# The impact of wattle on rural livelihoods in three villages in the Ongeluksnek area


**Inga Marie Galløe ADK10015**

**Niklas Holtne ADK10021**

**Taja Brenneche EM08266**

Supervisors: Myles Oelofse and Torben Birch-Thomsen


Word count: 8.699

Submission date: April 1, 2011

## Abstract (NIKLAS, Marie, Taja)

South Africa has problems with invasion of alien tree species that causes environmental problems as well as problems with water supply. Two of these invasive species, *Acacia mearnsii* and *Acacia dealbata*, are now common in the Drakensberg region, where the species spread and occupy still more land every year. An eradication program, Working for Water (WfW), was started with a dual purpose of increasing water availability and poverty alleviation.

The impact of these invasive species on local livelihoods, as well as the environmental benefits and constraints of WfW, were investigated in this study. In a local context, the two *Acacia* species have been well integrated into livelihoods strategies, and a dependence on the species as a natural resource, has been created. This resource has great value in form of firewood and construction material, but also drawbacks in form of damaging roots and a high water uptake, which causes concern amongst local people.

Our results showed that local people did not consider the WfW project a success. Problems with funding and logistics have lead to very late or missing payments, which affects the economic security of the employees. Problems with funding limit follow-up treatments and re-growth of wattle is common.

Overall the invasive *Acacia* species have dual impacts on the study area. Environmentally and for some stakeholders wattle is a pest while for the communities it is an important resource. WfW has major constraints which makes the project unsuccessful in obtaining the overall purpose.

# TABLE OF CONTENTS

(MAIN AUTHOR IS INDICATED WITH CAPITAL LETTERS FOLLOWED BY CONTRIBUTING AUTHOR(S))

# 1. Introduction

## 1.1 Invasive alien species (NIKLAS, Marie, Taja)

Alien species are species that have been introduced deliberately or accidentally to areas where the species previously did not exist. Invasive alien species (IAS) are alien species that have an invasive growth pattern, spreading on the expense of indigenous species. In South Africa, about 8750 species have been introduced and 161 of these species are now regarded as IAS (Nyoka, 2003). Sixty-eight percent of these species are woody species, many of them introduced for timber, firewood and tannin production during colonial times.

Invasive alien species can be detrimental to natural ecosystems, and are often perceived to have a negative impact on ecosystem goods and services (Shackleton *et al.*, 2006), resulting in tremendous costs for governments in terms of control, management and eradication. Even though IAS usually are seen as pests, they may perform several positive ecosystem services such as provisioning and regulating services (Pejchar & Mooney, 2009). Provisioning services include materials such as firewood, fodder, construction wood etc. Studies show that IAS, in a South African context, have been well incorporated into local livelihood strategies and serves as an important natural resource (de Neergaard *et al*., 2005; Shackleton *et al.*, 2006). This provisional service may help to alleviate rural poverty and create income opportunities (Pejchar & Mooney, 2009). Even though the regulatory services, e.g. water management, may be negatively impacted by invasive woody perennials (Le Maitre *et al*., 2002), other more global benefits are present from a more holistic approach, e.g. carbon sequestration, mitigating climate change. This specifically holds true when grasslands are afforested by woody species (Pejchar & Mooney, 2009).

Black wattle (*Acacia mearnsii* De Wild) and Silver wattle (*Acacia dealbata* Link) are pioneer species originating in Australia (Le Maitre *et al*., 2002). They are highly invasive in parts of South Africa, especially in the Eastern Cape, causing loss of biodiversity by outcompeting indigenous species and a major loss of water, because of high evapotranspiration rates, which reduce streamflow, surface run-off and available surface water for agriculture (Binns *et al*., 2001; de Neergaard *et al*., 2005). The two species of wattle were introduced to South Africa in the mid 19$^{th}$ century as shade trees and shelterbelts, and in the end of the century as plantation trees for tannin production (Nyoka, 2003).

## 1.2 Working for water (TAJA, Marie, Niklas)

South Africa suffers from severe water scarcity due to insufficient rainfall, increased agricultural production, industry and urban growth demanding water. Therefore the South African government started the ambitious project Working for Water (WfW) in 1995 employing thousands of poor people in a large scale eradication program, with dual purpose of conservation and poverty alleviation (Binns *et al*., 2001). The idea was to limit the spread of wattle, by cutting wattle and thereby make more water available. Other than improving the water supply, the program aims at improving biodiversity by securing and re-establishing natural vegetation, reduce erosion and flooding, reduce fire hazard and most importantly, reduce poverty by economically empowering poor rural communities (Binns *et al*., 2001; Marais & Wannenburgh, 2008). The latter makes the program somewhat unique (Turpie *et al*., 2008).

The projects under the WfW program are supported economically by governmental and international funds. They follow an established course of action, that state how potential sites are selected, how people from the local communities are trained, as they for the most part have little or no education. Aside from the government funds, private funds and foreign investments contribute economically (Binns *et al*., 2001).

The strong dependence on funding makes it questionable whether the projects are sustainable. The question is if they will be able to maintain the initiated goals, both regarding the assumed increased water yield, regeneration of natural vegetation and poverty alleviation, in the long run.

## 1.3 Wattle and livelihoods (NIKLAS, Marie, Taja)

The impact of wattle on rural livelihood strategies is generally poorly understood, but some studies in South Africa have shown the use and potential for wattle products (de Neergaard *et al*., 2005, Shackleton *et al*., 2006). These studies show how wattle is used for a range of provisional services, proving a very important resource for local households.  Shackleton *et al.* (2006) found that local households favour Black wattle as building material over indigenous species and that the short distance to the wattle stands facilitate firewood collection. Increased density of wattle is even preferred by some local households, showing the importance of wattle to rural livelihoods (Shackleton *et al*., 2006).

## 2. Objectives (ALL)

The aim of our study is to investigate local use and perception of wattle and the influence of the WfW program in the three villages of Motseng, Litichereng and Thabachicha , Eastern Cape, South Africa. Leading to the following research questions and hypothesises:

- What is the current distribution of wattle compared to recent years?
- What is the biomass of wattle?
  *Hypothesis: The wattle tree is an invasive alien species which spreads rapidly. Compared to recent years the stands will have expanded and the density will be high.*
  *By measuring extend and biomass of the current wattle stands, the rapid growth, spread and density can be demonstrated.*

- Which stakeholders can be identified with relation to wattle?
- How do the different stakeholders perceive wattle, as a pest or a resource?
- Is wattle a livelihood asset to the communities?
- How is the informal wattle market organized?
  *Hypothesis: There are different stakeholders concerning wattle. Both institutions and groups of the community have an interest in the species. Some stakeholders perceive wattle as a resource, some as a pest. The differences lie in their use and management of the natural resource. Wattle is a resource to the community and thus, constitutes a livelihood asset.*

- What is the WfW program's impact on the community in terms of poverty alleviation?
- How do the employees of the program perceive WfW in terms of work conditions, job security, improving water availability and success in eradication of wattle
  *Hypothesis: The WfW program has the dual purpose of improving water scarcity and alleviating poverty. The program's involvement in the community has an impact on the employees from the community. The members of the community who are employed in the program perceive the job in a way that might be different from the overall objectives of the program.*

- Is there a potential market for secondary wattle products and carbon sequestration?
  *Hypothesis: The market of wattle is only local and informal. The abundance of the species makes it possible to establish other market products which could be suitable for a regional*

*market. The rapid growth and density of the species, demonstrated by the biomass estimation, could make it suitable for carbon sequestration schemes in a global climate change mitigation frame.*

## Definitions

**Informal market** is defined as income generating activities that are not officially registered.

**Stakeholder** is defined as an institution or group of people who have an interest in the issue at stake, i.e. wattle.

**Community** is defined as the local people in the villages, who are further grouped in different ways.

# 3. Study site and methods

## 3.1 Study site (MARIE, Niklas, Taja)

The study took place in the rural villages of Motseng, Lithichereng and Thabachicha located in the Drakensberg region in Eastern Cape, South Africa (Fig. 1 and 2). The area is a part of the former homeland Transkei. Aside from the communities, land is also occupied by the Ongeluksnek Nature Reserve and the Mariazell Mission (Fig. 3).


**Figure 1. Location of the study site in South Africa. An enlargement of the Matatiele area can be seen in Fig. 2.(Map source www.usafrica.com**


**Figure 2. Location of Matatiele and the three study villages. An enlargement of the study area can be seen in Fig. 3. (Map source Google Maps)**

The three villages are located approximately 50 km from Matatiele, connected by a dirt road. The infrastructure between the villages consists of dirt roads as well. Thabachicha is less organized in

terms of infrastructure than the other villages, and is easily isolated during rains as major erosion and flooding problems can occur. The villages are several kilometres apart, making transport between them time consuming. Located at the foothills of the Drakensberg, the area is generally hilly.

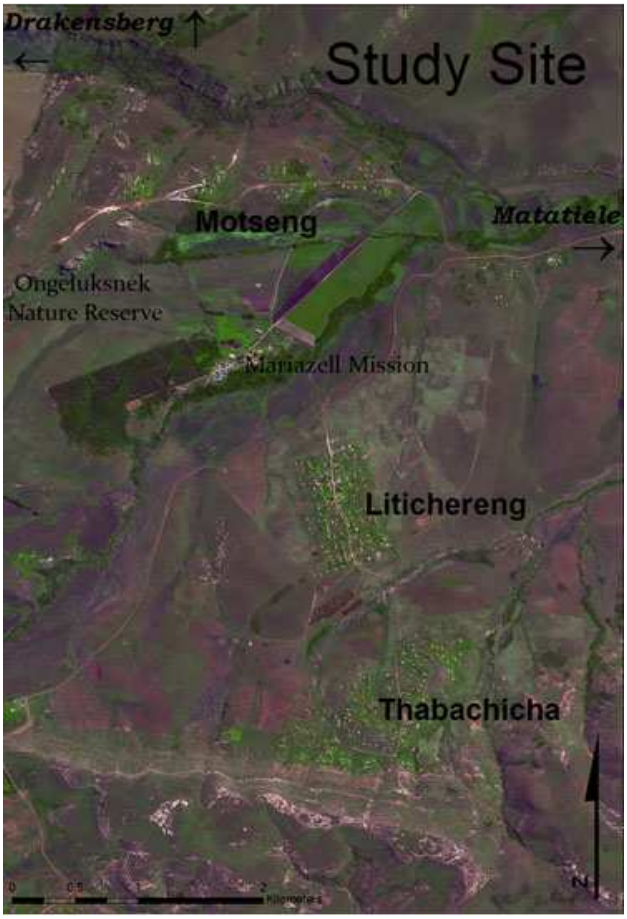



**Figure 3. Map showing the study area with the three villages investigated. The darker vegetation represents wattle growth, except the square patch west of the Mariazell Mission, which is a tree plantation. The Nature Reserve is bordering the Mission and the village of Motseng and stretches out to the west, further than the boundaries of the map.**

There is no electricity in the villages, but some small solar panels and gas generators exist, mainly amongst the wealthier households. People living in the communities are mainly Sotho or Xhosa speaking. Most of the household do subsistence home gardening, and their main income comes from governmental grants, pensions and/or remittances from migrant workers. Some informal markets additionally exist in the communities. Three forms of land tenure exists; communal-, private- and state land. Most of the area is constituted as communal land.

## 3.2 Methods (ALL)

In order to answer the proposed research questions, a number of methods were used to triangulate the results: An orientations walk of the village, questionnaires, semi-structured interviews with key informants, different forms of PRAs, biomass estimations of the wattle stands and GPS measurements of the extend of the wattle stands.

### 3.2.1 Questionnaire

Thirty-two questionnaires were carried out in three villages to discover possible differences between them as well as to represent the entire area. The sampling method for the questionnaires was structured sampling, with the aim of a spatial spread throughout the villages. Fig. 4 shows the sampling of the questionnaire interviews. A mistake occurred with one of the waypoints, which is why only 31 households are visible on the map.

