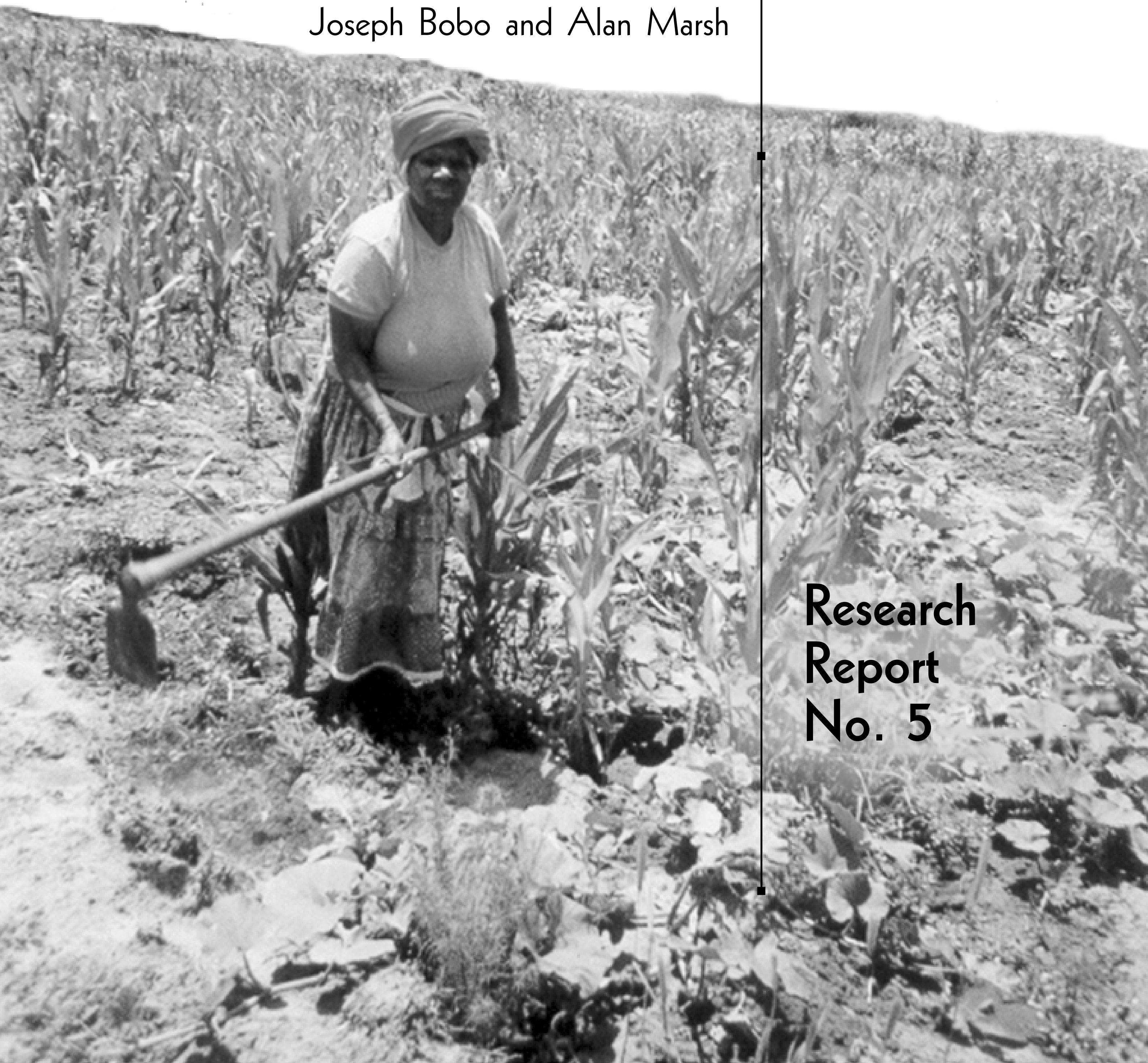
# Land reform, sustainable rural livelihoods and gender relations

## A case study of Gallawater A farm

## Volume two

Susanne Vetter and Wiseman M Goqwana
Joseph Bobo and Alan Marsh



Programme for Land and Agrarian Studies

SCHOOL of GOVERNMENT
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Research Report No. 5

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Grazing management and sustainability in a Land Reform Pilot Project: A case study of Gallawater A farm, Eastern Cape province

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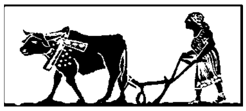

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# Section one:

# Grazing management and sustainability in a Land Reform Pilot Project: A case study of Gallawater A farm, Eastern Cape province

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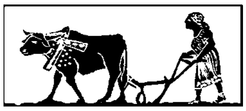
# Section one contents





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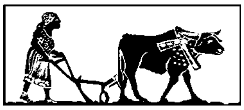


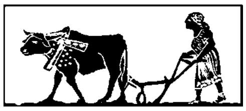
# Executive summary

There is an ongoing debate about the sustainability of South African communal rangelands as old views on overgrazing and degradation are being widely challenged. The degradation issue has recently received renewed attention in the light of land reform, as this is expected to lead to an increase in the area of South Africa which is held under some form of communal tenure. District-level data on vegetation and soil degradation (Hoffman et al. 1999) have shown that communal districts have significantly higher levels of soil erosion, and that communal and commercial districts experience very different vegetation changes under the same environmental conditions, even if livestock densities are similar. The implications of this for communal livestock farmers are still under debate, and the interrelationships between high human population density, high stocking rates, land degradation and people's livelihoods need to be better understood for land reform to result in economically and ecologically sustainable land use.

This case study of a land reform pilot project in the Eastern Cape focuses on the changes in the biophysical environment, particularly soils and vegetation, which are likely to result from the change of land tenure and land use on Gallawater A. The aims of this study are:

1. To understand the production objectives of livestock owners and how their grazing practices are likely to affect the achievement of these objectives.
2. To determine the constraints to achieving desired objectives and management practices.
3. To determine whether these practices are likely to result in environmental degradation.

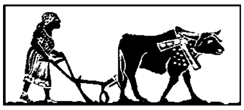
Gallawater A is a farm of about 900ha which was bought by 102 people from Zweledinga, a settlement in the Hewu district of the former homeland of Ciskei. Zweledinga has been under communal tenure since 1976, when people moved there from Glen Grey to avoid being incorporated into Transkei. Zweledinga is considered to be overcrowded, overstocked and degraded by outsiders and residents alike, which is why people from Zweledinga had long fought for additional land and were considered eligible to benefit from land reform. From existing statistics and records, Gallawater A and Zweledinga were found have similar human population densities (if all shareholders eventually move onto Gallawater A) and stocking rates. Since the biophysical environment (geology, vegetation, rainfall and so on) is the same on Gallawater A and in Zweledinga, it is feasible to predict environmental changes in Gallawater A on the basis of data from Zweledinga.



