and perceptions: people went there to break trees because they were dead or dying of natural reasons, and not the other way round (that trees were dying because of human intervention).

The eroded area can be seen as a case of scientific controversy, where interpretation was highly depending on the scientific methods that were used to examine the results. We experienced that conclusions cannot be based only on observations or interviews as several factors can interact in modes which are impossible to identify without comparing different methodologies.
Observations can be misleading as it is shown by Leach and Mearns (1996); they have proved how experts can miss out on important points by ignoring indigenous knowledge and misread landscapes. On the other side observations can also be indispensable because it is also a known fact that you can not only relay on local peoples perception. An example could be the previous mentioned case where informants said that they did not break live branches but we confirmed by observation that they did (Figure 4.6). No matter the cause of erosion of this area, the observation shows how changes of plant cover can destroy the soil and an area for further growth of Mophane vegetation.

5 Conclusion

Our expectation with our fieldwork was to identify problems and maybe find solutions to them. But first of all it has been a process of learning, and once we were in the field we realised that the context was much more complex and different from what we had expected. Because of many more problems emerged and the confusion that this created, we found it difficult to maintain focus. This lack of focus caused our results not to have sufficient data of important aspects of each area studied. Our case study of the eroded area showed that different methods led to contradicting results. This was confusing but it helped us to be critical and put our own methods in a new perspective.

Our conclusions are results of interdisciplinary work and we arrived at these by using a wide range of natural and social scientific methods.

In answering the question whether the use of firewood, timber, traditional medicine and fruit in Lerala is sustainable, we found that access is sustainable now and in the near future and the harvest of veld products does not exceed the supply.

Our assessment of sustainability of firewood and timber included the most aspects.
The demand will not exceed the supply of trees in the veld in the next decades. However, the distance to the veld where dead firewood and good timber could be collected had grown. It seemed to be proportional to the population growth. We found that the implicit management strategy was to harvest sustainably, but that some people were contesting this strategy by damaging trees. This practice was not in itself a serious constraint to the growth of the resource but it could be interpreted as an indicator that people find it too far to collect. We found that most people had ways of mitigating the problem of distance in that many had acquired means of transportation, and by engaging in small scale commercialization. A part of the population did not have the means to enjoy the benefits of this development because of the opportunity costs caused by distance to the resource. However, we did not assess the scope of these opportunity costs or if this group will increase or decrease in the future. Overall, the management of the common land meant inclusion of everyone in the community, and our expectations of a Tragedy of the Common theory was not confirmed.

Regarding medicine, we were dealing with a resource in a common property regime, but we did not see any unsustainable harvesting techniques leading to degradation. This was due to the many implicit rules and the role of the traditional healers as providers of processed products.

Regarding Morula trees, the products seemed to be in abundance on both common and private property, and access seemed to be easy to all members of the community. We did observe that there was not a large regeneration in the village because animals were not restrained from destroying the plants. This could be a problem in the future but the picture is not clear.

6 Perspectives

As mentioned in the beginning of our project, natural resource management is a scientific contested battlefield, and it is therefore dangerous to take any general knowledge or assumptions for granted. Our research is an example of this. We started our research with an interview with the Natural Resources Board in Gaborone, where national law regarding natural resource management is being drafted and surveyed. During this first interview we were confirmed in our assumptions that we were dealing with a "tragedy of the commons" and that something had to be done to prevent this. After our field trip to Lerala, where we had difficulties in proving this tragedy or even a drama, but only had obtained vague indicators for possible problems, we returned to the Natural Resources Board. We here tried to track the information of the assumed tragedy, but were told that this was actually not based on any hard facts, but that research was still to be carried out. This means that the policy regarding control of veld resources, was not based on researched but rather on an assumption that management needs to have explicit rules in order to work, and that a tragedy might occur if control would not be carried out. If it had been the case that the national government actually had had the capability to reach a rural society as Lerala through implementation, this would have meant severe restriction to current activities, since commercial activities would be criminalized. To restrict commercial use of veld products would have serious consequences for the many people who add to the livelihood strategy by selling small scale products, and for the ones who benefit form this commercialization. The decision of the policy can therefore be seen as being eco-centric evaluating the intrinsic value of the environment in Lerala higher than its users. Controls are decided on in order to conserve the veld until it is proved that local management is harmless. From an anthro-centric point of view, the opposite should be the case: To ensure respect for livelihood of the population of Lerala, and to respect local resource management until it might be proved that this creates either socio-economic or environmental unsustainability.

7 Acknowledgements

This report originated from the SLUSE (Sustainable Land Use) Programme, which is a consortium of Danish universities cooperating with Universities in Southern Africa. We were working with students from Denmark, South Africa, Swaziland and Botswana.
We would like to thank University of Botswana in Gaborone, for arranging our stay in Botswana.

We would also sincerely like to thank the cooperation in our group for the valuable input regarding the African context.

Helen King
Penny Pistorius
Oteng Tot
Vusi Matsebula
Basetsana Ntalabgwe.

Finally we wish to show our gratitude to the chief of Lerala and the families who hosted us for 10 days in their private homes.

8 References

Atlhopheng, J., Molebatsi, G., Toteng, E., Totolo, O. (1998): *Environmental Issues in Botswana. A Handbook*. Environmental Education Project, Faculty of Education, University of Botswana.

Banks D.I., Griffin, N.J., Shackleton, C.M., Shackleton, S.E., Mavrandonis, J.M. (1996):*Wood supply and demand around two rural settlements in a semi-arid savanna, South Africa.* Biomass and Bioenergy Vol. 11. No. 4.

Central District Council, Central District Development Committee, Ministry of Local Government (2003): *Central District Development plan 6: 2003-2009.* Republic of Botswana.

Cullis, A. & Watson, C. (2004): *Winners and Losers: Privatising the Commons in Botswana – briefing paper*. International Institute for Environment and Development (ILED).