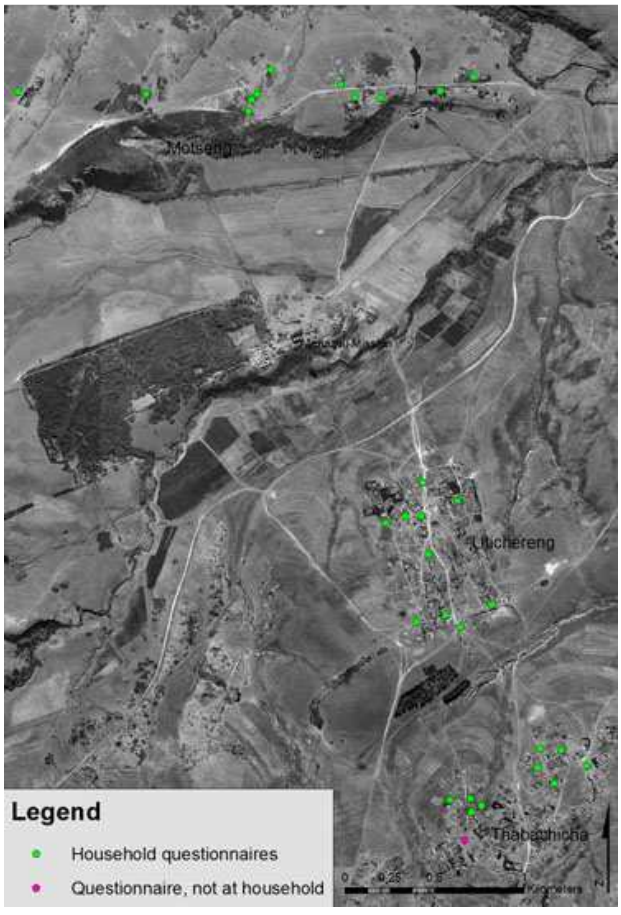



**Figure 4. Map showing sampling of questionnaires. For a larger version see App. 2.**

The questionnaire had the purpose of quantifying major patterns in the villagers' use and perception of wattle and water; their perception and involvement in the WfW program and how this

information was spatially distributed. In order to examine the villagers' perception of wattle, the respondents were asked to point to some benefits and constraints regarding wattle. The questionnaires were conducted on a household basis. In this regard a household is defined as people belonging to the same homestead, using from and adding to the same budget.

### 3.2.2 Semi-structured interviews

For the semi-structured interviews snowball sampling was used to identify key informants. The interpreter, the guides as well as the interviewees from the questionnaires were helpful in this regard. Two sets of semi-structured interview guides were used. One had the purpose of giving in-depth information about aspects related to the wattle stands and the villagers' use of wattle. The other focused on issues related to WfW and were conducted on employees or former employees of WfW. In total eleven interviews was conducted.

### 3.2.3 Collecting track

Our field team went with two of the villagers, who were members of the same household, to collect firewood. The route from their homestead to the wattle stands, and back again, was tracked, and during the walk informal interviewing was conducted.

**Picture 1. Different methods used. Community mapping, tree measurments, semi-structured interviews and questionnaires.**

### 3.2.4 Focus group discussion

WfW employees were identified and invited to discuss and share opinions and experiences from the program. Discussions ranged from their involvement in the project, common socioeconomic and environmental problems related to the project; if the project had improved their livelihood, whether they thought the program was sustainable and how they got involved.

### 3.2.5 Community mapping and ranking

A group of villagers from Motseng were asked to discuss an in advance prepared rough map of the area and draw in different points of interest on the map. Villagers from Motseng were chosen as they live close to the wattle stands, and often go and collect wattle by themselves. They were asked to place their houses, where they collected water and wattle, the route they took to collect it, as well as the sites where WfW have been operating.

The same group were asked to make two different rankings. The ranking exercises were based on information derived from the questionnaire survey, listing benefits and problems in two different matrices. Participants were asked to rank the benefits according to most important and problems according to most problematic using small stones, which were later scored.

### 3.2.6 Area measurements with GPS

Thirteen of the wattle stands north of Motseng were measured by walking around them with a GPS. The purpose of this method was to determine the present size of the wattle stands. The stands were selected based on their close vicinity to Motseng, where many collectors live. A few stands further from the villages were also targeted to get more data on the spread of wattle. The data was plotted into a satellite image from 2000, an aerial photo from 2004 and a satellite image from 2008 to see the difference in the distribution of wattle.

### 3.2.7 Biomass estimation

Biomass estimation of wattle stands were conducted through measurement of diameter at breast height (dbh) and height of all wattle trees above 130 cm in six sample plots of 5x5meters. Plots were located at the slope towards the river, north and in proximity of Motseng. Wattle stands with different densities were chosen to represent an average stand. Plots were chosen by throwing an object into the stand, marking the centre of the sample plot. Data were analysed to see stocking density, biomass and to calculate carbon content.

# 4. Results and discussion

## 4.1 Current state of wattle in Motseng area (NIKLAS, Marie, Taja)

### 4.1.1 Distribution

The wattle trees are abundant in parts of the study area. Especially in Motseng, along the roads, on the grazing lands towards the nature reserve, on river banks, on the slopes close to the river, and on the mountain slopes north of Motseng (Fig. 3). A few stands are located south of Thabachicha.
The wattle is very invasive and fast growing, which makes it very hard to control in the area. The GPS measurements revealed that the wattle has spread extensively when compared to aerial and satellite photographs from 2000, 2004 and 2008 (see Fig. 5). On the photographs, all of the darker vegetation areas are wattle. The figure shows that some single trees have given rise to much denser stands, e.g. on the map from 2004, the small stand furthest to the east has grown from a few trees in 2004 to a regular stand in 2011. The gradual growth of wattle can be seen over the years, even if WfW have been operating in the area. Data from measurements of cleared areas were unfortunately lost and cannot be presented, but they showed areas where there is no re-growth because follow-up treatments have been applied.
Generally the wattle spreads extensively, which means that the wattle now occupies areas that used to be grazing lands, and are spreading more and more from the river towards the village of Motseng, which is located in southern parts of the maps (Fig 5). This is in accordance with information obtained from villagers and WfW-employees.

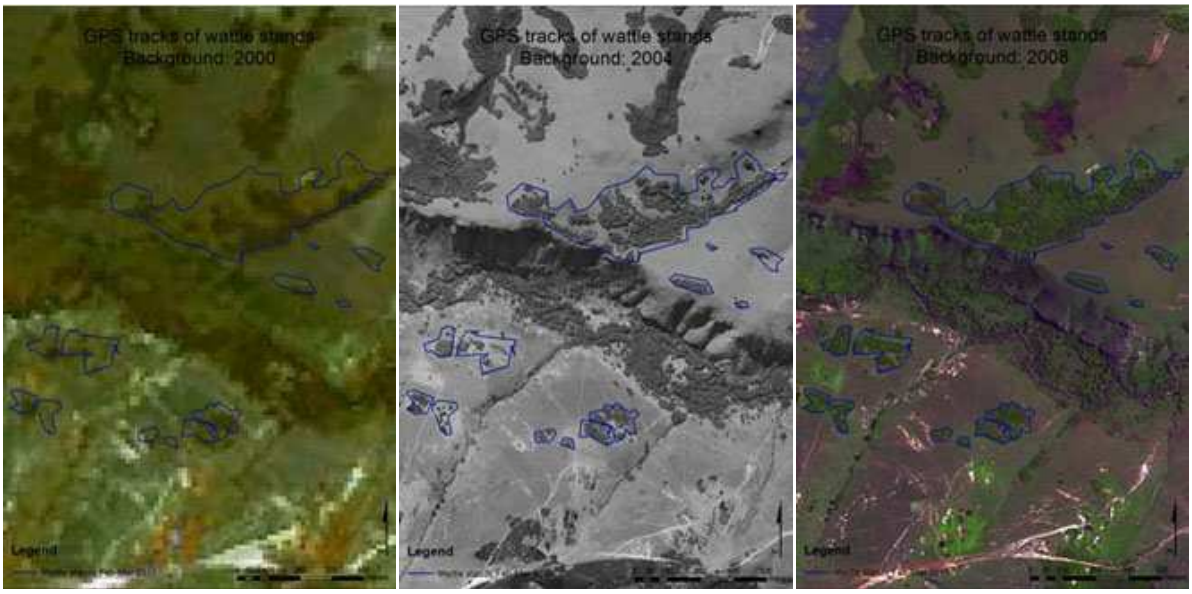



**Figure 5. GPS tracks around the current wattle stands overlaid aerial photographs and satellite images from 2000, 2004 and 2008. GPS measured areas (February-March 2011) is indicated with blue lines. For larger versions of maps from 2004 and 2008 see App.3.**

### 4.1.2 Spread of wattle

WfW have been active in the area, but not the last few years, they are currently only operating within the Ongeluksnek Nature Reserve, and 200 meters outside the borders of the reserve. This has caused massive re-growth during the last few years around killed trees and those trees that were left alive or survived the poisoning. Another project eradicating wattle is the Mehloding adventure trail. It is a community based tourist project, where guided hiking tours and local accommodation is organized. The project is only eradicating wattle in limited areas, 20 meters on either side of the trail. Areas where WfW have been operating are visible since stumps are left standing, showing signs of poisoning (see Pic.5), but unfortunately re-growth is a serious problem in most cleared areas. Even if the tree and the roots have been killed by poison, new wattle seedlings colonize the area faster than natural grasses can establish growth. The allelopathic abilities of wattle can have a delaying effect in the re-establishment of grassland (Fatunbi *et al*., 2009). Lack of funding for the WfW project limits the follow-up treatments, resulting in fast re-growth of wattle stands. At the areas where follow-up treatment has been successful, grasses are able to cover the area (see Pic. 2). Stumps remained visible in these areas, but there was no re-growth from stumps or roots, i.e. no vegetative regeneration from killed wattle, and grass now covers the cleared area. A few young wattle trees (<1 year) were growing, most likely originating from seeds in the soil.

**Picture 2. Re-growth of grass on eradicated land.**

### 4.1.3 Land conflicts

Wattle spreading into the grazing lands causes some concerns for herders in the area. Another problem for the herders is access to the river, where growing wattle limits the sites where animals can cross the river and where they can drink. There is no apparent conflict between wattle and agriculture since there are almost no locally owned agricultural practices in Motseng where wattle is growing most extensively. Our survey showed that many villagers were concerned with the roots of wattle destroying buildings and limiting the area where new houses could be constructed. Although there are no major conflicts now, the continued spread of wattle will likely cause more land cover conflicts in the future.

### 4.1.4 Biomass estimation

The tree measurements show that the new wattle stands are very dense, with an average stocking density of 24.000 trees $ha^{-1}$ and with a volume of 90,50 $m^3ha^{-1}$ (SD +/-2,70) (Tab. 1). In the center of the stands larger and older trees grow, and young wattle trees grow around them, expanding outwards and claiming the grassland area. Foelkel (2008) describes a similar situation where one single mature tree can give rise to 15.000-20.000 seedlings per hectare. The wattle trees in these stands only exhibit limited branching, with elongated stems competing for sunlight.