People on Gallawater A were interviewed about their objectives, plans and ideas on management. The objectives of different people differ, but most would like to derive a greater part of their livelihoods from livestock and crop farming than was possible in Zweledinga. Some of the farmers are therefore keen to have a veld management system (based on fenced grazing camps) in place to keep animals from straying, ensure adequate winter grazing and maintain the veld in good condition. Others, including the chairman of the Gallawater Trust who owns a large proportion of the livestock on the farm, prefer to decide themselves where their livestock should graze. At present, livestock are allowed to graze where they want, and there are no restrictions on individual livestock holdings or the total number of livestock on the farm. Several farmers are frustrated with this system, as they feel they have no more control over their resources on Gallawater A than they had in Zweledinga.

Vegetation data from Gallawater A and Zweledinga showed that veld condition (a measure of forage production potential and ecological status of the grass component) does not differ significantly between the two areas, but is much more variable in Zweledinga. This is due to the fact that sites near villages in Zweledinga have very sparse grass cover and very poor veld condition, while the more remote mountain slopes are densely covered in palatable grasses. Grass cover and biomass tend to be lower overall in Zweledinga. In areas that have been under communal tenure for longer than Zweledinga, grass cover is sparse even on the higher slopes, and bare soil is easily visible.

The bush component in the two areas differs in a number of ways. Zweledinga has fewer and smaller palatable bushes and therefore lower browse potential than Gallawater. *Acacia karoo* has become scarce around villages in Zweledinga, largely due to uncontrolled fuelwood harvesting. Some other species (for example, *Cussonia spicata* and *Encephalartos* sp.) are no longer found there at all. Encroachment by *Euryops floribundus*, an unpalatable shrub with resin-rich leaf litter which suppresses grass growth, is becoming a big problem in communal areas.



Gallawater A already has some erosion gullies, which largely predate communal tenure. Soil erosion, especially around villages, is common in the low-lying areas in Zweledinga and was observed to be widespread and severe in all parts of the communal areas beyond Zweledinga.

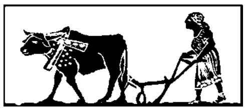
Farmers from Gallawater A and Zweledinga were interviewed about their perceptions of environmental changes and to interpret the vegetation in terms of their own criteria. Farmers observed that *Acacia karoo*, which is a very important resource providing browse, shelter and fuelwood, is gradually being lost in Zweledinga and other communal areas due to uncontrolled harvesting, especially around the villages. The proliferation of *Euryops floribundus* is a cause of great concern, as it is considered to be a useless plant which reduces the grazing value of the land. Encroachment by *Euryops* is very difficult to control or reverse. There has been a general reduction in bush in Zweledinga, and farmers consider this to be a loss.

The short grass species (*Aristida congesta*, *Cynodon dactylon*, *Digitaria eriantha*, *Eragrostis chloromelas*) that dominate the heavily grazed, flat areas are considered to be desirable forage species, especially for sheep. However, the fact that these low-lying areas are prone to erosion (they are already severely eroded in Zweledinga and surrounding communal areas) worries farmers. The mountains on Gallawater A and in Zweledinga are covered in tall grass, which is preferred by cattle. While the grasses in the mountains of Zweledinga are 'sweet', the grasses on Gallawater A are considered to be 'bitter' and livestock obviously do not like grazing in these areas. From vegetation data, this can be explained by the dominance of *Cymbopogon plurinodis* (turpentine grass) in the mountains of Gallawater A, probably as a result of area selective grazing which now continues as animals choose not to graze in these areas.

In terms of farmers' criteria, the vegetation changes resulting from uncontrolled grazing and other resource use under communal tenure are largely undesirable. Since human and livestock densities on Gallawater A are the same as in other communal areas, resource management is the main factor which will determine whether Gallawater A becomes like the neighbouring communal areas. We recommend a simple grazing management system based on rotational resting of two camps per year and keeping animals from straying out of designated grazing areas, as cropping areas and vegetable gardens need to be protected from livestock. Controlling stocking rates in communal areas is notoriously difficult, but closing two grazing camps every year should compensate for this as the total grazing area available at any one time is reduced. Establishing resting camps ensures a forage reserve which can be accessed in times of drought, which is important given the dry and variable climate in the region and the very limited access to grazing resources outside the farm.

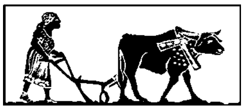
It is not clear whether the Gallawater A land reform project was aimed at improving farming opportunities or simply at expanding residential areas with some surrounding commonage. If the former is the case, there should be fewer shareholders per farm in future land reform projects. On Gallawater A, the economic returns from farming are very low for any individual shareholder (for example, average livestock holdings are 4 LSU per household), and thus people are still dependent on outside incomes. As a result, few people have the means or motivation to invest much money or labour in farming. Livestock holdings on Gallawater A are highly skewed (with nearly half of the total livestock belonging to one individual), despite the fact that all farmers have to contribute equally to the purchase and maintenance of the farm. Attention thus needs to be paid to equity if poor people are to benefit from land reform projects.

There appears to be a lack of communication between the government and the people who bought the land, as well as among the land users themselves, about the aims of land reform, the objectives and expectations of the people buying the farm, and the responsibilities of the different parties concerned. For example, the farm originally had well-developed infrastructure for grazing management (fences and water provision), but this has already partially collapsed due to shortage of capital for maintaining existing structures and investing in new equipment, as well as the perception that it is the government's responsibility to provide and maintain these structures. In future land reform projects, it should be made clear at the outset what the responsibilities and resources of the government and the farmers are, so that farmers can make an informed decision when committing themselves to purchasing a share in a farm.



# 1. Introduction

There is an ongoing debate about the sustainability of communally grazed rangelands in South Africa, particularly the impact of communal grazing on the future productive potential of the land. It is a well-established view in South Africa that 'overgrazing', a term used for continuous utilisation of the veld at high stocking rates without periodic resting, causes undesirable vegetation changes such as bush encroachment, changes in grass composition (from good forage grasses to weedy, unpalatable or unproductive grass species) and reduction in grass cover which leads to accelerated soil erosion.