Hardin, G. (1968):*The Tragedy of the Commons*, Science, 162(1968):1243-1248

Leach, M., Mearns, R. (1996): *The lie of the land*, Villiers Publications, London.

Luoga, J.E., Witkowski, F.T.F., Balkwill, K (2001): *Harvested and standing wood stocks in protected and communal miombo woodlands of eastern Tanzania.* Forest Ecology and Management, vol 164. (used in Appendix 4)

Mateke, S. M. (1998): *Questions and Answers about: How to grow Morula*. Veld Products Research & Development, Gabane, Botswana.

Ostrom E., Dietz T, Stern P.C.(2002): *the Drama of the Commons*, National Academies Press. Washington, DC

Peters, P. (1994): *Dividing the Commons. Politics, Policy and culture in Botswana*. University Press of Virginia.

Shackleton, S. (2002): *The informal marula beer traders of Bushbuckridge, Limpopo Province, South Africa.* Department of Environmental Science, Rhodes University, Grahamstown, South Africa.

Appendix 1: Synopsis (December 10th 2004)

Background

"Veld" is the term of wildlife and plants (wild fruits and roots) for consumption, medicinal or decorative purposes. They are widely distributed in Botswana and account for an important income for the majority of the poor in the rural areas of Botswana (Atlhopheng *et al.* 1998). There exist about 150 species wild food plants and about 150 insects for consumption and/or medicinal use in Botswana. The geographical distribution of the veld products vary in the different parts of the country, and local communities from different parts of Botswana are hence not dependent on the same veld products (Atlhopheng *et al.* 1998).

In Lerala, which is the area we will examine during our research field trip in January 2004, the community is largely dependent on the Mophane tree (*Colophospermum mopane*), which is widespread in the North- and Central East Botswana. Mophane is the host of the Phane worm, one of the most important veld products in Botswana. There are two harvest seasons per year of the Phane worm (October-November and February) and the worms are delicacies, which are consumed boiled or roasted. The cocoons of the insects are made of silk and can be further used for clothing (Atlhopheng *et al.* 1998). The Mophane tree is without being the host of the Phane worm, also used for fuel wood and construction timber. In Lerala the Mophane vegetation is declining in numbers (Hand outs by Andreas & Quentin).

Reports state depletion of veld products in almost all areas where veld products are an important source of income. Depletion is caused both by environmental and human factors. The area is semi-arid and is exposed to severe droughts, which some times last for years and can affect the ecological system. On the human side, it seems that use of inappropriate harvesting techniques, and conversion of veld areas to ex. grazing areas of cattle (Atlhopheng *et al.* 1998) has been leading to depletion of the veld.

Historically, Botswana communities have been undergoing major social changes within the last decades. During colonization and accelerating since independence in 1966, the society has changed from a "traditional" society based on a structure of small tribes controlled by chiefs to a "modern" state based on Western concepts (Picard 1987). These social changes have had an enormous impact on the way that people see and treat nature. Whereas land traditionally was not seen as a commodity in itself but only as a mean for subsistence, land has today in many places gained monetary value. This has led to new patterns of land tenure, such as freehold, which has not existed in Botswana previously (Peters 1994). As a part of the privatisation process, areas are being fenced off, and access to communal lands - previously available for veld production - is getting less available. Other social structures, such as belief systems and power structures, are also changing and it has been pointed out, that modern bureaucracy (such as the Land Boards that have substituted traditional chiefs) is not able to carry out the same level of control over society (Ministry of Lands, Housing and Environment 2002). Taboos did formerly restrict the use of veld products, for example by not using fruit and medicinal trees for fuel wood, or prohibition of cutting of branches of fruit trees (Atlhopheng *et al.* 1998).

Today a dual system of traditional communal land tenure exists together with private ranchers. The confusion of land tenure as well as lack of enforcement measures, has led to overgrazing in many communal lands. This, however, is all part of a larger political and economical framework, where cattle owners are gaining more power because of national political interests as well as internationally, particularly in the EU. Vested interests do in this way shape local power structures and marginalize the importance of the veld and the people gaining their livelihood from it. This is a paradoxical development, since landlessness and other societal changes - such as many female-headed households because of male immigration and AIDS- has led to poor people even more dependant on the veld than before (Cullis & Watson 2004).

From the point of view of marginalized groups in rural areas in Botswana, a possible depletion of the veld will be likely to have severe consequences for income possibilities. Keeping the veld sustainable therefore has a purpose of social justice. Furthermore, veld vegetation consists of native species and contributes to the biodiversity of nature, which also has a value in itself. A reduction of resources could change the balance of the ecosystem, which could affect the people depending on the veld. We therefore find that sustainability of the veld is an important issue that needs to be understood further.

Problem statement

Our point of departure for our research will be to examine:

To examine if the local use of the veld products in Lerala is sustainable.

Definitions

Sustainability is not a neutral or an easily definable concept. The concept has become widespread since the end of the 1980s, especially as understood in The Brundtland Report, also known as O*ur Common Future,* which in 1987 formulated sustainable development as:

"Development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Even though this definition is a starting point, it does not capture the complexity of the concept. Therefore, the term needs to be defined: for whom, what and in which context. Our definitions are given below:

1. **Sustainable environment:**

The veld products used in Lerala should not undergo a higher depletion rate than the regeneration rate.

We only look at the sustainability of the plants important for local livelihood in Lerala, and not the ecosystem as a whole. Changes do not necessarily mean that the system is not sustainable.

2. **Sustainable social aspect:**

The group we are concerned with is the group of people for whom the veld provides an important part of their livelihood strategy. We are not concerned with other groups such as livestock owners and

agricultarlists, who might benefit from using the same communal areas, even though this would make sense in a larger analysis taking Lerala as a whole.

If the concerned group can rely on veld products despite changes of the environment of the veld, we consider the group sustainable.