**Table 1. Result of biomass estimation in six different plots and average. *Value of biomass per volume for *Acacia mearnsii* adapted from Searle & Owen, 2005. **Value of percent carbon in *Acacia mearnsii* adapted from Foelkel, 2008.**

| | Plot 1 | Plot 2 | Plot 3 | Plot 4 | Plot 5 | Plot 6 | Average |
|---|---|---|---|---|---|---|---|
| **Number of trees per plot a 25m²** | 69 | 59 | 46 | 21 | 107 | 58 | 60 |
| **Stocking rate (trees/ha)** | 27.600 | 23.600 | 18.400 | 8.400 | 42.800 | 23.200 | 24.000 |
| **Stand basal area ($m^2$/ha)** | 14,4 | 9,8 | 19,0 | 10,1 | 28,7 | 20,7 | 17,1 |
| **Volume ($m^3$/ha)** | 53,0 | 42,6 | 100,1 | 50,5 | 167,7 | 129,4 | 90,5 (+/- 2,70) |
| **Biomass (ton/ha) using 663kg/$m^3$*** | 35,1 | 28,2 | 66,4 | 33,5 | 111,2 | 85,8 | 60 |
| **Carbon (ton/ha) using 77-80% **** | 27-28 | 21-23 | 51-53 | 26-27 | 86-89 | 66-69 | 46-48 |

There is a clear abundance of wattle in the area and growth exceeds local extraction, as can be seen on the area measurements and through observations. The wattle stands, in which measurements were conducted, are still young, no more than 5 years old, but already contain about 60 tons of biomass per hectare. Not much extraction is taking place in these stands because of the young age of the trees, even though selective extraction was observed. Several respondents confirmed that they want the trees to reach a certain size before they were extracted. This further increase the spread of

wattle, since *Acacia mearnsii* is able to reach flowering maturity after only 18 months (Foelkel, 2008), and seeds are dispersed from these young stands. Mature *Acacia mearnsii* produces 40.000-90.000 seeds per kilo (Foelkel, 2008; ICRAF). This massive production of seeds creates enormous seed banks in the soil, making eradication efforts harder. In order to reduce the size of the seed bank, and reduce further spread, it is crucial to kill the wattle trees at a very young age.

## 4.2 Stakeholders and management of wattle (TAJA, Marie, Niklas)

During the field study different stakeholders managing wattle in the study area were identified. The Communities, WfW program, the Mariazell Mission and the Ongeluksnek Nature Reserve. These stakeholders each perceive wattle in different ways according to their own interests. These stakeholders manage wattle according to their ability and their right to manage the areas. The relationship between the different stakeholders can be seen in Fig. 6.

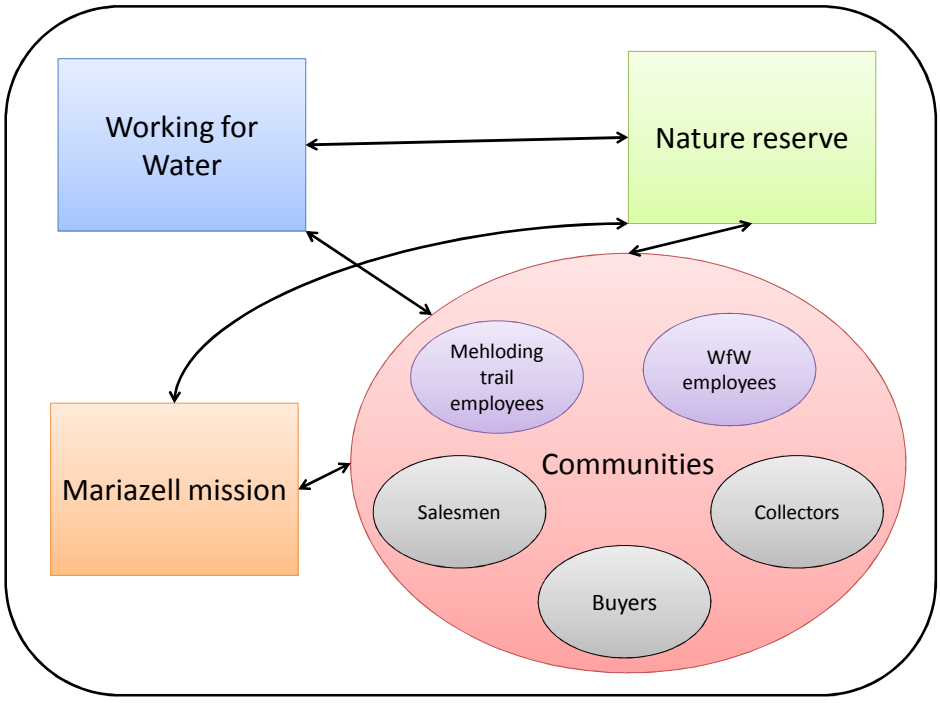



**Figure 6. Boxes illustrates the different stakeholders in the study area. The small circles inside "Communities" demonstrates grouping of villagers according to their interest in wattle. Arrows illustrate interactions between the stakeholders.**

In the following sections the different stakeholders are presented and their relation to wattle is described. This survey concentrates on the community, and how the community as a stakeholder is influenced by the other three stakeholders. WfW also has a prominent role in this report, as WfW influence the community by creating jobs.

### 4.2.1 Community (TAJA, Marie, Niklas)

The communities in the study area consist of the people living in the three villages. During the study different groups of villagers relating to wattle, were identified. There are the people from the community who are employed in WfW, there is The Mehloding Adventure trail, and lastly there are the wattle users. As all of the villagers are wattle users in one way or the other, they are further divided into collectors, who collect wattle themselves, buyers, who buy it, and finally salesmen, who sell it. Thus the community is not an entity as Fig. 6 illustrates.

The community is a stakeholder in the sense that the villagers use the wattle trees and therefore the interest for wattle trees in the communities is great. However, the communities have no direct control over how the land is managed. The chief has the tenure right. In fact, if the villagers need large amounts of wattle, e.g. for funerals[1], or when the salesmen collect large amounts to sell, they have to ask the chief's permission to cut the wattle.

The villagers' use and perception of wattle and thus the impact of wattle on their livelihood will be described and analysed in the following sections.

#### *4.2.1.1 Different uses of wattle*

The survey showed that 100% of the respondents used wattle. In Fig. 7 the distribution of different uses are shown. Clearly the most popular use is firewood, which is used both for heating and cooking. Second most popular is construction, under which category the respondents mentioned fences, houses and other household practicalities such as ladders, poles for oxen span and wooden spoons. A few mentioned the use of wattle as fodder for animals. However, in those specific cases it was unclear whether the respondent clearly understood the question. Interviews confirmed that wattle is browsed by livestock in the winter when no grass is available, but no cut-and-carry system exists to our knowledge. Wattle is not commonly used as fodder because of its low palatability (ICRAF), and it is hardly necessary in this specific area where grass pastures are abundant.

Regarding the use of wattle for medicinal purposes, it is unclear whether the medicine is extracted from another type of wattle than the one investigated. One respondent used wattle to produce charcoal, but only for his own personal use. The respondents who answered that they used it for traditional beer making, was most likely referring to the heating process of the brewing.

[1] Funerals are community events where everyone participates and have a feast for which a large amount of firewood is needed.

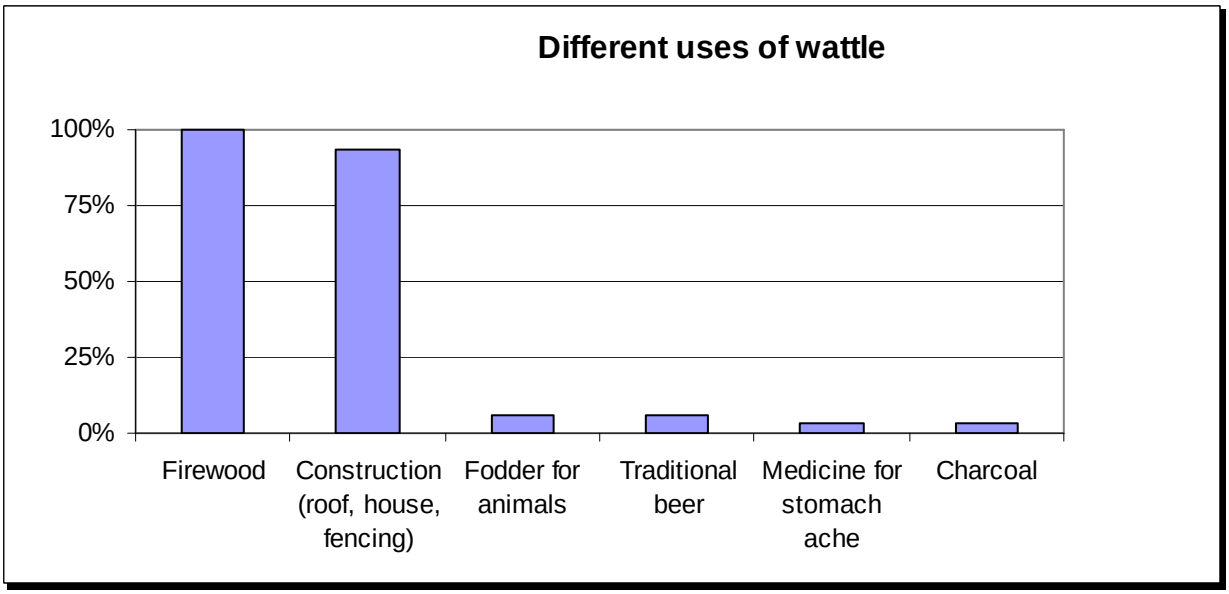



**Figure 7. Distribution of different wattle use as a percentage of questionnaire responses (n=32).**

**Picture 3. The photos illustrates different wattle uses e.g. firewood and fencing.**

### *4.2.1.2 Trade and collection*

The wattle is brought to the houses of the villagers in different ways. Many villagers collect themselves, some cut down the trees and pay for the delivery, some pay for both delivery and cutting and some receive wattle from family, friends or neighbours (Fig. 8).

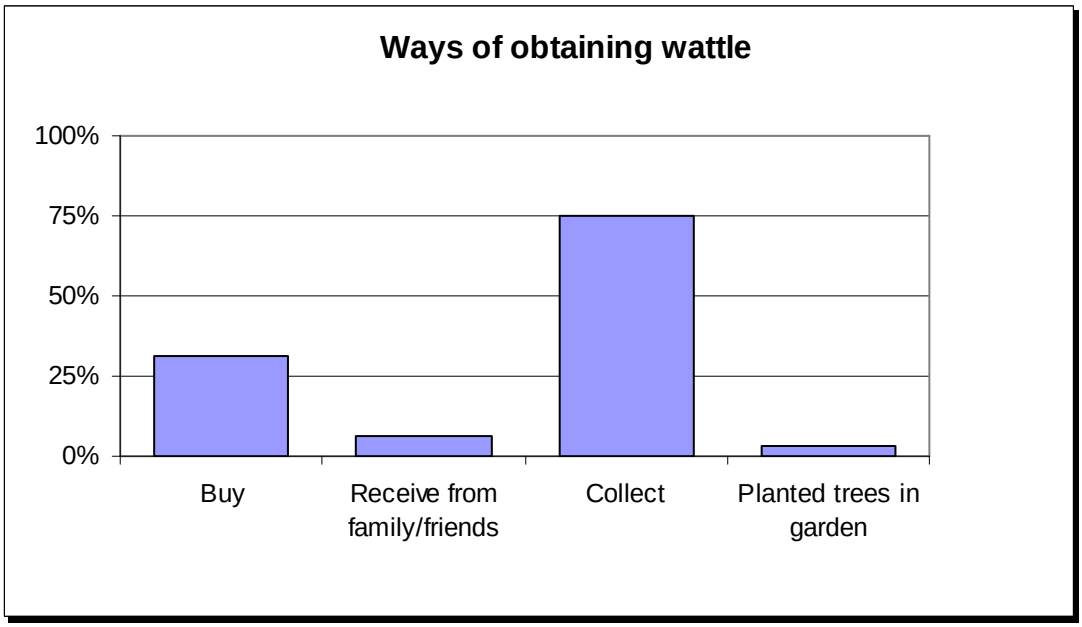



**Figure 8. Ways of obtaining wattle as a percentage of questionnaire responses (n=32).**

When categorizing the users into buyers, collectors and salesmen, the respondents who bought the wattle constitute the group of buyers regardless that they were also collectors to some extent. The different categories overlap, but to make the spatial analysis somewhat easier, the categories were made simpler (Fig. 9).