Ultimately, the degradation of the grazing resource is expected to lead to an irreversible decline in animal production. These concerns led to government interventions such as betterment planning and stock reduction schemes in the past.

The 'old' view that communal grazing results in widespread, severe and irreversible degradation of soil and vegetation has been widely challenged. It was recently pointed out in a working paper on land use and environmental policy in South African rangelands that degradation needs to be defined and assessed in terms of the land users' objectives (Dikeni et al. 1996). Many researchers maintain that in terms of communal farmers' production objectives, few examples can be found where there has indeed been a loss (for example, Tapson 1993; Shackleton 1993). These studies or policies are generally based on the assumption that, unlike commercial farmers, communal farmers are less interested in maximising the productive output of one or a few commodities (for example, beef production) but rather derive a multitude of benefits (meat, milk, manure, traction power, security, ritual slaughter) from a 'multipurpose herd'. Many of these are derived from live animals and it is therefore thought that communal farmers maximise such benefits by having more animals (Sandford 1983; Behnke & Scoones 1993). The fact that in many areas, livestock numbers have not declined over several decades (for example, Bembridge 1979; Tapson & Rose 1984; Tapson 1993), has been used as evidence that farmers are still able to fulfil their objectives, despite the fact that from a commercial farmer's or a conservationist's point of view, the land appears to be degraded.

Another common perception is that communal land use is unproductive, particularly with regard to saleable offtake of livestock and livestock products (for example, Bembridge 1979), and past policies and extension have focused on increasing 'commercial' production in the former homelands, for example through marketing schemes. However, some work has indicated that if all the use values of cattle in a communal system are considered (including non-material benefits such as security and traditional uses), the economic returns are comparable to, if not higher than, standard commercial herds (Shackleton 1998 and references therein). It is also argued that communal rangeland use is not confined to livestock rearing, but includes harvesting of other plant products and deriving other benefits, material and other, from the natural resources. The combined value is believed to commonly exceed the profits from commercial farming systems (Cousins 1998).

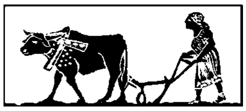
While much of the 'new' thinking has been adopted in policy, the debate about degradation remains unresolved. Degradation has recently received renewed attention in policy making since South Africa became a signatory to the United Nations Convention to Combat Desertification (UNCCD) in 1995 and ratified the convention in 1997. The UNCCD is a legally binding document, and signatories are committed to practical action at the local level to assess, combat and prevent land degradation (Hoffman et al. 1999). In a nationwide audit of land degradation where soil and vegetation degradation were assessed for each magisterial district of South Africa (Hoffman et al. 1999), land tenure system (commercial vs. communal) emerged as the most important predictor of land degradation. Soil erosion in particular was found to be significantly higher in the communal areas than in the commercial areas of South Africa. The underlying reasons for land degradation in communal rangelands – high human population pressure, high livestock densities, government policies and investment, patterns of land use and management, the attitudes and practices of individual land users – are complex and need to be better understood if tenure reform is to result in sustainable use of natural resources.

In this context, some critical attention has been focused on land reform, as the communal use of land (for example, on farms bought by a number of shareholders) is expected to expand considerably.

The focus of this study is on the changes in the biophysical environment, particularly soils and vegetation, that are likely to result from the change of land tenure and land use on Gallawater A. The aims of this study can be subdivided as follows:

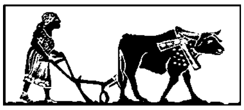
1. To understand what the objectives of livestock owners are, and how the current (or any envisaged) grazing practices are likely to affect the achievement of farmers' objectives in the short- and medium-term.
2. To determine constraints to achieving desired objectives and/or desired management practices.
3. To determine whether these practices are likely to result in environmental degradation, thus limiting the long-term productive potential of the farm.

As this study focuses on the impacts of grazing, other rangeland uses are not dealt with comprehensively. It is, however, difficult to separate grazing and other rangeland uses (for instance fuelwood harvesting) and their impacts. An attempt was therefore made to understand the value of different vegetation elements including their non-grazing value, and to assess how they will be affected by land use, particularly grazing, on Gallawater A. The study aims to illustrate the impacts of changes in land tenure and land use in the area on the rangeland resources; its conclusions should thus be relevant to similar land reform projects in the region.



# 2. Research approach

To gain a better understanding of the medium-term effects of communal grazing, we compared stocking rates, human population density, vegetation data and peoples' interpretations of the biophysical resources on Gallawater A and Zweledinga. Gallawater A farm is part of the Queenstown district and borders on communal areas in the neighbouring district of Hewu. Zweledinga lies in the Hewu District of the former Ciskei and was commercial farming land until people who left Glen Grey in 1976 were settled there to avoid being incorporated into a newly 'independent' Transkei. Zweledinga thus provides a good opportunity to see what environmental changes occur in an area which has been converted from commercial farmland to land under communal tenure.



This report is based on fieldwork done on Gallawater A and Zweledinga over two weeks in late August 1999.

### Vegetation data

Vegetation data was obtained from different parts of Gallawater A farm and in Zweledinga, covering the range of different slopes, aspects, geology and soils found on Gallawater A. This was done to determine present condition and (from the communal areas) what happens to the land under heavy continuous utilisation. Twenty surveys were carried out on Gallawater and 16 in Zweledinga, each comprising the following three components:

1. A 100-point transect, with 50 points set parallel 25m apart, where the grass species nearest the point was identified (including counts of bare ground, rock and forbs) and the distance from the point to the nearest tuft was estimated in centimetres. The average point to tuft distance can be related to basal cover, which is a measure of the percentage of ground covered by rooted plants and gives an indication of the area's resistance to soil erosion. For details of data collection and analysis see Beckerling et al. (1995).
2. A belt transect of 2x100m recording the species, total height and height of lowest available browseable material of each bush in the transect. This was done to get an indication of bush density, acceptability (i.e. whether goats browse it or not) and availability (Trollope 1986).
3. An estimate of grass biomass by measuring the height above ground level to which the disc of a disc pasture meter (DPM) drops (Trollope 1983). One hundred DPM measurements were taken in each transect. The grass biomass in each transect gives an indication of the amount of forage available towards the end of the dry season (since the measurements were taken in late August). Also, higher grass biomass protects the ground from soil

erosion. Grass biomass estimates are expressed in kilograms of dry matter per hectare, but to make comparisons, the DPM measurements (in centimetres) were used without conversion.

4. The extent (widespread, isolated or none) and type (sheet or gully) of soil erosion were also be recorded for each survey, as well as notes on top soil loss, crusting of the surface and severity of erosion.