Our underlying assumption for our research is that sustainability of the veld depends on natural processes as well as social factors. This interrelatedness can be showed as follows:

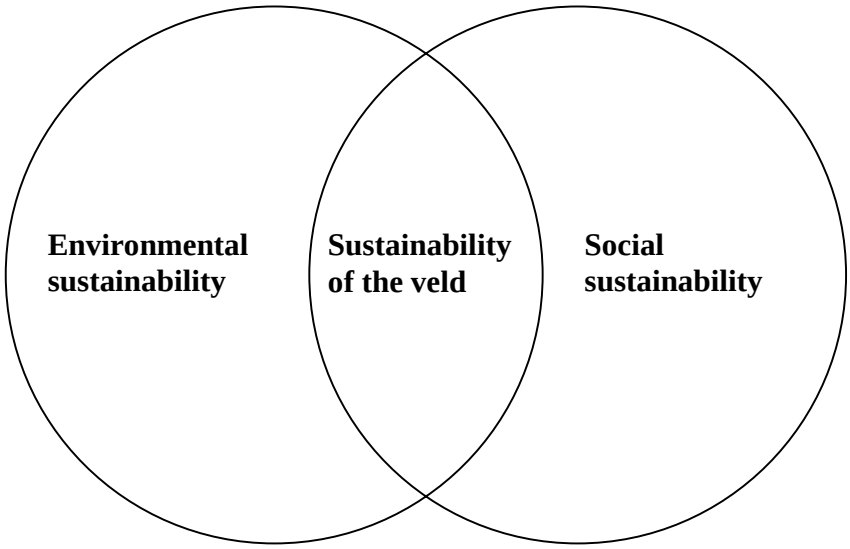


Figure 1: Model of veld sustainability (modified after Whiteside, 1997).

Methodology

Our choice of methodology in our research of the sustainability of the veld in Lerala, reflects our perception of sustainability and the veld. As we will look at the two aspects (environmental and social) we will carry out research based on natural scientific and social scientific methods.

The veld on one hand sustains the livelihood of a group of people, and this group is hence dependent on the condition of the veld. At the same time, however, the condition of the veld is dependent on its human influence. It is therefore crucial to equally examine these two aspects, and for that reason an interdisciplinary approach is needed.

The aim of our research is to enhance our understanding of ecological processes of the veld and its possible changes within recent years as well as understanding the human institution related to the veld, i.e. the structures that shape the human use – the legal, sociological and political framework.

The first task we face is to get an overview of the area, and this is our point of departure for the methodology that we will apply first. Since our knowledge of the field is very limited, this will occupy a large part of our time and work.

1. **Literature**

We will first of all consult literature and getting as much information as possible regarding the veld.

We will contact the Veld Research Centre and The Agricultural Research department in Gaborone in order to obtain research literature.

2. **Questionnaire**

To create basic knowledge, we will corporate with the other groups and carry out quantitative research – filling out a questionnaire for around 100 households. In this questionnaire we will get a fast overview, which we hope will be statistically representative. The questions we are concerned with are how many people are connected to the veld production – either as direct users or as buyers. We also hope to get a picture of the social status of this user group (income, gender, education). Finally, we wish to know what the most important products are (fuel wood, timber, medicinal products, food or other).

3. **Maps**

We will try to get hold of a local map and maybe an aerial photo in order to get an overview of the physical features of the area we are to examine. We aim to make a local informant explain us the location of the veld that the users of Lerala use. If it is not possible to obtain help from a person who is familiar with the reading of maps, we can alternatively make an interview with one or more informants where these will be asked to draw a map and the location of the veld. We can later compare this with a printed map.

4. **GPS**

In case that no local map or aerial photos exist and we cannot get a picture of the extend of our area, it is a possibility to measure the limits of the area buy visiting the area taking points with a GPS.

5. **Field observation with informant and qualitative interview**

In order to understand which are the most important plants used in the veld, their use and harvesting methods, we plan to go to the field with a key informant and observe his/her work. At this time we will ask information regarding different plants and note this information down. At this time we will also carry out qualitative interview regarding changes in the veld ecology within the last 50 years or the time limit the informant can remember.

6. **Sample plot measurement**

Being cautious of the fact that we are only observing a snapshot of reality and that the veld will look very different during different seasons, we will plot 3 * 2 areas (of 50 * 50 metres) and observe the density of the important plants that we have identified during above mentioned field observation. We can expect a higher collection of veld products nearest to the village and therefore we will observe the utilisation by making 2 plots in 3 areas gradiating away from the village. The areas we will delimit by GPS measurement.

In these plots we will make veld inventory. This means that we will count the number of important plant and tree species in different height categories; less than 1 m, 1 to 3 m and above 3 m.

7. Semi-structured interview

We believe that a semi-structured interview with a local authority related to the veld would be an essential starting point to understand the legal and political framework. Since our knowledge is limited and there is a big risk that we will leave out important questions with a very closed interview, a semi-structured interview will be the most suitable. With open questions and a checklist of issues to be raised, we can hope that the informant will provide us with more information. (Mikkelsen, 1995)

8. Venn Diagram (PRA method)

Even though an official outline of the veld as an institution is very valuable, it is also important to test this on the ground. For that reason we plan to ask some veld users (key informants) to draw a Venn diagram. This method implies that the informants will draw circles for each of the actors involved in veld production, and the size of these circles (or other forms that the informants might prefer) should be proportional with the importance of these actors. We believe that this method is suitable because we most likely will be communicating with illiterates. Furthermore, empowering the informants will also give the possibility for them to come up with information that has not been revealed at this point. (Mikkelsen, 1995)

9. Problem ranking (PRA method)

We will ask the same key informants as mentioned above (or maybe others in the same position, being cautious of not taking too much time away from the informants) to create a problem ranking for veld production. Again, this can be done by letting the informants define their own cardinal problems, and after that rank their importance. This could for instance be done by letting informants placing beans or other on a chart. (Mikkelsen, 1995)

10. Seasonal calendar (PRA method)

In order to understand the importance of the veld for the livelihood of the users, it would be suitable to ask them to make a time calendar showing their rhythm during the year with main activities. This will show the time spent on veld collection, which we assume can vary greatly over different seasons. This will also show the users diversification strategy and other livelihood strategies. (Mikkelsen, 1995)

11. Possible additional methods:

If time allows for it, it would be important to carry out above mentioned methods for as many different key persons as possible coming from different groups. This does not only mean different age and gender groups but also different stakeholders, which means not only veld collectors but perhaps also pastoralists. This of course would not guarantee the reliability of our research, since we will only be able to carry out research on a small scale, but however it would test our thesis with a more critical approach and hence test the validity.