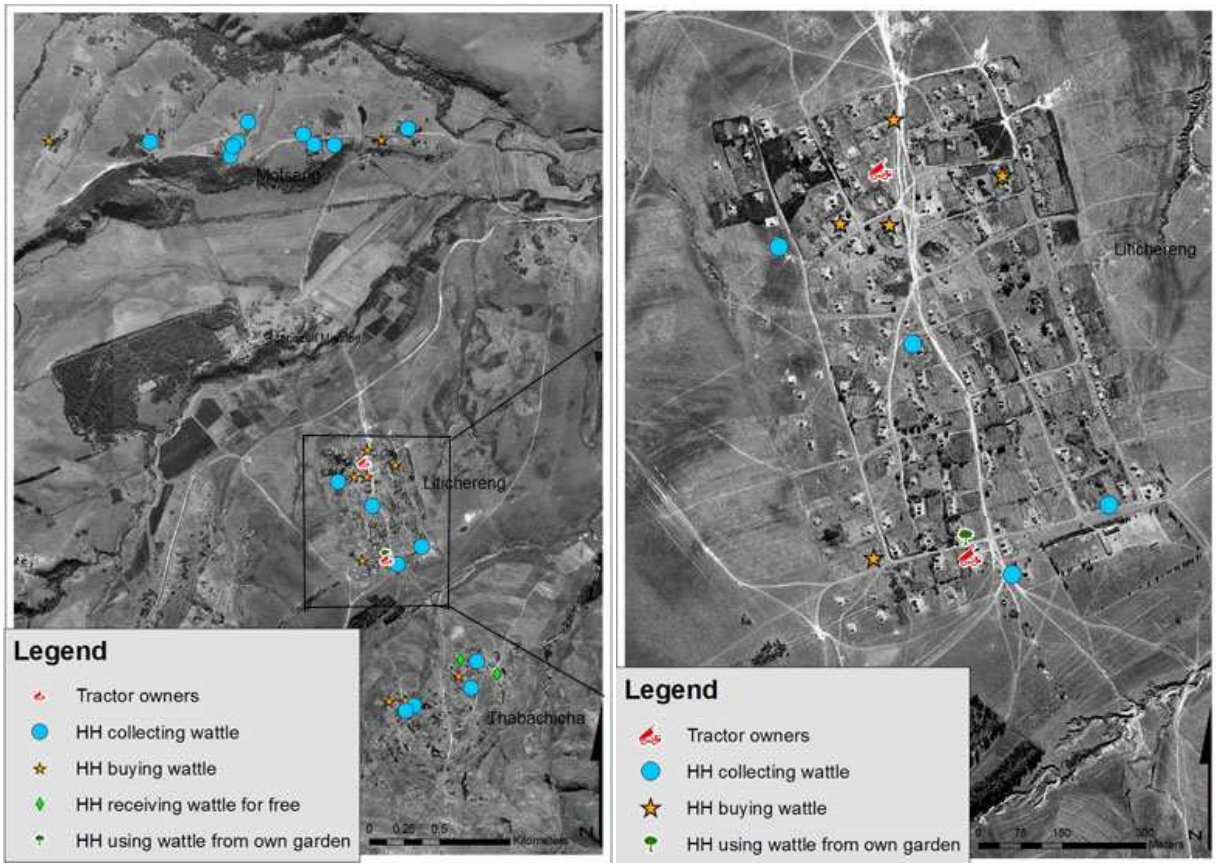



**Figure 9. Spatial distribution of different wattle users. The map to the left gives an overview over all three villages investigated. A more detailed view of Litichereng can be seen on the map to the right. Tractor owners = salesmen, HH = Households.**

The buyers are located in all three villages. There is only one in Motseng, the rest is in Litichereng or Thabachicha. The villagers of Litichereng and Thabachicha are further away from the resource and therefore more inclined to buy wattle. This specifically holds true in the case of Litichereng, as there are some wattle stands south of Thabachicha. This is probably the reason for most of the buyers being located in Litichereng.

**Picture 4. Different ways of transporting wattle. From the right: headload of wattle, wattle ready for transport by oxen, tractor and wagon.**

The salesmen live in Litichereng, the village with the greatest distance to the resource. Both of the salesmen were wealthy with the wattle selling as a secondary business.

The collectors are in all three villages. Most of them in Motseng, close to the resource, a few located in Thabachicha and Litichereng respectively. Even though they are close to the wattle stands in Motseng they do not extract wattle from the most nearby stands, as these stands are young and too small to use as firewood. During the tracking of collectors, it could be seen that they walked twice the distance to collect wattle (Fig.10). They walk past several wattle stands in order to get the ones that are most suitable for firewood.

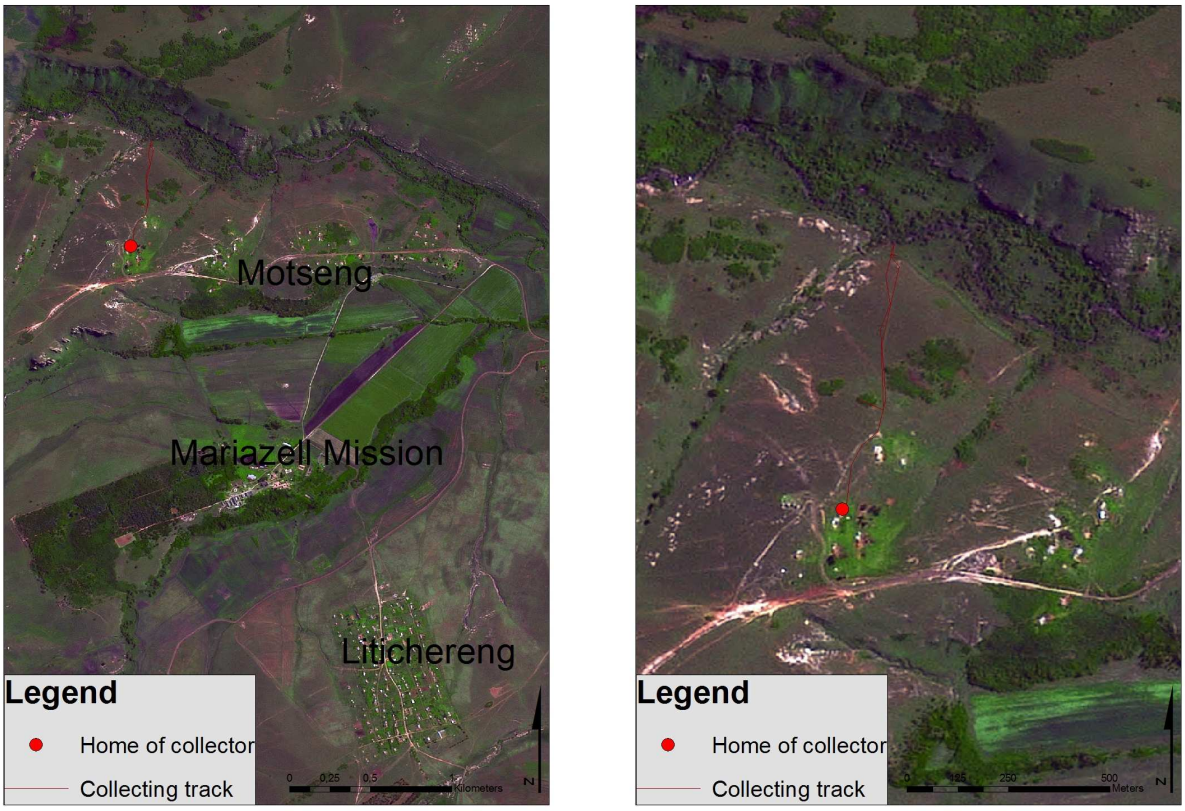



**Figure 10. Firewood collection route for collector in Motseng. Closest wattle stands are not used. The map on the left show an overview of the area and the map on the right is a close up of Motseng.**

Furthermore, they collected dry wattle which had already been cut by WfW or the Mehloding Adventure trail. The dry wood is lighter and therefore easier to carry, and since it is already dry it can be used as firewood instantly. The followed villagers live very close to the resource, as can be seen from Figure 10. It took no more than half an hour to collect the firewood, but this is probably not representative of the entire community. Pictures from the collection can be seen in  Pic. 5.

**Picture 5. Following two villagers to collect firewood. Participation and informal interviewing. The collected amount was assumed to last for three weeks.**

### *4.2.1.3 Perception of wattle*

#### 4.2.1.3.1 Wattle as a resource

Only two respondents from the questionnaires did not have positive remarks on wattle. Many positive comments referred to the everyday uses that were mentioned earlier, and some of them seemed to have the opinion that the question was repetitive, which leads to the interpretation that they perceive wattle as an obvious resource. The ranking exercise revealed that firewood and construction are the most important qualities of the wattle resource (Fig. 11).


**Figure 11. Results of ranking exercise showing the main benefits of wattle.**

A range of other positive characteristics were also pointed out. The benefits were triangulated by a number of different informants among the semi-structured interviewees. The wattle salesmen might

have the opinion that wattle is a resource due to the fact that they generate an income from it. Informants in Thabachicha further claimed that they would prefer a wattle plantation in Thabachicha, as the wattle is not as abundant in that surrounding as north of Motseng.

#### 4.2.1.3.2 Constraints

A fair amount of the respondents, i.e. 15 out of 32, replied that the wattle is a problem as it absorbs water from the soil. Five respondents mentioned that there is a risk of the houses cracking as a result of the roots spreading. Another four mentioned that it either kills grass and other plants as grass and other plants cannot grow where wattle grows. Ten respondents did not have any negative comments, as they perceive the wattle tree as a resource only.

The ranking exercise revealed that the absorption of water is perceived as the largest constraint among the participants as seen in Fig. 12.


**Figure 12. Results of ranking exercise showing the main problems with wattle.**

#### 4.2.1.3.3 Livelihood constraints are limited

The perceived constraints can be categorized into environmental and livelihood constraints, in order to evaluate which are the main constrains influencing the livelihood (Table 2).

**Table 2. Categorization of constraints (n=32)**

| | **Perceived constraint** | **Number of respondents** |
|---|---|---|
| **Environmental constraints** | Absorbs water from the soil/river | 15 |
| | Kill plants/grass | 4 |
| | ”Bad for the land” | 2 |
| | Causes forest fires | 1 |
| **Livelihood Constraints** | Make houses crack | 5 |
| | Compete with planted crops | 3 |
| | Criminals can hide in stands and kidnap children | 1 |

Some responses are easily identified as environmental or as a livelihood constraint, while others need interpretation.

The water absorption constraint is an environmental constraint, but could very well be a livelihood constraint as well. If the water absorption means that the villagers experience water scarcity as a result of this, it has a tremendous impact on the livelihood of the villagers. Even though this might be stating the obvious, water is an important resource for the everyday lives of the villagers, i.e. an important livelihood capital. Furthermore it was clear that there was no water scarcity in the area. On the contrary, when asked about the taste of their water many respondents explained how their water was fresh from the source and therefore better than the water in Matatiele and towns further away. The conclusion to this is that the observed water absorption that the respondents mention is solely an environmental constraint.

Another environmental constraint is the stated problem that wattle outmatches other vegetation. That it is bad for the land is presumably an environmental constraint as well, although there is no explanation of what exactly is meant by “bad”. The perceived land cover conflicts could arguably be of an environmental kind, but since the respondents mentioned the conflicts of planted crops and medicinal plants, both of which are harvested for use or consumption, the land cover conflicts in this regard are livelihood constraints.

Categorizing the constraints as above, 22 of the responded constraints are of environmental character, against nine constraints of livelihood character. The rest is unsuitable for categorization. Only one respondent had no positive remarks, a fair amount of the respondents did not perceive any constraints to wattle and more than half of the stated constraints can be categorized as environmental.

#### 4.2.1.3.4 Wattle is a necessity

In general it is clear that wattle is a resource to the villagers. Every source of information has confirmed this. The uses for construction purposes presumably are not executed on a daily basis, but nevertheless important, as the constructions are used on a daily basis. The firewood is used every day, more in winter than summer obviously, as the heating are not necessary in summer. The wattle tree is thus a major part of the villagers' livelihood. As financial capital is for many villagers a scarcity, because they rely on public benefits and/or remittances, the reliance on other capitals is all the more evident. In this regard, the wattle tree is part of the natural capital as well as the abundant water resources in the area.