Due to time constraints, no data was collected in communal areas which have been managed communally for several decades longer than Zweledinga. However, a day was spent driving and walking in parts of these areas to see whether their condition is different from that of Zweledinga and Gallawater A.

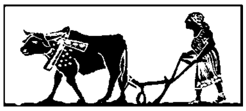
## Data analysis

### Grass component

Grass composition was used to calculate veld condition scores and grazing capacities using a standard method for assessing veld condition (Beckerling et al. 1995). Veld condition scores indicate the current ecological status and forage production potential of an area, based on the responses to grazing and forage qualities of the grass species present. Veld condition scores are expressed as percentages relative to a benchmark which represents veld in ideal condition for animal production. Grazing capacities (expressed as hectares per large stock unit) are calculated on the basis of veld condition. Veld condition score, grazing capacity, mean DPM measurement and the mean point-to-tuft distance in each transect were compared between Gallawater A and Zweledinga using the Mann-Whitney U test to see whether, from a traditional assessment, significant differences in the condition of the grazing resource can be found between the two areas.

The relevance of using these traditional assessments in communal areas has been challenged, especially the values of grazing capacity and veld condition which they calculate. This is due to the fact that these methods and their interpretation are based on the assumption that farmers wish to maximise animal performance, as is the case in commercial farming systems. The most suitable stocking rate may be considerably higher than the calculated grazing capacity if farmers wish to have high animal numbers and are willing to compromise the performance of individual animals to some extent. Likewise, the benchmarks used to calculate veld condition scores may not reflect the desired state of the vegetation, given the different farming objectives of communal farmers. Traditional measures of veld condition are included in this analysis under the assumption that more realistic stocking rates and veld condition scores (VCS) would be proportional to the grazing capacities and VCS calculated. They are thus used for comparative purposes, bearing in mind that the actual values may not reflect the farmers' objectives.

Another criticism of the traditional veld condition assessments is that calculations use subjective forage scores based on assessments by commercial farmers. These scores reflect forage production and quality and have been found to work well under commercial farming conditions, but whether these scores are appropriate in communal system (ecologically, or in terms of the criteria important to communal farmers) has not been researched. For this reason, veld condition scores were interpreted with caution and communal farmers in Gallawater and Zweledinga were interviewed to understand their assessment of the vegetation (see below).



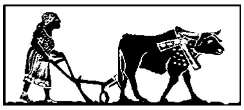
Because of the limitations of univariate analyses on fairly complex data (especially where there is great variation between sites within each area), multivariate analyses were performed to assess and interpret the similarity of different sites within and between Gallawater and Zweledinga. This also provides a more objective analysis than the traditional veld condition assessments. Bray-Curtis similarity indices were calculated between all sites using square root-transformed grass data (the percentage of each grass species in the transect).

These were used to produce a dendrogram which clusters similar sites into groups, and a multi-dimensional scaling (MDS) ordination plot which produces a two-dimensional representations of how similar each site is to each other site.

Environmental variables (geology and aspect) as well as veld condition score, grazing capacity and point-to-tuft distance were superimposed on the MDS ordination plots to see whether any of these factors explain the grouping of sites. SIMPER analysis was used to determine which grass species contribute to similarities within the groupings that emerged in the MDS plot and the dendrogram. A Mantel-type Monte Carlo analysis was performed to test whether Gallawater A and Zweledinga sites are significantly different.

### Bush component

Bush data was divided into acceptable and unacceptable browse species (according to whether they are browsed by goats) and size class distributions for each category was compared between Zweledinga and Gallawater to see whether certain classes of bush had been affected by management and browsing. Browse availability, calculated as browse units (equivalent to an acceptable browse tree 1.5m high) per hectare was calculated and compared between Gallawater A and Zweledinga.



The same multivariate analyses as for grass were performed on square root-transformed bush abundance data (number per 120 $m^2$).

## Information from farmers

Interview information from groups and individuals was used to interpret the vegetation data in the light of the criteria of Gallawater A farmers as well as those which had previously been developed.

In a meeting with several members of the Gallawater Trust, residents of Gallawater A were interviewed about their objectives and plans for livestock farming. This was done to establish whether farmers are keeping livestock to meet traditional and subsistence needs, or whether people, individually or as a group, are trying to produce livestock and products for sale (for example, wool, live animals for slaughter, milk) or both. Present grazing management, and peoples' plans and ideas for grazing management were also explored during the meeting. This was followed up with conversations and interviews with individual Gallawater A residents about objectives and management ideas to explore their different views outside the group context.

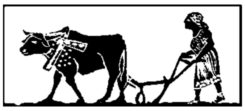
Individual Gallawater A residents, as well as two people who live in Zweledinga and have no share in Gallawater A farm, were also interviewed about their perceptions of the grazing resource on Gallawater A and in Zweledinga and the desirability of certain vegetation types or key species (for example, *Acacia karoo*). We also tried to get a better idea of what changes people have observed in Zweledinga since they settled in the area in 1976, and what their predictions are regarding vegetation changes and soil erosion in Gallawater A.

# 3. Biophysical information

Gallawater A farm is fairly mountainous with altitudes ranging from 1 080 to 1 500m above sea level, most of the grazing lying between about 1 100 and 1 350m. Zweledinga covers a similar range of altitudes, but consists of a large alluvial plain (much of which is used for cropping) surrounded by mountains. The vegetation surveys were performed in the mountainous areas which have a similar topography to Gallawater A.

The mean annual rainfall in the area is 480mm (DBSA 1985) with a coefficient of variance of around 30 per cent (Schulze et al. 1997). Gallawater A and Zweledinga thus experience a semi-arid climate with relatively unpredictable rainfall. Rain falls mostly in summers while winters are dry and cold with frequent frost.

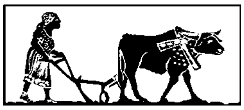
The study areas lie in the Dry Cymbopogon-Themeda veld type (South-Eastern Variation), which is dominated by *Themeda triandra* and *Cymbopogon plurinodis* (Acocks 1988). Other grass species commonly found in this veld type include *Aristida congesta*, *Eragrostis* species, *Cynodon dactylon*, *Tragus berteronianus*, *Setaria flabellata* and *Elionurus muticus*. *Acacia karoo* trees are common in the study areas, especially in the valleys, and Karoo shrubs (for example, *Felicia filifolia*) are common in the mountains. Most of the area is covered by bush of varying densities, including *Rhus undulata*, *R. erosa*, *R. longispina*, *Maytenus heterophylla*, *Grewia occidentalis*, *Cussonia spicata* and *Diospyros* species. Several cycad populations (*Encephalartos* species) were found on rocky mountain slopes on Gallawater A, but these are no longer found in Zweledinga.