Methodology table

Aspects	Aim	Methods	Time
Overview	Define geographical area	- literature - maps - interview - collectors - authorities - possibly GPS	2 hours 2 hours in Gabs 2 hours 1 day
Environment	Identify which products	- interview collectors - field observation	1 day
	Identify the distribution of veld products	- interview collectors - sample plot measurement in three gradients	2 hours 2 day
	Compare vegetation changes	- interview - collectors - authorities - sample plot measurement in three gradients	2 hours -
	Identify the parts of the plants used	- Interview collectors (field observation)	-
	Identify harvesting methods	- interview collectors - field observation	-
Social	Identify for what the plants are used	- Interview collectors - Questionnaire	1 hour 1 day
	Define importance of veld products	- Questionnaire	-
	Identify land tenure system	- Interview - collectors - owner - authorities - literature	4 hours 3 hours
	Identify livelihood strategies	- Interview collectors - Seasonal calendar - Problem ranking	 4 hours
	Identify power relationships	- Venn diagram	3 hours

Preliminary time schedule

January	Activity
15.	Questionnaire
16.	Define geographical area with interview (authorities) and mapping
17.	Interview with collectors (seasonal calendar, mapping)
18.	Field observation with interview (GPS measurement)
19.	Mid way evaluation. Student presentation and Feedback Interview with collectors (Venn Diagram, Problem ranking)
20.	Mid way break. Excursion.
21.	Interview with collectors (Venn Diagram, Problem ranking)
22.	Sample plot measurement in Lerala
23.	Sample plot measurement in Lerala
24.	Open for changes

Attached Interview guidelines (Appendix 1)

References

Atlhopheng, J., Molebatsi, G., Toteng, E., Totolo, O. (1998): *Environmental Issues in Botswana. A Handbook*. Environmental Education Project, Faculty of Education, University of Botswana.

Cullis, A. & Watson, C. (2004): *Winners and Losers: Privatising the Commons in Botswana – briefing paper*. International Institute for Environment and Development (ILED).

Hand outs by Andreas & Quentin.

Mikkelsen, B (1995): *Methods for Development Work and Research. A Guide for Practitioners*. Sage Publications. New Delhi, Thousand Oaks, London.

Ministry of Lands, Housing and Environment. Departments of Land (2002): *Botswana National Land Policy- Issues Report*. Natural Resources Services, Botswana.

Peters, P. (1994): *Dividing the Commons. Politics, Policy and culture in Botswana*. University Press of Virginia.

Picard, L. (1987): *The Politics of Development in Botswana. A Model for Success?* Lyne Rienner.

Whiteside, M (1997): *Encouraging sustainable family sector agriculture in Botswana.* Co-operation for Research, Development & Education (CORDE), Gaborone, Botswana.

Synopsis: Appendix 1

Interview guidelines

Authorities (land board, headman)

- Map
  - veld area of Lerala
- Land tenure systems
  - ownership of veld
  - changes over years
  - problems with ownership
- Vegetation change
  - decrease/increase in products
  - projects and future

Collectors

- Map
  - drawing of map
- Which products are used
  - most important products
  - the use (timber, fuelwood, medicinal, food...)
- The use of veld products
  - timber
  - fuelwood
  - medicinal
  - food
  - other
- (Harvesting methods) only in field observation
  - method
  - part of plant
  - changes in harvesting techniques over time
- Vegetation changes
  - decrease/increase in products
  - important veld products years ago/ important veld products today
- Land tenure systems
  - users of the veld (years ago/today)
  - problems between users
  - lost land (fencing...)
- Livelihood strategies
  - (seasonal calendar)
  - changes because of external factors

Appendix 2: Activity sheets

Activity sheet for Stine H. Pedersen

Day	Activities
Saturday 15	Questionnaire
Sunday 16	Morning: Church Afternoon: Location trip round in Lerala and surroundings Typing data from questionnaire in SPSS
Monday 17	Interviews with traditional healers and KyT staff Measuring timber in traditional houses and fens
Tuesday 18	Walk with traditional healer in the mountains, to get information about harvesting of products. Got lost in the mountains!
Wednesday 19	Day off
Thursday 20	Sample plot measurement near eroded area. Discussion of group presentation and presentation.
Friday 21	Interviews Matrix ranking
Saturday 22	Interview Village transects walk – counting timber Typing data Group presentation
Sunday 23	Sample plots – for supply estimations Sample plots – broken branches
Monday 24	Village transect walk – asking about firewood use and Morula Presentation in the village

Activity sheet for Nadia Glæsner

Day	**Activities**
Saturday 15	Questionnaire
Sunday 16	Morning: Church Afternoon: Location trip round in Lerala and surroundings
Monday 17	Community mapping with 2 informants Interviews with one traditional healer, one pastor and KyT staff Group presentation
Tuesday 18	Followed timber collector to eroded area One problem ranking Went to private farm to see if possible to use for control sample plots. Then went to a veterinary fence for the same reason.
Wednesday 19	Day off
Thursday 20	Sample plot measurement near eroded area. Soil analysis. Group presentation.
Friday 21	Type in results. Went again to the veterinary fence and discovered there had been harvested so we could not use it. Interview at social office and one Matrix ranking
Saturday 22	5 Interviews Village transects walk – counting timber Group presentation
Sunday 23	Followed firewood collector at the hill with a follow-up interview. Sample plots – broken branches
Monday 24	Village transect walk – asking about firewood use and Morula Presentation in the village