### *4.2.1.4 Market of wattle*

The market of wattle in the three villages is somewhat complicated. There are two tractor owners in Litichereng who sell wattle to people, either by collecting and transporting, or by providing the transport only. The buyers order the wattle from the salesmen and they have the wattle at their household a few days later.

Other people transport the wattle using oxen, either for their personal use or for other households. The average price for an oxen load is R 155 (SD +/-54) and a tractor load R 383 (SD+/-97). The oxen price depends on the distance the salesmen have to go, whether or not the wood collected is fresh or dry, and if the wood is dragged behind the oxen or transported on a carrier. When collecting for other households, it can either be for a cash price or the price of goods or favours such as food or local brew. Only the location of the salesmen using tractors are known, which is why they only appear in the spatial analysis of the salesmen.
The market activities mostly take place in Litichereng, due to the remoteness of that village to the resource.

### 4.2.2 Working for water (MARIE, Niklas, Taja)

The WfW program is a major stakeholder in relation to wattle, as the program has the aim of eradicating the wattle by employing the local communities and therefore also intend to perform poverty alleviation. WfW is thus also relating to the communities in the sense that the employees in the program are found in the communities. The communities' perception of the program is described and analysed in this section.

#### *4.2.2.1 Local perception of Working for Water*

Investigating local people's perception of WfW, one major issue became apparent. Some of the WfW employees, from the community, expressed negative opinions about the program which according to them has major constraints.
It was hard work and salaries were low and often delayed. If they had an alternative job they would not be involved in WfW, but often there are no other job opportunities in the area. A former supervisor of WfW saw the project as a never ending job, meant in a positive way, as he liked the fact that the wattle spreading gave him job security, even though it did not pay well. This example shows that different opinions are present in the community, regarding employment in WfW.

It can be discussed whether or not employment within WfW is stable enough. Employees of WfW are offered a contract lasting for five years, but other people are allowed to take over the same contract after one year. One person in the focus group was no longer employed in WfW, as her contract was taken over by somebody else. Information about how, and with whom the contracts were conducted in the first place, was hard to obtain. Our impression was that the rumour of a job opportunity spread in the village. Somehow only few people knew about WfW, so there might have been some selective information sharing. The correct information would have been valuable for evaluating the project in terms of poverty alleviation, as the government's aim of WfW is to employ the poorest people in each community. It would be interesting to know whether the poorest people are being contracted, and how the contracts are managed.


**Picture 6. Top: Focus group with WfW employees. Bottom: WfW employee with a T-shirt from the program.**

In general people from the communities did not think WfW had been efficient in facilitating poverty alleviation. The main problem is that payments to the employees are often delayed. When people are not paid, they use credit for subsistence and build up debt at local stores. When they finally get paid, they have no other choice than to use their salary to pay off their debt. Furthermore the salaries are not high enough to set aside money for later use, i.e. no buffering capacity. A buffer would make them able to make it through times of difficulty or make it possible to invest, which might be a way out of poverty. Another common opinion was that WfW is not a way out of poverty for the community, as only ten people are involved in the project at a time.

#### *4.2.2.2 Water availability*

One major motive for the government to initiate the WfW program was to increase the water availability (Binns *et al*., 2001). In the study area the water scarcity does not appear to be a problem, because the villages are located near the spring source and water scarcity is more likely to occur in more densely populated areas further downstream. Villagers fetch clean water from streams, or used taps in Litichereng or Thabachicha.

Even though water is abundant, there is an awareness of the problem that wattle uses a lot of water. In the ranking session water uptake was ranked as the biggest problem (Fig. 12). The awareness of

the problem might simply be through observations. Wattle can be seen growing near streams and rivers, which indicate high water use. Another observation is that no other vegetation grows underneath or amongst the wattle stands (Pic. 7 left).

**Picture 7. Left: Cut wattle, where it can be seen that nothing can grow under the wattle stands. Right: Eradication site with grass re-growth. Middle: Stump showing visable signs of poisoning.**

The locals believe this is because the wattle absorbs all the water from the soil. Another explanation could be shading effects and allelopathic substances emitted by the wattle trees (Fatunbi *et al.*, 2009).

Even though the water issue was mentioned several times, no one mentioned that it was a good project, because it made more water available. This might be because they did not feel like the project was successful in eradicating wattle in the long run.

#### *4.2.2.3 Follow up treatment is depended on funding*

Several former employees mentioned that lack of funding limited the follow-up treatments. One of the employees of the Mehloding adventure trail, confirmed these observations. He said that WfW was a success in some places where the follow-up treatment was organized, but other places they failed to control wattle when the follow-up treatment were neglected or poison was not mixed correctly.

Follow up treatment should include further clearance and herbicide treatment a year after first cutting, rehabilitation with indigenous species in order to prevent erosion and removal of cut timber, sometimes used for charcoal production in certain areas (Binns *et al.*, 2001). In Motseng where there is a serious problem with spreading wattle, it was obvious that there had been some successful follow up treatments, as traces of poison were seen on old wattle stumps. The area near Motseng also included areas where the follow up treatment had failed. In some places wattle trees were ring barked, but new shoots could be seen beneath the ring. In other places trees had been cut, but were

re-shooting as poison had not been applied, or the poison did not work. An important issue which makes eradication difficult is that the poison has to be applied minutes after cutting, or else the poison will not reach the roots, and the tree will be able to regenerate. A former WfW employee mentioned that this process is difficult, as one cannot use a chainsaw without having a lot of employees to apply the poison, therefore normal saws are used.
The semi-structured interview and questionnaire also revealed problems with soil erosion and less fish in the rivers due to poison. These problems were only mentioned once each, so maybe these are minor problems or perhaps they were not noticeable by the community.

### 4.2.3 Wattle – a pest for the Nature reserve manager (MARIE, Niklas, Taja)

The Ongeluksnek Nature Reserve manager perceives wattle exclusively as a pest. It is spreading in the nature reserve, and they have to use a lot of resources controlling it. Furthermore, wattle increases risk of forest fires and when forest fires occur, it is easier for wattle seeds to germinate, as they lose their dormancy (Foelkel, 2008). The reserve manager link this problem to another one related to the WfW´s eradication program. The cut wattle wood is not removed from the area because of the isolation and restricted entrance to the reserve, so when fires ravage the area, the dead trees create an extra fuel load, which further increase germination of seeds in the soil. This is also confirmed by former employees that have been involved in WfW, working inside the nature reserve. Only one respondent mentioned the increased fire risk in the questionnaire, but in the ranking session, it was perceived as the second largest problem of wattle. In order to minimize the forest fire problem, the reserve manager will try to change practices so that dead wattle wood is removed from the eradication sites.

**Picture 8. Top: showing the border between grazing land and nature reserve in Motseng. Bottom: eradicated wattle stands inside nature reserve (brownish area).**

It was a concern of the reserve manager that if nothing more is done to limit the spread of the wattle, as much as 80% of the reserve could be covered by wattle within the next few decades. The Ongeluksnek Nature Reserve aims to start their own eradication program within months, employing up to 30 local villagers. In terms of wattle eradication, or even controlling the spread of wattle, the reserve manager do not think WfW is efficient enough, as there are major problems with follow-up treatment in cleared areas – it is simply not happening. There must be substantial extra funding to be able to keep up with the invasive wattle, e.g. by ensuring follow-up treatment.

#### *4.2.3.1 Evaluation of Working for Water and nature reserve*

Seeing the different results in the light of triangulation, it appears that WfW is socioeconomically beneficial on short term by providing the community with job opportunities. There are major constrains regarding the payment, which makes the project unsustainable in the long run. The money does not create a surplus and therefore does not have a poverty alleviating effect. The short term job security can be seen as unstable since contracts are held for a short period, but at the same time the wattle will keep spreading, so the project will be there for many years if there is a steady flow of funding. Evaluating the environmental effects of WfW, the project have been successful some places, but other places failing, as no follow up treatment is initiated. Cut wattle is not removed inside the nature reserve which creates risk of fire and further spreading of wattle. There is a need of a continuously and effective eradication program.

### 4.2.4 Mariazell Mission (TAJA, Marie, Niklas)

The Mariazell Mission is located between the villages Motseng and Litichereng and differs from them in terms of relation to, and perception of, wattle as well as management of land in general. At the mission the relation to wattle is different as they do not use wattle at all. The mission houses a large amount of people, many of them school children. The kitchens in the mission are fuelled with wood, but other tree species, cedar, cypress and gum, are used (Pic. 9). They grow larger than wattle, last longer and are therefore more cost-effective.

**Picture 9. Photos of the mission's firewood supply, the mission manager said that this amount would last approximately four months.**

Due to the rapid spread of the wattle and the fact that the mission makes no use of it, the wattle is a pest in the mission manager's state of mind. It is costly and labour intensive to clear, but it is nevertheless a necessity to keep them out of the agricultural fields. Eradication efforts are only applied every second year, because of the costs involved. This takes place within the mission's property and along the channel, leading water from the river to the hydro-electrical plant. The channel is very old and fragile to root intrusion, so it has to be maintained. Information about the wattle issue is shared between the mission and their neighbour, the Ongeluksnek Nature Reserve, so the mission is always updated on the status of the wattle invasion.

To some extent the villagers from the neighbouring communities are allowed to collect firewood from the mission's premises. With the permission of the manager the villagers who work for the mission can cut the wattle free of charge. In some cases the transport with tractor is provided at a cost far less than the market price in the villages. The manager is aware of cases, where the villagers collect wattle from the premises without permission. The manager's laissez fair approach to this issue adds to the conclusion that wattle is not a resource within his premises.

## 4.3 Future potential for wattle (NIKLAS, Marie, Taja)

In order to help limit the spread of wattle in a sustainable way, an economical incentive could be created. There are several possibilities to use the wattle trees for secondary production. *Acacia mearnsii* have great potential for tannin production, paper pulp, wood bricks, honey production, charcoal making etc. (Shackleton *et al*., 2006; Foelkel, 2008; ICRAF). In a study in the Eastern Cape, Shackleton *et al.* (2006) showed that some locals preferred higher densities of wattle so

income generating projects could be created. However, in our study area, poor infrastructure is a major constraint for production and market establishment for all types of products, also agricultural products, especially in the rainy season. Costs may be too high to compete with existing outside markets and it is a limitation for small scale production of wattle products. Even though no specific production exists in the study area, it could be that innovation and production might arise after prolonged exposure to the wattle invasion, as suggested by Shackleton *et al.* (2006). When the density of wattle reaches a certain level, local management and production is more likely to arise.

A simple product that can be used within the communities, as well as for a more regional market, is charcoal. It is easy and cheap to produce, and can be stored for a long time. *Acacia mearnsii* has a calorific value of 3.500-4.600 kcal/dry kg (ICRAF) which produces charcoal with a calorific value of 7.400-7.500 kcal/dry kg (Foekel, 2008). According to the Ongeluksnek Nature Reserve manager, wattle is used extensively for charcoal production in the Krüger Park area, where a regional market has developed. The production was started after an experienced charcoal maker showed the locals the techniques of the production. The manager would like to implement this kind of charcoal production in the Ongeluksnek area, but there is currently very limited knowledge and skills of charcoal making in the area. Charcoal production could be beneficial for the communities, both in terms of creating employment opportunities and cash revenues, but also in controlling the spread of wattle. During our study only one producer of charcoal was identified, and it was small scale production for subsistence use.

*Acacia mearnsii* biomass consists of about 77-80% carbon (Foelkel, 2008). Using this value, the new wattle stands in the area already contains an average of 46-48 ton carbon $ha^{-1}$. At a value of USD 5-10 per ton[2] this would mean USD 230-480 $ha^{-1}$, for these young stands. The growth rate of wattle is high, 15-26$m^3$ $ha^{-1}$ $year^{-1}$ (Foelkel, 2008), and 10-17 tons of carbon can be sequestered per hectare each year. There could be a possibility for selling stored carbon, but it could be regarded as "unethical" in the case of wattle, since it is an invasive plant and the water shortage and conservation issues are prioritized higher than carbon sequestration. In terms of opportunity costs, the land where wattle grows is not used extensively, which minimize the costs.