Gallawater A and surrounding areas – including the whole of Zweledinga – lie on sandstone of the Katberg formation which is part of the Beaufort Group. Dolerite intrusions form hills and ridges throughout the area. Dolerite gives rise to fertile soils which are good for cropping and support sweet veld. Dolerite slopes tend to be very rocky; while this reduces the amount of grass because of the higher percentage of ground covered by rocks, it tends to make these slopes more resistant to erosion, and rock crevices also provide refuge for palatable grass species from where they can re-seed. Sandstone soils are less nutrient-rich and, especially at high altitudes and on south-facing slopes, the grasses can be ‘sour’, that is, their nutrient content becomes so low in winter that they are virtually unpalatable.

# 4. Human population density and stocking rates on Gallawater A and Zweledinga

Before drawing direct comparisons between Zweledinga and Gallawater A, it is necessary to ensure that both areas experience similar biophysical conditions as well as similar densities of livestock and human settlement. Zweledinga is notoriously overcrowded, and this is considered to be an important factor contributing to resource degradation.



It turned out to be impossible in the time available to obtain reliable live stock numbers on Gallawater A farm, as it was impossible to ask all livestock owners (some of whom are still resident in Zweledinga) about their livestock holdings. This is complicated by the fact that some people feel uncomfortable discussing their own or other people's livestock numbers. Also, some of the livestock on Gallawater A are said to belong to friends of Gallawater A shareholders who do not own a share in the farm themselves. No records are kept of individual livestock holdings, the total number of livestock on the farm or the number of livestock entering or leaving the farm.

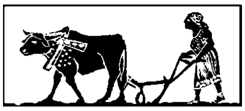
In 1995, 275 cattle, 238 sheep and 340 goats were recorded on Gallawater A farm (Wotshela 1997, cited in Beinart 1998). These figures have changed since then; for example, about 400 sheep are presently owned by two people on Gallawater A. It is not clear whether total numbers have increased or decreased, although people reported that more and more people are bringing their livestock from Zweledinga. With 860ha of grazing land (from an assessment of the farm by GG Antrobus) and the above livestock numbers, stocking rate in 1995 was calculated to be 0.46LSU/ha. This compares with Antrobus's estimated carrying capacity of 800 sheep, 100 cattle and 200 goats or 0.30LSU/ha, which is high compared to the Department of Agriculture's recommended stocking rate of 0.17LSU/ha. Livestock holdings are highly skewed with a few people having large herds and most others having few or no livestock. The stocking rate in Hewu is 0.21LSU/ha. Beinart (1998) cites a rough figure of 0.3LSU/ha in Thornhill (an area near Zweledinga with a similar settlement history, and also reputed to be overcrowded), which is reported to be twice the recommended carrying capacity. Effective stocking rates in certain localities, especially near villages, are likely to be higher as grazing tends to be concentrated around villages where all livestock are kraaled at night.

It is often argued that in communal areas, everybody aims to maximise livestock numbers, and that stocking rates reflect the maximum possible animal densities, sometimes referred to as the ecological carrying capacity of the land. Assuming that Gallawater A has the same biophysical resources as Zweledinga and surrounding communal areas in Hewu, it appears from these figures that Gallawater A farm is already stocked to capacity, in fact more densely than the other communal areas at present. The vegetation at this stage is still good enough to allow the addition of more animals and to maintain animals in better condition than in the communal areas, but it is reasonable to expect that if the same stocking rates and grazing patterns are maintained, that vegetation changes in response to grazing will be similar to that in Zweledinga.

Livestock, although considered to be the main cause of rangeland degradation, are not the only agents of vegetation and soil changes. Humans, through walking, building homesteads and harvesting resources, can also contribute significantly to these changes, especially at high population densities. Zweledinga and other areas in the vicinity are reputed to be severely overcrowded by people. Using census data of the rural population from 1996 and a total area of 110 930ha (DBSA 1985), human population density is calculated as roughly 0.44 people/ha in Hewu. Since the urban population is not included, population density is somewhat underestimated by this calculation.

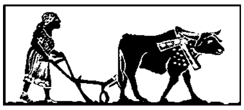
Gallawater A has a relatively small population at this stage, as only 26 of the 102 households have moved onto the farm. According to 1996 statistics, 209 people were living on the farm at the time of the census. It is hard to predict how many households will eventually move, since the provision of services (electricity, water, schools and so on) is considerably better in Zweledinga and it is not known what services will be supplied to the village on Gallawater A. If all 102 households were to move, and one assumes average household size to be six people (which was found to be the average household size in different districts in Transkei in the 1991 population census), population density would be about 0.67 people/ha. While not all of the 102 households may move onto the farm, this would be offset in the longer term by population growth.

Stocking rates and human population pressure – at least in the future – are thus similar enough on Gallawater A and in Zweledinga to base predictions for vegetation change and sustainability of grazing on Gallawater A on data from Zweledinga.



# 5. Farming objectives and ideas on management

During the group meeting, people generally agreed that they wanted to use Gallawater A to improve their livestock production, to rear fat and healthy animals and sell them to increase household income. They reported that their animals reproduced better and were generally in better condition on Gallawater A because animal densities are still relatively low, there is more grass and there are still more *Acacia karoo* trees on the farm than there are in Zweledinga. According to farmers, livestock are already sold from Gallawater A, especially goats which are sold to the neighbouring communal areas including Zweledinga.



Farmers at the meeting explained that no grazing management is currently in place. There is no limit on the total number of livestock or individual livestock holdings. Animals are usually kraaled at night and allowed to graze wherever they go during the day. Gates between grazing camps are left open so animals can pass freely from camp to camp which enables them to access water as well as grazing areas in camps without water sources. The lack of water provision in most grazing camps was described as the main hindrance to the implementation of a grazing management strategy.

People at the group meeting agreed that the vegetation on Gallawater A was in better condition than in Zweledinga, the most notable difference being that *Acacia karoo* is still abundant on Gallawater A while many *Acacia* trees have been cut for firewood in Zweledinga. *Acacia karoo* is desired as a source of fuelwood, browse for goats and shelter from the elements for all livestock. The better condition and more frequent reproduction of livestock were seen as a sign that conditions on Gallawater A are better than those in Zweledinga. It was noted by one farmer at the meeting that Zweledinga used to be beautiful like Gallawater A but has been denuded due to poor management, and that the future condition of Gallawater A would depend on management practices. For that reason, it was explained, Gallawater A had regulations to protect natural resources such as prohibiting the cutting of live trees and branches.