Activity sheet for Dennis Christian Larsen

Day	**Activities**
Saturday 15	Questionnaire
Sunday 16	Morning: Church Afternoon: Location trip round in Lerala and surroundings
Monday 17	Interview with the chief Seasonal calendar Interviews Group presentation
Tuesday 18	Interviews Problem ranking Went to private farm to see if possible to use for control sample plots. Then went to a veterinary fence for the same reason.
Wednesday 19	Day off
Thursday 20	Sample plot measurement near eroded area. Group presentation.
Friday 21	Went with an informant to eroded area. Interviews Interview at social office and Village Development Committee two Matrix ranking
Saturday 22	Interviews Group presentation
Sunday 23	Followed firewood collector at the hill with a follow-up interview. Sample plots – broken branches
Monday 24	Followed timber collector at the hill Presentation in the village

Appendix 3: Sample plot method

The plots were 10x10m and to get them randomly placed (and not subjective placed) they were placed on a selected bearing with 20 m between each plot. We were measuring the circumference at a height of 30cm but we made a mistake because, at trees that branch form the base we were measuring the circumference at the base of all the branches together. This does not give us a correct estimate of the biomass of wood in the sample plot. The first sample plots were made near the eroded area with the hope to emphasize our hypothesis by finding a gradient with more trees away from the bare soil. We did not find this gradient. Instead these plots and the other plots will be used for estimating the supply of firewood.

Table A.1 Example of results from one 10x10m sample plot:

Veld Products Sample Plots
23/01/05
17km from Lerala
Collectors: Stine & Helen
Quadrat No.: D2

No.	Species	Height Catergories				Stem Diameter	Branching	Harvested
		0 - 0.49	0.5 - 1	1 - 3m	3 -			
1	A.tortilis					7		
2	Mophane		1			7,5	1	
3	Mhalatsamaru		1	1		3	1	
4	Mhalatsamaru	1				2	1	
5	Mophane				1	25		1
6	Mophane			1		10		
7	Mophane			1		15		
8	Mophane				1	17		
9	Mophane				1	14		
10	Mophane				1	20		
11	Mophane				1	17		1
12	A.tortilis			1		19	1	1
13	A.tortilis			1		13		
14	A.tortilis	1				2	1	
15	Mophane		1			8	1	
16	Mophane	1				8	1	
17	Mophane				1	29	1	
18	Mophane Seedlings	30						
	Total	***33***	***3***	***5***	***6***			

Appendix 4: Supply – demand

Supply of firewood and timber
The supply can be calculated as:

Supply = growth rate * volume of existing trees

Table A.2 Supply for the first year:

	Formula	**Result**
Growth rate, k_b	Banks *et al*. (1996)	**4%**
Circumference, C	Measured	e.g. 16 cm
Radius, r	$r = C/(2\pi)$	2.55 cm
Basal area, BA_{tree}	$BA_{tree} = \pi * r^2$	20.4 cm^2
Total basal area, BA	$BA = \Sigma BA_{tree}$	9.29 $m^3 ha^{-1}$
Volume of wood per ha, V (Luoga *et al.* 2002)	$V = 6.18 BA^{0.86}$	1,069,651 m^3
Inner limit, L_1	Estimated	6 km
Outer limit, L_2	Estimated	12 km
Area, A	$A = ¾ * ((\pi L_2^2)-(\pi L_1^2))$	254.47km^2 = 25,447ha
Volume of existing wood	= A * V	**1,069,651m^3**
Supply		**42,786m^3**

The numbers are rounded off but calculated in excel without rounding of.

The volume of existing trees can be estimated from the volume of wood per ha (V) multiplied with the area where firewood and timber can be collected.

Assumptions for volume
The following equation for estimation the volume (m^3ha^{-1}) of wood is found for miombo woodlands (Luoga *et al.* 2002).

$V = 6.18 BA^{0.86}$

Where BA is the basal area in m^2ha^{-1}. The basal area can be found from our measurement of circumference in the sample plots. Miombo has a different structure than mophane but this is the best estimate that we can find.

Assumptions for area
Some informants said that they were going 8-12 km form the centre of Lerala to collect firewood and timber with their donkey cart or by foot. So we will use 12 km as the outer limit for firewood and timber collection. There is collected firewood and timber both within Lerala and at the agricultural fields but primary in the veld outside the fields. We will only look at the area outside the fields and it starts at approximate 6 km from the centre of Lerala. At one side the village is the Tswapong hills located. People are going a little up the hill to collect firewood and timber but not to the top because the ancestors do not allow it. For this reason we will only look at ¾ of the circle. For another scenario we

have used an outer limit of 20 km. This assumption was made to estimate the supply if the inhabitants get more access to go even further to collect.

Demand for firewood and timber

Population growth

In 2001 was the population of Lerala 5747 inhabitants (Central district council, 2003).
And from the numbers we can also calculate the population growth from 1991 to 2001 to be:

$$P_n = P_0 \cdot (1+r)^n$$

$$\Updownarrow$$

$$r = \sqrt[10]{\frac{P_n}{p_0}} - 1$$

$$r = \sqrt[10]{\frac{5747}{3779}} - 1 = 0.043$$

In the Serowe/Palapye sub district has the population growth been 2.2% and they expect it to be the same the next 20 years. So we will also expect the population growth rate to be 4.3% from 2001 henceforward.