[2] Prices of carbon differs greatly in literature so a broad range (USD 5-10) are used in this report.

# 5. Reflections of fieldwork (ALL)

## 5.1 Sampling strategies

The intention for the questionnaires was to use random sampling, interviewing every third household. In reality, the households were spread out haphazardly, sometimes with no connection to a road, so some households were purposefully selected to get a good spatial spread in the villages.

The snowball sampling strategy, used for semi-structured interviews with WfW-employees, might influence the results, as people that know each other could have the same opinion and perception of the issues discussed. Because of this, other interesting sources might have been excluded, but there was no other way to find people who had been involved in the project during the short fieldwork, so the snowball sampling technique turned out to be efficient.

For the community map and ranking session, a household and its neighbours were selected. The optimal way of selecting participants would have been to use structured sampling, and identify different wattle users from the questionnaire. This strategy were indented in the first place, but reviewed as the invited participants did not show up for our scheduled meeting.

## 5.2 Data validity

The questionnaire was restructured after a pilot test in the field, where several shortcomings became apparent, both in terms of content and phrasing of questions.
The questionnaires had shortcomings as we did not know which uses, problems and benefits of wattle that was most important for the respondents. To get around this problem, a ranking exercise was used to rank the most commonly mentioned issues. Another problem encountered with the questionnaires was that questions about perceptions reflect the interviewee's individual opinion, rather representing the household.

For the community mapping and ranking session the participants had not been interviewed before, so background information was missing, which may cause the results to be less representative, as some participants may have been migrant households members. We also lacked information regarding whether all five participants were firewood collectors, which were necessary information, as the mapping session was designed to fit collectors. Another problem in the ranking session was the way the different positive and negative issues were presented, e.g. some might not have understood the issue "No problems" that was used in the exercise.

A knowledgeable key-informant was asked to give us a brief overview of the history in the area, which was turned into a historical time-line. The major drawback was that only one participant did this exercise, so there was no discussion, and the reliability of the result is low and is therefore not used in the report.

Unfortunately some GPS-tracks of WfW cleared areas were lost. We found it interesting to track and measure the area of a site where WfW had been active, but there was some unidentified problems transferring the data from the GPS to the computer.

Values for *Acacia mearnsii* were used when calculating biomass and carbon content, since this species was most prominent in the study area. However, there is also *Acacia dealbata* present in the area, especially growing close to the river. The species have slightly different densities and carbon content so calculated values should therefore be seen as crude estimates.

## 5.3 Biases

Since the questionnaires and interviews were conducted by five group members, different skills and techniques were used. Results may be coloured by the fact that we, as an interdisciplinary group, have different backgrounds and approaches to the questions asked. Unintentionally, answers were sometimes prompted too fast to get the “top-of-mind” information from the respondents. Furthermore, answers were sometimes “accepted” right away, even though we needed a more detailed meaning of the answer, and should have probed the issue further.

## 5.4 Other constraints

Problems were experienced in setting up a meeting for several PRA-sessions. People failed to show up, so meetings had to be re-arranged. The turnout of the focus group could probably have been improved with more than three participants, but WfW-employees were hard to locate. Therefore problem with low participation influenced this session as well as our timeline session.

The language barrier was a big problem, especially in the focus group session. It might not have influenced the main results, but was a cause of frustration and irritation and resulted in waste of energy. In the semi-structured interviews, it was difficult to get a natural conversation flowing because of the language barrier. Important lessons to reflect on and learn from related to this is the motivation for having a good relationship to the interpreter. It is important to brief the interpreter about the project before start, but also guidance is important, in terms of making sure the interpreter

understand and perceive the investigation the same way as oneself. This was unfortunately an issue which were to some extent neglected in the field, and it caused some difficulties working with the interpreter. Taking the time to present the project, and to discuss possible difficulties, would have been an easy way to avoid misunderstandings between group and interpreter.

## 6. Conclusion (MARIE, Niklas, Taja)

The study showed that the wattle invaded area at the study site is expanding every year, forming dense stands on former grazing land. Different stakeholders have been identified revealing a dualistic perception of wattle. The local people for whom the use of wattle is part of their livelihood, e.g. as firewood and construction, perceive wattle as a resource. A market of wattle is present in the area, turning wattle into an income generating resource for tractor and oxen owners. For the managers of the Mariazell Mission and Ongeluksnek Nature Reserve, wattle is a pest as it continues to spread into valuable land. WfW have been operating in different places in the study area, but the success of eradicating wattle is questionable, as follow-up treatment in most places have been unsuccessful. WfW employees from the community consider the project a failure in terms of poverty alleviation, as the wages are too low and often delayed. If there is continuous funding in the future, WfW could create job security for some people, as the wattle keeps spreading. Biomass measurement revealed a potential for carbon sequestration. However, in reality this might be unethical as wattle also causes problems for the community, and some secondary products of wattle would probably be a better future source of income.

Our final conclusion is that wattle is a resource for the community, but a pest to other stakeholders, i.e. the Mariazell Mission and the Ongeluksnek Nature Reserve, for whom the species constitute a management problem caused by a land cover conflict.

## 7. Acknowledgements (NIKLAS, Marie, Taja)

We would firstly like to thank our South African counterparts, Luke Bodmann and Sian Waldron, honour students at University of Kwa-Zulu Natal, for good teamwork and a wonderful time in South Africa. We would also like to give our thanks to Torben Birch-Thomsen and Myles Oelofse, both from University of Copenhagen, for their invaluable help, expertise, support and positive attitude during all stages of this study, and to Trevor Hill, University of Kwa-Zulu Natal, for making the fieldwork of this project possible. Our thanks also goes to our interpreter Nomathemba, and our guides Siseko and Makhosini, who helped us a lot and shared with us their local knowledge. Our appreciation is given to all the people living in the communities, which gladly invited us into their homes and shared with us their knowledge. Last but not least, we would like to thank all the other field groups, for information sharing during the field work and for making the field experience a pleasure.

## References

**Binns, J.A.,** Illgner, P.M., and Nel, E.L. (2001): Water shortage, deforestation and development: South Africa´s working for water. Land degradation & Development. 12:341-355.

**de Neergaard, A.,** Saarnak, C., Hill, T., Khanyile, M., Berzosa, A.M., and Birch-Thomsen, T. (2005): Australian wattle species in the Drakensberg region of South Africa – An invasive alien or a natural resource?. Agricultural Systems 85:216–233.

**Fatunbi, A. O**., Dube, S., Yakubu, M. T., and Tshabalala, T. (2009): Allelopathic Potential of *Acacia mearnsii* De Wild. World Applied Sciences Journal 7 (12):1488-1493.

**Foelkel, C.** (2008): The Eucalyptus and the Leguminosae, Part 01: Acacia mearnsii. Eucalyptus Online Book & Newsletter, June 2008. www.eucalyptus.com.br (visited 16.03.2011).

**ICRAF**. World Agroforestry Centre. Agroforestree Database. www.icraf.com (visited 18.03.2011).

**Le Maitre, D.C.,** van Wilgen, B.W., Gelderblom, C.M., Bailey, C., Chapman, R.A., and Nel, J.A. (2002): Invasive alien trees and water resources in South Africa: case studies of the costs and benefits of management. Forest Ecology and Management 160:143–159.

**Marais, C.,** and Wannenburgh, A.M. (2008): Restoration of water resources (natural capital) through the clearing of invasive alien plants from riparian areas in South Africa — Costs and water benefits. South African Journal of Botany 74:526–537.

**Pejchar, L., and Mooney, H.A.** (2009): Invasive species, ecosystem services and human well-being. Trends in Ecology and Evolution 24, No.9:497-504

**Nyoka, B.I.** (2003): Biosecurity in forestry: a case study on the status of invasive forest trees species in Southern Africa. Forest Biosecurity Working Paper FBS/1E. Forestry Department. FAO, Rome.

**Searle, S. D.** and Owen, J. V. (2005): Variation in basic wood density and percentage heartwood in temperate Australian *Acacia* species. Australian Forestry 68:126-136.

**Shackleton, C. M.,** McGarry, D., Fourie, S., Gambiza, J., Shackleton, S. E. and Fabricius, C. (2006):Assessing the Effects of Invasive Alien Species on Rural Livelihoods: Case Examples and a Framework from South Africa. Hum Ecol 35:113–127.

**Turpie, J. K.,** Marais, C., Blignaut, J. N. (2008): The Working for water programme: Evolution of a payments for ecosystem service delivery in South Africa. Ecological Economics 65: 788-798.

## Appendix 1. List over methods used

Questionnaires (32)

Semi-structured interviews (11)

Orientation walk

PRA: following villagers to collect firewood (2 participants)

Focus group discussion (3 participants)

Community mapping (5 participants)

Ranking (5 participants)

Timeline (1 participant)

Biomass estimation (6 plots 5x5 meters)

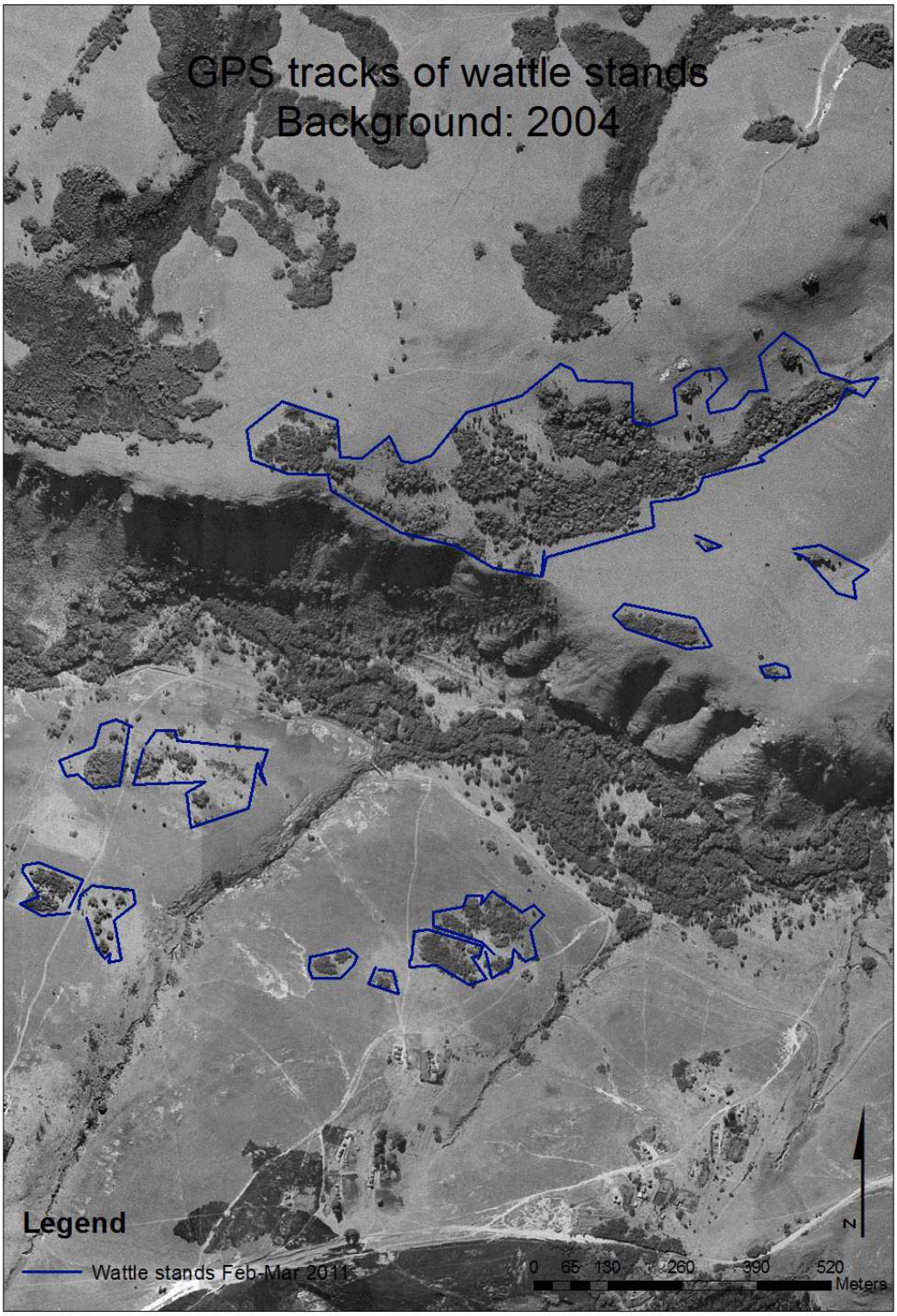
Area measurements with GPS (13 wattle stands)