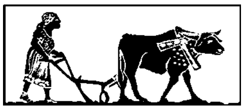
Some of the statements and opinions from the group meeting were queried in conversations with individuals following the group meeting. According to one woman, men at the meeting gave the ‘ideal’ answers, saying that they had commercial production aims and the desire for a planned management system. In reality, according to her, men wanted to keep their livestock in a ‘traditional’ way and decide as individuals how and where they should graze.

Two men echoed these misgivings. The group had originally intended to develop a planning committee which would co-ordinate grazing management (opening and closing of camps for grazing and resting), ensure the upkeep of fencing (especially trying to prevent theft of fencing materials) and keep track of animal numbers and movements in and out of the farm (especially animals belonging to people who are not Gallawater A shareholders). They felt very strongly that such a committee was necessary to prevent Gallawater A from deteriorating like Zweledinga. The planning committee was opposed by several people, including the vice-chairman of the Trust committee who owns many livestock and holds much influence on decision making on the farm. The men interviewed suggested that their leaders' resistance to having a planning committee for veld management was a way of maintaining their powerful positions. When asked about his ideas about management, the Trust chairman said that as far as he was concerned, getting the land was the most important achievement, while management is of secondary importance and can be developed at a later stage.

The two men also felt that being among the first households to move to Gallawater A placed them in a difficult, costly and vulnerable position: They had made the sacrifice of leaving their old homes, only to find that Gallawater A is not as big as they expected. They believed that electricity and other running costs of the farm are being paid by them while people still living in Zweledinga are not paying for upkeep and running costs of the farm, even though many have brought their livestock to graze on the farm. The management committee of Gallawater A does not provide access to information on income and expenditure, and farmers are unsure of how their money is spent. This is exacerbated by the fact that many of the shareholders have only poor reading and mathematical skills, and hence feel that it would be easy for the more educated Trust committee members to take advantage of them. The lack of trust, which is engendered this way, is not conducive to farmers being prepared to spend more money or labour on communal management of the farm.

# 6. Gallawater farm: resources and infrastructure

Of the approximately 900ha farm, 860ha is grazing land which is fenced into 12 grazing camps (see Figure 1). Arable lands (the irrigable area along the river and two tracts of drylands) are fenced off from the grazing areas. The fencing is generally still in functional condition although in several places, particularly where people seem to cross regularly, the fences have become slack or some of the wires have been broken.



The parts of the perimeter fence we saw looked in good condition, but goats manage to cross the fence separating Gallawater A from the neighbouring commercial farm fairly frequently, something which is leading to conflict with the neighbouring farmer. Stray goats are impounded regularly, and according to farmers on Gallawater A as well as a recent report (Wotshela 1997; cited in Beinart 1998) this has resulted in heavy expenditure in pound fees. Given the present lack of financial resources for maintenance of structures such as fences, it is generally perceived as inevitable that fencing – especially within the boundaries of Gallawater A – will gradually deteriorate.

Gallawater A farm is well endowed with water resources in the form of several seasonal streams, a perennial river and infrastructure such as pumps, piping and troughs for livestock. Each grazing camp has a concrete trough for water provision, but due to a problem with the piping or the pump, these are not used. The only sources of perennial water (that were observed towards the end of a dry winter) are:

- The Klipplaat River which forms the eastern boundary of Gallawater A farm. Using the river to water livestock exposes the fields along the river to damage.
- The water supply which is pumped to taps in and around the main farm house. This is where people also obtain their drinking water as there is no supply nearer the village.
- A windmill near the north-western corner of the farm.
- A small farm dam in a valley in the south-western quarter of the farm. The gates between the main body of the farm and the two grazing camps are closed with wire and farmers explained that they were trying to use the two far camps as a winter grazing area. Livestock were, however, observed on both sides of the fence.
- Some stagnant pools in a seasonal stream which runs down the highest mountain on the farm in the north-western quarter of the farm.

A fairly large farm dam on the latter river, which is said to have supplied the water troughs in the different grazing camps is completely dry, probably due to damage to the dam wall. There seems to be some uncertainty among Gallawater A shareholders about whose responsibility it is to maintain water sources and infrastructure such as the piping, dams and pumps. All the people resident on the farm pay for the electricity to run the pumps, but a lack of maintenance, money for materials and probably the necessary technical skills (and, among some people, the feeling that the government should assist them) have already resulted in a partial collapse of the water infrastructure.

There is at present enough perennial water in different parts of the farm to enable livestock to access all areas of the farm in winter if the gates between camps are left open so animals can pass between water sources and different grazing areas. Without a functional water supply to the troughs in the different grazing camps however, several of the grazing camps cannot be used in winter if they were closed off from other camps.

It does not appear that the grazing areas on Gallawater A were in very good condition when the farm was sold. The lower lying areas are dominated by short grasses and have poor grass cover which would have been exacerbated but probably not caused by the new owners. The farm