Number inhabitant 2005:

$$P_{2005} = P_{2001} \cdot (1+0.043)^4 = 6992$$

Number of households:
6992 people / 6 people per household = 1165 households

Demand for firewood

The demand for firewood in Lerala per year can be estimated from:

Demand for firewood = household consumption * number of households

Table A.3

Firewood:	Formula	Result
Load of 4 wheel donkey cart pr. 2 weeks	measured	0.28 m^3
Household use per year	=(0.28/2)*52	7.3m^3/yr
No of households in Lerala	estimated	1165 households
Firewood demand		**8460 m^3/yr**

Assumptions

The average household consumption of firewood was estimated by asking different households about there use of firewood, and then by measuring one load of firewood on a 4 wheel donkey cart. This

number is 7.3 m^3 per year. We found that one household in average is using one 4 wheel donkey cart every second week.

Demand for timber:
The demand for firewood in Lerala per year can be estimated from:

Demand for timber = timber per household * number of new households

Table A.4

Timber:	Formula	Result
Population growth of Lerala	estimated	4.3%
No of households in 2005	estimated	1165 households
No of new households per year	=1165*4.3%	50 households
Timber used per household	counted	139 poles/household
Average volume of a pole	measured and estimated	0,025 m^3/pole
Volume of timber per household	=139*50	3.5 m^3/household
Timber demand	=50*3.5 m^3	**172 m^3/yr**

Assumptions:
We assume that timber is only used for building new houses and fences. Another assumption is that the use of timber is proportional with the growth rate of the population, this is not realistic for one year but for longer periods this should be adequate. The timber used in a household was counted for 24 households, and the poles were measured for two traditional huts and one fence.

Demand vs. supply

Assumption for extrapolation (Projection to the future)
Total demand in 2005 = Demand for firewood + Demand for timber = **8,632m^3**
Total supply in 2005= **42,786m^3**
The supply in 2005 is 34,154m^3 more that the demand. Even that the production of wood is higher than the removal will we assume that the vegetation does not get more dense. The trees will die and we do not have this factor in our estimates. To extrapolate the supply to the future we assume that the volume of existing wood will not get higher that it is this year.
Another assumption in our extrapolation is that the population growth will continue with a growth rate at 4%, so in 40 years from now will the population of Lerala be approximate 37,000. This is maybe not realistic but we will still use this assumption.

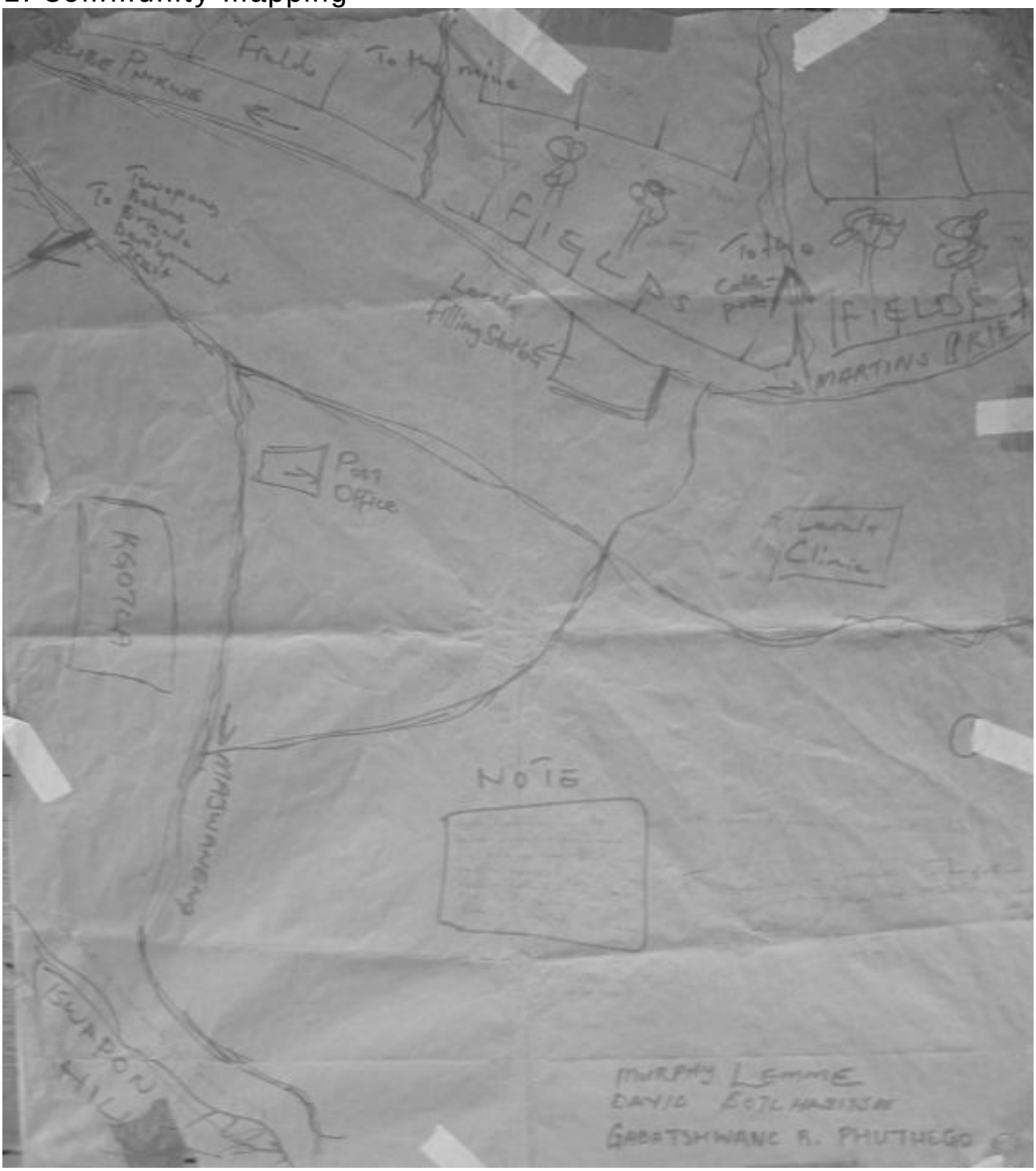
Firewood species:
From interviews we know that the preferred firewood and timber species are mophane and mohudiri. In our sample plots these species account for 69% of the trees.
If we compare the results from our matrix ranking and sample plots (Table A.5) we can see that the majority of the trees found in the veld can be used for firewood.