Informal talk/interviews (numerous)

## Appendix 2. Sampling of households for questionnaires


Questionnaires

## Appendix 3. Area measurements of wattle stands




GPS tracks of wattle stands
Background: 2008
Legend
Wattle stands Feb-Mar 2011
0 65 130 260 390 520
Meters
N

## Appendix 4. Project synopsis

# The impact of wattle on rural livelihoods in the Ongeluksnek area

## Project synopsis

Inga Marie Galløe ADK10015
Niklas Holtne ADK10021
Taja Brenneche EM08266

Submission date: February 22, 2011

# Introduction

**Invasive Alien Species**

Alien species are species that have been introduced deliberately or accidentally to areas where the species previously did not exist. Invasive alien species (IAS) are alien species that have an invasive growth pattern, spreading on the expense of indigenous species. In South Africa, about 8750 species have been introduced and 161 of these species are now regarded as IAS (Nyoka, 2003). Sixty-eight percent of these species are woody species, many of them introduced for timber, fuelwood and tannin production during colonial times. Two of these species, Black wattle (*Acacia mearnsii* De Wild) and Silver wattle (*Acacia dealbata* Link) are highly invasive in parts of South Africa, causing a major loss of water, especially along rivers, and loss of biodiversity by outcompeting indigenous species (Binns *et al.,* 2001; de Neergaard *et al,.* 2005). The two species of wattle were introduced to South Africa in the mid 19$^{th}$ century as shade trees and shelterbelts, and in the end of the century as plantation trees for tannin production (Nyoka, 2003).

Invasive alien species can be detrimental to natural ecosystems and are often perceived to have a negative impact on ecosystem goods and services (Shackleton *et al.,* 2006), resulting in tremendous costs for governments in terms of control, management and eradication. Even though IAS usually are seen as pests, they may perform several positive ecosystem services, e.g. provisioning and regulating services (Pejchar & Mooney, 2009). Provisioning services include materials such as fuelwood, fodder, construction wood etc. It has been shown that IAS has been well incorporated into local livelihood strategies and serves as an important natural resource (de Neergaard *et al.,* 2005, Shackleton *et al.,* 2006). This provisional service may help to alleviate rural poverty and create income opportunities, as market opportunities for products are established (Pejchar & Mooney, 2009). Even though the regulatory services, e.g. water management, may be negatively impacted by invasive woody perennials like wattles (Le Maitre *et al.,* 2002), other more global benefits are present from a more holistic approach, e.g. carbon sequestration, mitigating climate change. This specifically holds true when grasslands are afforested by woody species (Pejchar & Mooney, 2009).

In Eastern Cape, South Africa, Black wattle and Silver wattle are pioneer species originating in Australia (Le Maitre *et al.,* 2002). They are fast growing, very invasive and have high evapotranspiration rates, which reduce streamflow, surface run-off and available surface water for agriculture (Binns *et al.,* 2001).

**Working for water**

As post-apartheid South Africa suffers from severe water scarcity due to increased agricultural production and urban growth among other things, the South African government started the ambitious project "Working for Water (WfW)" in 1995 employing thousands of poor people in a large scale eradication program, with dual purpose of conservation and poverty alleviation (Binns *et al.*, 2001). As mentioned earlier, the wattle species are invasive species which has a large water uptake. Therefore these species are the most targeted within the WfW scheme. In the Drakensberg region, where grassland is the natural biome, reduction in streamflow due to afforestation is assumed to be 2600 $m^3$ $ha^{-1}$ $yr^{-1}$ (Marais & Wannenburgh, 2008). Further, the reduction in streamflow is assumed to have a direct impact on the extractable water, which is available for use, i.e. water yield. The water yield is reduced to 75% of the reduction in stream flow (Marais & Wannenburgh, 2008). Based on these both empirical and theoretical assumptions, there is much water yield to gain by clearing IAS, such as the Black wattle.

On that background, the WfW program was initiated to oblige this problem and further to reduce poverty and marginalisation in rural areas, especially in the former Homelands (Binns *et al.*, 2001). The WfW program is an agency under the Department of Water Affairs and Forestry (Turpie *et al*., 2008). The legislation to support the WfW scheme represented a general shift in policy, after democratization in 1994. A general aim was to make the access to water equal and improve water security for all South Africans. The National Water Act stated that the ownership of water was replaced by a right to use water (Binns *et al*., 2001). This meant that nobody could legally own water, but only buy the right to extract it though government officials.

Other than improving the water supply, the program aims at improving biodiversity by securing and re-establishing natural vegetation, reduce erosion and flooding, reduce fire hazard and reduce poverty through economically empowering poor rural communities, by job creation (Binns *et al.*, 2001; Marais & Wannenburgh, 2008). The latter makes the program somewhat unique (Turpie *et al*., 2008).

The projects under the WfW program are supported economically by government funds. They follow an established course of action, that state how potential sites are selected, how people from the local communities are trained – as they for the most part have little or no education – among other things. Aside from the government funds, private funds and foreign investments contribute economically (Binns *et al.*, 2001).

The strong dependence on funding makes it questionable whether the projects are sustainable. The question is if they will be able to maintain the initiated goals, both regarding the assumed increased water yield and poverty alleviation, on the long run.

**Wattle and livelihoods**

The impact of wattles on rural livelihood strategies is generally poorly understood, but some studies in South Africa have shown the use and potential for wattle products (de Neergaard *et al.*, 2005, Shackleton *et al.*, 2006). These studies show how wattle is used for a range of provisional services, proving a very important resource for local households. Shackleton *et al.* (2006) found that local households favour Black wattle as building material over indigenous species and that the short distance to the wattle stands facilitate fuelwood collection. Since fuelwood is often collected by women, a nearby source of fuelwood positively influence their time spent collecting, leaving more time to other duties (Cavendish, 2002). Increased density of wattle is even preferred by some local households, showing the importance of wattle to rural livelihoods (Shackleton *et al.*, 2006).

## Objectives

The aim of our study is to investigate local use and perception of wattle and the influence of the WfW program in the Ongeluksnek area. Leading to the following research questions:

- What is the local use of wattle?
- Is there any market – formal or informal – for wattle? If so, how is it organized? If not, is there any potential?
- What is the local people's perception of wattle?
- What are the distribution and biomass stock of wattle?
- What are the short and long term benefits and/or constraints of the WfW program regarding land use, environmental- and socioeconomic effects?
- What is the local people's perception of the project? With regards to:
    - Employment opportunities (security)
    - Work load
    - Socioeconomic effects
    - Environmental effects
- Are there any changes in wattle invaded areas after the WfW-project?

- Are there any, and if so what are the conflicts between the land cover wattle and other potential land uses (e.g. agriculture, sacred ponds, livestock access to water and grazing)?

## Methods

### Local context

The study area is located in the province of Eastern Cape, part of the Matatiele local municipality in the Alfred Nzo district. The local municipality of Matatiele is further divided in administrative units of wards, where our study site is located in ward 14, Ongeluksnek. The villages Motseng, Litichereng (Maphelle) and Moeketsi with the surrounding land constitutes our study area. The population in the Alfred Nzo district is almost solely black, the gender distribution is 54,3 % female vs. 45,6 % male and more than half of the population is under the age of 35 years (Province of Eastern Cape, Social Development & Special Programmes).

The area is located at the foot hills of the Drakensberg escarpment. This larger area is the part of South Africa that has the highest annual rainfall due to the escarpment of which fast flowing streams run down the steep slopes (Lester *et al*., 2000).

The area is a part of the former homeland Transkei. The Homelands were established under the apartheid regime, spatially and economically segregating the South African population. Some of many consequences of the Homelands were overpopulation, marginalisation, many migrant labourers and dependence of their remittances and land degradation due to insufficient land use practices; repercussions of which is still apparent today (Agergaard & Birch-Thomsen, 2006; Bond, 2002).

Three forms of land tenure exists; communal-, private- and state land. Most of the area is constituted as communal land. The land management is generally difficult to tackle and is an ongoing challenge in the municipality of Matatiele (Matatiele Local Municipality). There may be different management approaches applied in order to eradicate wattle stands in the different land tenure areas.

### Village walk

The first day in the field is reserved to a walk in the village and surrounding areas in order to observe and get a general impression of the village e.g. how people interact, the number of households, resource availability, local authority and infrastructure. Furthermore this is an

opportunity to speak with the local people and to identify key-informants, and find someone interested and motivated for participating in questionnaire, semi-structured interviews and PRA. Key-informants which could be interesting to speak with are people who have been involved in WfW, fuelwood collectors, and head or staff of local NGOs.

**Semi-structured interviews**

Through semi-structured interviews our goal is to get knowledge about the local use of wattle as a resource, the value of wattle for the household, spatial pattern in the use of wattle and peoples perception of wattle. Furthermore we would like to identify the most important problems and benefits regarding both wattle and WfW. To get information about environmental effects of WfW, e.g. increased stream flow and soil erosion, and socioeconomic effects e.g. employment opportunities and security when employed in WfW. To obtain this knowledge it would be valuable to interview people from randomly selected households, people which have been employed in the WfW program and a staff member or head of a local NGO for information about benefits and constrains of WfW. Another key-informant for issues regarding the wattle management in the Ongeluksnek nature reserve could be a park manager or staff.

**Questionnaire**

In the questionnaire we want to obtain information about general use of wattle, people's perception of wattle, if they see it as pest or a resource, and people's perception of the WfW program. Statistics will be used in order to quantify the most common use of wattle correlated to gender, age and income aspects. Results will also provide information about the most common reason to classify wattle as a pest or a resource and WfW as beneficial or negative. Households for the questionnaire survey will be selected by random sampling from a satellite image from Google Earth.

**PRA - community mapping and ranking**

Mapping of the community and ranking will be an important source of information about people's perception of spatial distribution of wattle, value of wattle for subsistence use and trade, community infrastructure, both social and physical, and the benefits and constrains regarding wattle. The assignment for the participants will be to draw a map of the village including the different households, resources available, markets, resource- and service flow. After this session the participants will be asked to rank the problems and benefits of wattle-invaded areas, according to the answers given in the questionnaire and semi-structured interviews. Two focus groups will be

formed, one consisting of representatives of different households and another of people who is or has been involved in a WfW project.

**PRA – timeline**

A key informant, possibly the village chief or a relevant NGO-member, will be asked to draw a timeline over the events in the WfW project spanning the pre and the post WfW period. The timeline should include work load, number of people employed, socioeconomic consequences, area of wattle, land use and environmental impacts. This will give information about the history of the wattle in the area. The WfW focus group will be asked to discuss and comment on the timeline. The timeline session provide information of people's perception of the WfW project and the benefit and constrains of the project.

**Biomass estimation**

Weight measurements of fuelwood collected per day/week per household will provide important data which can be used for estimating the importance of wattle as a resource. Quantification of the amount of fuelwood collected are also important in order to compare how much wattle the local community use held against the amount of available wattle biomass after the WfW project has taken place. Measurements of biomass in random sample plots can be extrapolated in order to get a quantification of wattle biomass in the whole area. The quantification of wattle biomass are important to include when discussing carbon sequestration, as it is a measurement of how much carbon can be stored.