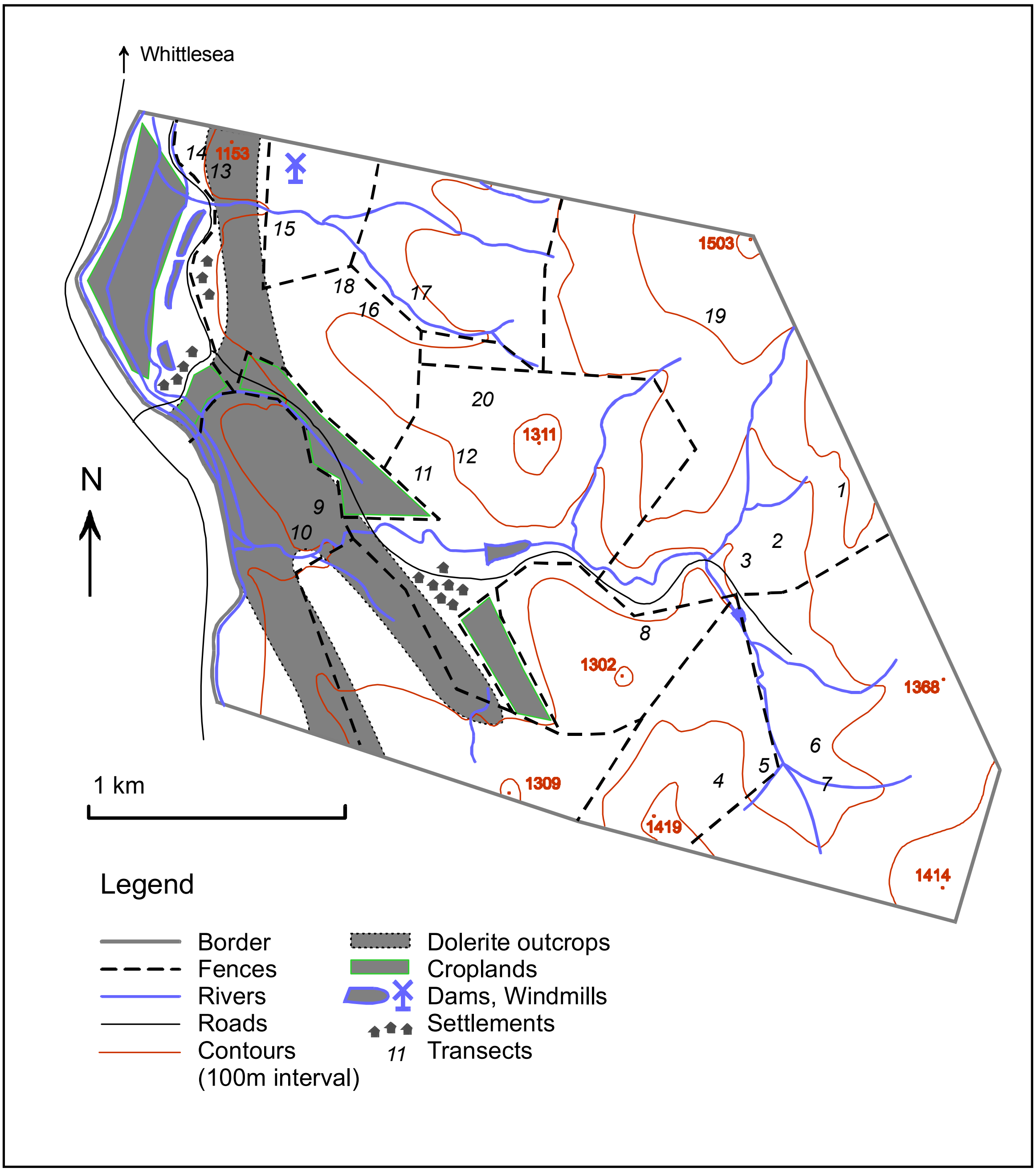
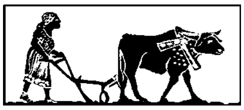



**Figure 1. Map of Gallawater A farm showing natural features and farming infrastructure.**

assessment done by Antrobus in 1991 already describes the lower lying areas as having poor vegetation cover. Sheet erosion and some deep dongas are also found in some of these areas where soils are deep. The mountains on Gallawater A are dominated by *Cymbopogon plurinodis* ('turpentine grass') which is unpalatable to livestock and is seen as an indicator of underutilised veld. The overgrazed low areas and the underutilised high slopes suggest that under the management of the previous owner, the farm was unevenly grazed. This is quite likely as farmers are often reluctant to use the more remote parts of their farms in areas where stock theft is a problem. The condition of grazing resources on Gallawater A will be dealt with in more detail later.



# 7. The condition of rangeland resources

### Some perspectives from a district-level survey

Data from workshops conducted for each magisterial district to assess soil and vegetation degradation in South Africa (Hoffman et al. 1999) was examined for the districts of Hewu and Queenstown to gain a larger scale impression of the impacts of land use system on the natural resources. Ninety percent of the Queenstown district is under individual tenure and farmed commercially, while Hewu is entirely under communal tenure. Interestingly, stocking rates in Queenstown (0.31LSU/ha) are considerably higher than in Hewu (0.21LSU/ha). Compared to the Department of Agriculture's recommended stocking rates, Queenstown and Hewu are overstocked by 182% and 168% respectively.

During the workshops, soil and veld degradation were assessed separately and then integrated to give an overall index of degradation. These indices take into account the degree (light to severe), extent (percentage of the area affected) and rate of spread (slowly or rapidly increasing or decreasing) of different degradation components. Queenstown and Hewu have similar veld degradation indices (in fact, the index for Queenstown is somewhat higher), but while Queenstown has a soil erosion index of zero, the soil erosion index of Hewu is high.

Veld degradation in Hewu is mainly in the form of moderate loss of cover and light bush encroachment (mainly *Euryops floribundus*, commonly known as Harpuis). Veld degradation in Hewu is of moderate severity and covers less than 10% of the total area. In Queenstown, veld degradation consists of bush encroachment (*Acacia karoo*) and encroachment by alien plants (*Acacia mearnsii*, *Opuntia* spp.) which are perceived to be light and moderate respectively. While the degree of these changes is rated to be light, up to 25 per cent of the area is affected and overall severity of the problem is thus considered to be moderate. Rates of vegetation changes in both districts are slowly increasing.

Hewu experiences moderate degrees of sheet and gully erosion and loss of topsoil due to wind in grazing areas, croplands and settlement areas. Loss of topsoil due to wind blowing appears to be the most important of these and is considered to be severe in grazing areas. Erosion is judged to be slowly to moderately increasing in Hewu. In Queenstown, low scores for light and localised erosion are offset by the fact that erosion rates are decreasing, resulting in an overall soil erosion index of zero.

From this district comparison, and from the analysis of all South African districts (Hoffman et al. 1999), it is apparent that communal and commercial farming systems generally lead to quite different vegetation changes, and that soil erosion is significantly more severe in communal areas. What is particularly interesting is that tenure, management and/or human population density seem to have more impact on the environment than livestock densities *per se*.