Table A.5 Species ranked for firewood in matrix ranking (5 is highest and – shows that the species was not included in the matrix ranking), and trees observed on sample plots

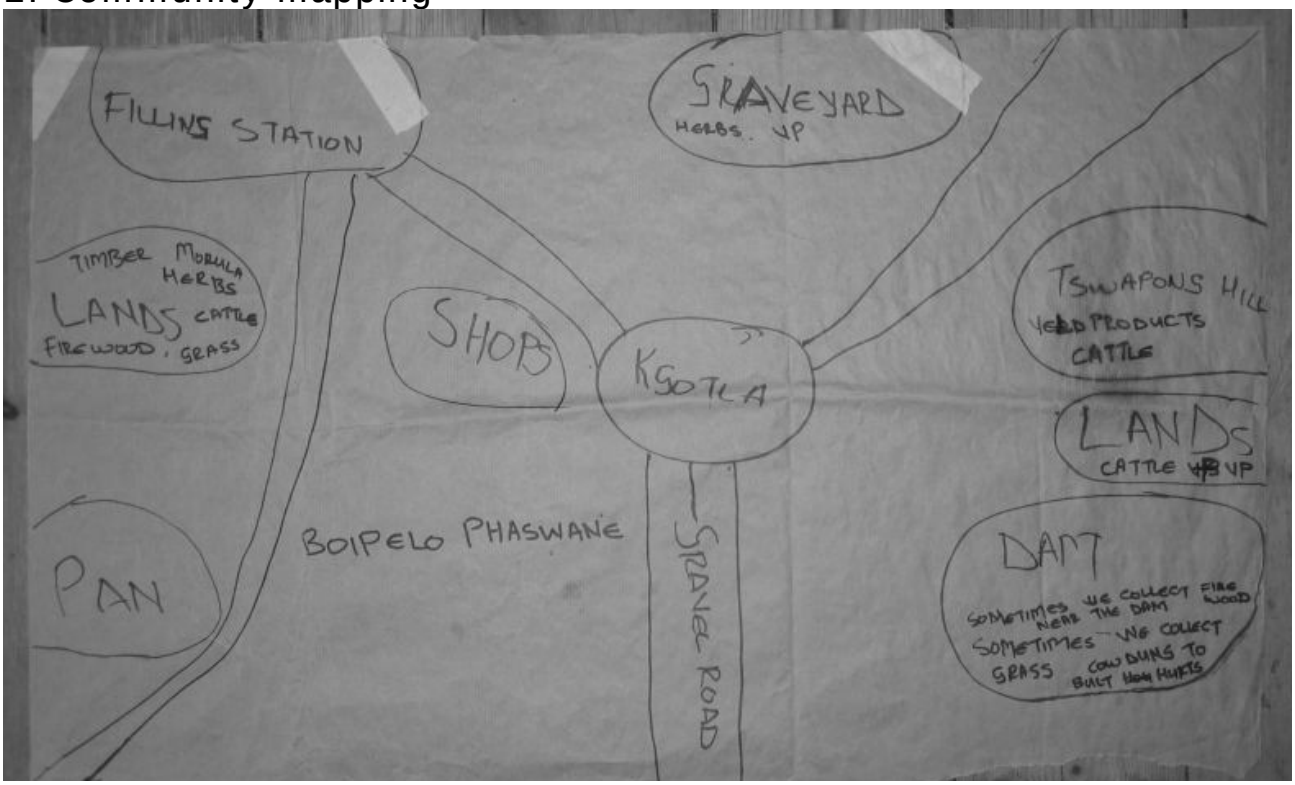
Species used for firewood according to Matrix ranking					Trees on sample plots
Local name	Latin name	Matrix 1	Matrix 2	Matrix 3	
Mokoba	*Acacia nigrescens*	3	-	5	3 %
Mosu	*Acacia torilis*	1	-	-	7 %
Mogogo	*Cissus cornifolia*	-	-	-	1 %
Mophane	*Colophospernum mopane*	5	5	5	55 %
Mohudiri	*Combretum apiculatum*	4	5	5	14 %
Motswere	*Combretum imberbe*	-	-	5	
Serokwane	*Commiphora sp.*	-	-	-	8 %
Moselesele	*Dichrostachys cinerea*	-	5	-	6 %
Mogwana	*Grewia bicolor*	0	-	2	
Moretlwa	*Grewia flava*	0	-	-	5 %
Mhalatsa-maru	*Protoasparagus africanus*	-	-	-	1 %
Morula	*Sclerocarya birrea*	0	0	1	
Molodo		-	-	3	