A rough assessment of biomass will be done by laying out sample plots and measuring tree diameter at breast height (dbh), and the height (h) of the tree. Parabolic volume ($V_p$) will be calculated using the formula:

$$V_p = \frac{1}{2} \times \pi \times \frac{\left(\frac{dbh}{2}\right)}{2} \times h$$

Density values to calculate biomass will be taken from literature sources. Wattle stands will be classified into three different groups according to appearance, and all groups will be sampled. Observations will determine which group a wattle stand belongs to and together with GPS area measurements, a rough estimation of biomass can be calculated.

**GPS**

GPS–tracking of fuelwood collector routes to get an impression of the workload and which wattle stands are most attractive for the collection of fuelwood.

A GPS-contour walk around wattle stands, both stands that have been exposed to WfW activities, and those which have not. This will provide data appropriate for GIS analysis. The current wattle invaded area can be compared with aerial or satellite photos to determine if wattle is still spreading, and to what extent, and to evaluate if WfW has been efficient.

For an overview of the methods see App.1.

**Time schedule**

Our time schedule is shown in figure 1. Some methods provide information which will be used in other methods to define sample group and further investigations. As we at this point do not know the villagers weekly routine, the methods including key-informants are kept flexible in able to adapt to local conditions.

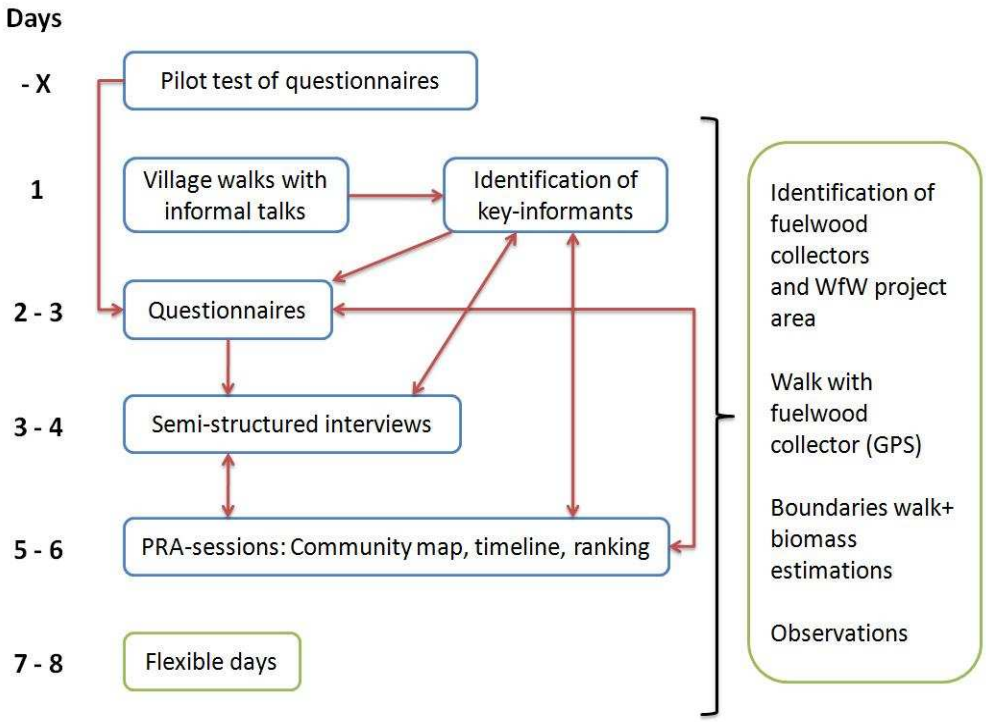



**Figure 1. Methods and activities for the days in the field.**

## References

**Agergaard, J.** & Birch-Thomsen, T. (2006): Transitional rural landscapes: The role of small-scale commercial farming in former homelands of Post-apartheid KwaZulu-Natal. Geografisk tidsskrift, Danish Journal of Geography 106(2): 87-102

**Binns, J.A.,** Illgner, P.M., and Nel, E.L. (2001): Water shortage, deforestation and development: South Africa´s working for water. Land degradation & Development. 12:341-355.

**Bond, P.** (2002): Unsustainable South Africa. Environment, development and social protest. University of Natal Press, Scottsville, South Africa and The Merlin Press, London. Part One: An unsustainable legacy pp 25-47.

**Cavendish, W.** (2002): Quantitative methods for estimating the economic value of resource use to rural households. In Campbell, B.M. and Luckert, M. (eds) Uncovering the hidden harvest: valuation methods for woodland & forest resources. Earthscan, London, pp. 17-65.

**de Neergaard, A.,** Saarnak, C., Hill, T., Khanyile, M., Berzosa, A.M., and Birch-Thomsen, T. (2005): Australian wattle species in the Drakensberg region of South Africa – An invasive alien or a natural resource?. Agricultural Systems 85:216–233.

**Le Maitre, D.C.,** van Wilgen, B.W., Gelderblom, C.M., Bailey, C., Chapman, R.A., and Nel, J.A. (2002): Invasive alien trees and water resources in South Africa: case studies of the costs and benefits of management. Forest Ecology and Management 160:143–159.

**Lester, A**., Nel, E., Binns, T. (2000): South Africa, Past, Present and Future. Gold at the end of the rainbow? Pearson Education Limited, Essex, England

**Marais, C.,** and Wannenburgh, A.M. (2008): Restoration of water resources (natural capital) through the clearing of invasive alien plants from riparian areas in South Africa — Costs and water benefits. South African Journal of Botany 74:526–537.

**Nyoka, B.I.** (2003): Biosecurity in forestry: a case study on the status of invasive forest trees species in Southern Africa. Forest Biosecurity Working Paper FBS/1E. Forestry Department. FAO, Rome.

**Shackleton, C. M.,** McGarry, D., Fourie, S., Gambiza, J., Shackleton, S. E. and Fabricius, C. (2006):Assessing the Effects of Invasive Alien Species on Rural Livelihoods: Case Examples and a Framework from South Africa. Hum Ecol 35:113–127.

**Turpie, J. K.,** Marais, C., Blignaut, J. N. (2008): The Working for water programme: Evolution of a payments for ecosystem service delivery in South Africa. Ecological Economics 65: 788-798.

## Appendix 1

Table of research questions, data needed to answer the questions and methods used to obtain data.

| **The impact of wattle on rural livelihoods in the Ongeluksnek area** | | |
|---|---|---|
| **Research question** | **Outcome** | **Method** |
| Which are the local uses of wattle? | Description of local use of wattle resources. | Semi-structured interviews<br>Questionnaire, Quantification of products |
| Is there any market for wattle – formal or informal? | Value of wattle. Spatial use of wattle. | Observations<br>Semi-structured interviews<br>Questionnaire<br>Mapping (PRA) |
| What is the local people's perception of wattle? | Perception of wattle and most important problems/benefits. | Semi-structured interviews<br>Questionnaire<br>Ranking of problems/benefits (PRA) |
| What is the distribution and biomass stock of wattle? | Quantification of biomass.<br>Intrusion in nature reserve | Quantitative measurement of biomass<br>Quantification of products<br>GPS track of route of fuelwood collector<br>GPS measurement of a sample plot in a wattle invaded area<br>Semi-structured interviews |
| What are the short- and long term benefits and/or constraints of the working for water scheme? | The environmental and socioeconomic effects of WfW, e.g. increased stream flow, soil erosion, land use and employment opportunities. | Semi-structured interviews<br>Questionnaire<br>Interview with key-informants<br>Timeline (PRA) |
| What is the local people's perception of the project? | Information regarding: Environmental effects, employment opportunities (security), work load and other socioeconomic effects. | Semi-structured interviews<br>Questionnaire<br>Ranking of problems/benefits (PRA) |
| Are there any changes in wattle-invaded areas after the WfW project? | Current wattle invaded area compared to previous years | GPS measurement of a sample plot in a wattle invaded area<br>Google-earth (and Orto-photo) data compared with GPS data in a GIS. |

## Appendix 2

# Questionnaire

Household no:_____ Name of respondent:_____ Name of interviewer:_____

We are a group of students from University of Copenhagen (Denmark) and University of Kwa-Zulu Natal studying the impact of wattle on rural livelihoods in the Ongeluksnek area.

**General questions**

1. How many persons are included in your household?___
   How many people sleep here every day?___
   Are there anybody working in another city who you consider being part of your household?___

2. Do you have any livestock?
   Yes: □ How many? ____
   No: □

3. What is your main source of income (if pensions, how many?)?_____

**Concerning local use**

4. Do you use wattle?
   Yes: □
   No: □

5. What do you use wattle for?
   Fuel: □ Construction: □ Timber: □ Fodder: □
   Medicine: □ Nothing: □ Other: _____

6. Can you please show us how much fuelwood your household use a day in
   January (summer):_____
   July (winter):_____

7. How do you get hold of wattle?

Buy: □ Receive for free (from family, friends): □ Exchange: □

Collection: □ Do not use wattle: □

Other:_____

8. How often do you collect fuelwood?

   January (summer):_____

   July (winter):_____

9. How much time do you spend weekly or daily on collecting wattle (either to buy or collect manually)?

   January (summer):_____

   July (Winter):_____

10. Who collects fuelwood in your household?

    Male: □ Female: □

    Children and youth (0-19y): □ Grown ups: (20-39y): □

    Age: (40-59y): □ Elderly (60+): □

**Concerning perception of wattle – pest vs. resource**

11. Can you mention some positive thing about wattle?

    _____

    _____

12. Can you mention something about wattle that is not good? Can you mention some negative things about wattle?

    _____

    _____

**Water use**

13. Where do you get water from? _____

14. What do you use water for?

    Household: □ Livestock: □

Irrigation of homegarden: □ “Larger” scale agriculture: □

Other: _____

15. How would you describe the amount of water available to your household?

Plenty of water: □ Limited amount of water: □ Lack of water: □

16. How does the water you use taste?_____

**Concerning perception of Working for Water programs**

17. Do you know of the project “Working for Water”?

Yes: □ No: □

Can you tell me something about the project?

_____

_____

_____

18. Have someone in your household been involved in the project?

Yes: □ What was/is your/their job?: _____

_____

No: □

If yes – would you be interested in joining our focus group (PRA)?

Yes: □ I’m available at (day and time):_____

No thanks: □

19. Can you mention some positive things about WfW?

_____

_____

_____

20. Can you mention some negative thing about WfW?

_____

_____

_____

Can we contact you again for follow-up questions?

Yes: □ when (day and time):_____

No thank: □

Do you want to join a focus group meeting?

Yes: □ when (day and time):_____

No thanks: □

**Thank you very much for your time!**

## Appendix 3. Semi-structured interview guides

**Wattle use and perceptions (households/fuelwood collectors):**

1. Wattle use (description of multi use)
2. Time spent collecting wattle products (day/week)
3. Distance to collection site (who decides site?)
4. Amount of products (fuelwood, timber, medicine)
5. Seasonality, winter vs. summer (coldest months june, july, august)
6. Who collects the products (gender, age etc.)
7. Equipment used
8. Transport of wattle – collection/sale
9. Market/Price of products, (existing? attributes? which products? price of unit fuelwood)
10. Secondary production using wattle (charcoal)
11. Alternative to wattle products (what if wattle disappears from area?)
12. Distribution of wattle, land cover conflicts (agriculture/grazing)
13. Benefits from wattle stands (environmental)?
14. Problems with wattle stands (cattle theft, criminals, environmental?)
15. Water and wattle (water scarcity, water quality)

**Working for water (participants & NGO):**

1. Involvement/role in program (time involved and who?)
2. Logistics of program (only local or transport to site)
3. Wages/economic benefits of participation (influence on family?)
4. Describe methods used in program
5. Have the methods had any influence on water quality?
6. Who may use the land where wattle has been eradicated?
7. Benefits with program
8. Problems with program
9. Perception of the success or failure of program (detectable changes, wattle stands reduced?)
10. Environmental impact of wattle