Appendix 5: PRA

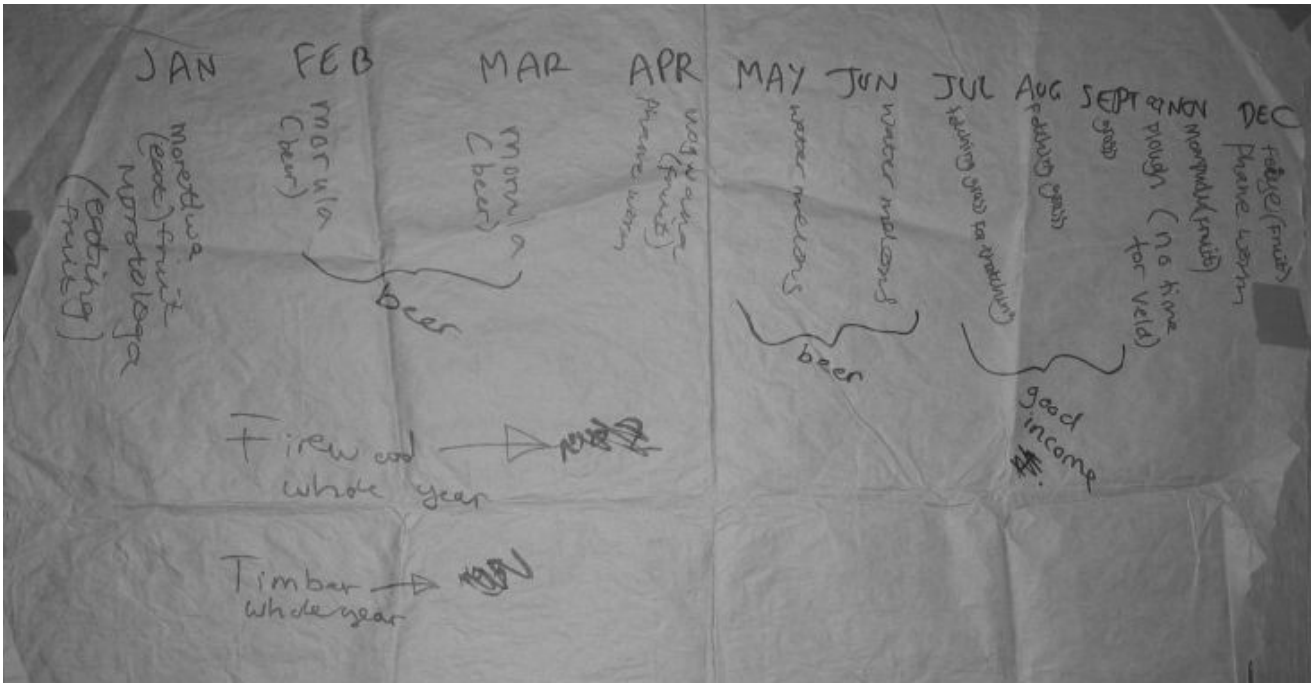
1. Community mapping



2. Community mapping



Seasonal calendar date



1. Problem ranking

1. Dangerous (snakes, rapists, scorpions)
2. Distance too far
3. Too many people
4. Changing of weather, wind
5. Difficult to sell caterpillar
6. No donkey cart
7. Difficult to sell beer

2. Problem ranking

1. Rapists.
2. No money to hire transport to go to the veld.
3. Lack of rain.
4. Difficult to find the firewood.
5. Rain can destroy phane worms harvest.
6. Snakes.

NON-PROBLMEMS:
People collect too much
Private land
Too far

Comments: a few of the girls have heard of the new veld regulations.

3. Problem ranking

(Young group of women)

Expensive transport (4 stones)
Rain (6 stones)
No markets (3 stones)
Distance (3 stones)
Snakes (0 stones)

NO – PROBLEMS:
Population growth
Permits

ADDITIONAL:
They only collect dead branches

1. Matrix ranking 21.1.05

The informants are non-members of KYT.
The uncertainty about this method is if the informants rank the quality of the tree or the tree's importance for the informants. (5 is best)

Tree	Firewood	Artefacts	Food	Timber	Income	Medicine	Alcohol	Tea	Fodder	Availability[1]
Mopane	5	5	3[2]	5	4	1[3]	0	0	1[4]	5
Morula	0	4	4	0	4	2[5]	5	0	3	5
Moretwa	0	2	2	1	1	1	0	0	3	4
Mompudu	0	0	2	0	2	0	0	0	0	3
Mogovogonwana	0	0	1	0	1	0	0	0	0	0
Mosata	0	0	1	0	1	0	0	0	0	3
Mogwana	0	2	1	1	2	0	4[6]	0	3	4
Monepenepe	0	0	0	0	2	4	0	0	0	4
Sengaparile	0	0	0	0	2	4	0	0	0	1
Morukuru	0	0	0	2	2	0	0	0	0	2
Seswagadi	0	0	0	0	1	1	0	1	1	5
Mosukujane	0	0	0	0	0	1	0	4	0	4
Mohudiri	4	3	0	3	3	0	0	0	5	5
Mosu	1	0	0	0	0	1	0	0	4	5
Mokoba	3	3	0	1	1	1	0	0	2	5

Timber: roof, fence, house, doorframes,..
-Moretwa and Mogwana: the timber for linking the cart and the donkeys on donkey carts.
Artifacts: decorative purposes, wooden spoons, bowls, axes, baskets.
Morula fruit is also eaten by cattle.

[1] O in this category means that the tree can not be found close by.
[2] Caterpillar and the white stuff on the leaves.
[3] Roots: medicine from young trees for diarhia.
[4] Leaves: Cattle eat when there are no grass in the area, if they have the choice they do not eat the Mopane leaves.
[5] Leaves: love medicine for women.
[6] Fruits: whisky brewing.

2. Matrix ranking 21.1.05

1 is best and 5 is lowest

	Timber	Firewood	Fruit	Medicine	Beads	Craft/ decoration	Food	Oils	Beer
Mophane	3	1				4	2		
Morula	2		1			5		4	3
Mohudiri	2	1				3			
Moselesele		1							
Monepenepe				1					
Morukuru	1				2				
Mososo						1			

3. Matrix ranking 21.1.05

1 is best and 5 is lowest

	Timber	Firewood	Medicine	Fruit	Beer	Food (worms)	Craft & decoration	Oil
Mophane	2	1				3		
Mohuderi	2	1						
Mokoba	3	1					2	
Mogwana		3		1	4		2	
Motswere	2	1						
Molodo	1	2						
Morukuru	1[1]						2[2]	
Morula		5		1	4		2	3

[1] Door frames
[2] Chairs