### Results from data collected on Gallawater A and in Zweledinga

#### Grass component

Veld condition scores calculated from grass composition data are low on average in both areas, but with much greater variation in Zweledinga (Figure 2a). Zweledinga has some sites (mostly flat, sandy areas near villages) which have extremely low veld condition scores, but

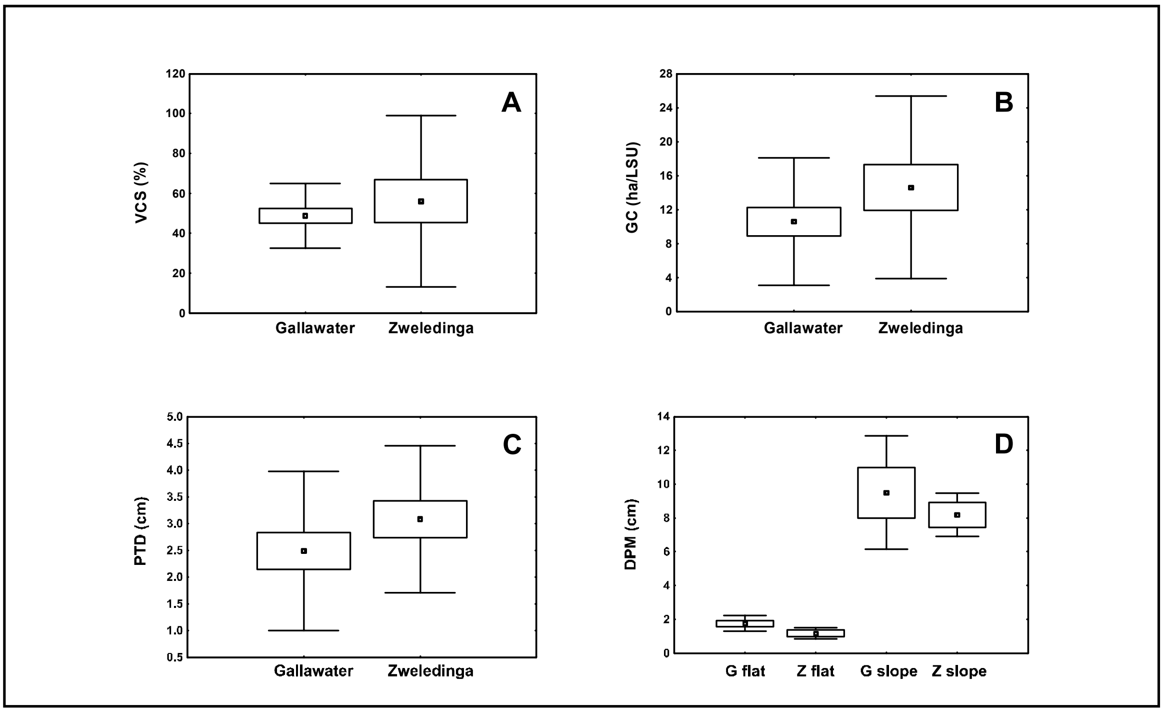



**Figure 2. Plots showing mean values, standard error and standard deviation of veld condition score, grazing capacity, point-to-tuft distance and disc pasture meter measurement on Gallawater A and in Zweledinga.[8]**

further from the villages on the mountains, sites which are in exceptionally good condition can be found. Overall, no significant difference was found to exist between veld condition scores in Gallawater and Zweledinga (p=0.52).

Grazing capacity (GC) for each transect was calculated in the same analysis as veld condition scores (Figure 2b). The GC ranges from extremely low to very high within both Gallawater A and Zweledinga but is very low on average (0.094 and 0.068 LSU/ha respectively). The GC values calculated are several times lower than actual stocking rates and are unlikely to be of any relevance except for comparing the relative grazing capacity of different sites. Mean GC does not differ significantly between Gallawater A and Zweledinga (p=0.44).

Veld condition scores and calculations of the grazing capacity are based on species composition and do not take into account biomass and basal cover which are assessed using disc pasture meter (DPM) measurements and point-to-tuft distance (PTD) respectively as surrogate measures. The mean PTD (3.1±1.4cm) is greater in Zweledinga than on Gallawater A (2.5±1.4cm; see Figure 2c), indicating lower basal cover in Zweledinga. A mean distance exceeding 3cm is considered to indicate moderate to low basal cover and increases the risk of soil erosion (Beckerling et al. 1995). Again, there is considerable variation within each area, and the difference is not statistically significant (p=0.12).

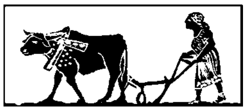
DPM measurements were only obtained for sites with either very high (in the range of 3.5 to 4 tonnes per hectare) or very low (less than 1 t/ha) standing grass biomass (see Figure 2d). The former are found in the mountains and are covered in tall grass, the latter are low-lying, sandy areas with very little grass and usually much bare ground. Intermediate areas were very rocky or stony and thus distorted the disc pasture meter measurements. Flat, low-biomass areas in Zweledinga had lower standing biomass than the same type of area on Gallawater A (p=0.07), although the significance level is not high. We observed more bare ground and more erosion (particularly sheet erosion) in low-lying areas in Zweledinga, especially near villages. No significant difference was found between biomass in the higher lying areas (p=0.65), and differences between Zweledinga and Gallawater A in the mountains were not discernible from observation.

A dendrogram which groups sampling sites according to the similarity of their grass composition is shown in Figure 3. Four main groups emerge, with sites from Gallawater A and Zweledinga in each. The same four groups emerge from the MDS ordination plot (Figure 4). The Monte Carlo analysis revealed no significant differences in grass composition between Gallawater and Zweledinga sites (p=0.16). Instead, the topography (and distance from settlements, with higher slopes being further away) has more influence on grass composition. Figure 5 shows that geology and aspect do not really explain the groupings, except that all sites on alluvium (which are low-lying, flat sites with deep soils) and none on dolerite are found in groups 1 and 2. These two groups are characterised by short and often sparse grass cover and this akes them vulnerable to soil erosion. Veld condition scores and grazing capacity are higher in groups 4 and 5, which are found in higher lying and usually more remote areas. Group 5, where *Themeda triandra* is the dominant grass species, contains areas which are in very good condition even by commercial farming standards. The point-to tuft distance varies across groups. SIMPER analysis was done to determine the species composition characterising each group. Table 1 summarises what environments, grass species (contributing more than 10% to the within-group similarity), biomass, cover, veld condition and grazing capacity are characteristic of sites in each group.

### Bush component

Bush abundance data was converted to the number of individual acceptable or unacceptable browse plants per 100m$^2$ for Gallawater A and Zweledinga. Size class frequency distributions for both categories of bush are shown in Figure 6. The size class distributions for unacceptable browse species are the same on Gallawater A and in Zweledinga. Acceptable browse species however have different size class distributions in the two areas, with small individuals predominating and acceptable bushes between 50 and 200cm height (the size class best suited to browsing by goats) being more poorly represented in Zweledinga. This is reflected in the significantly higher browse availability on Gallawater A (1 465±1 428 browse units per hectare) compared to Zweledinga (618±683 BU/ha; p=0.05). The fact that browse availability in Zweledinga is only about half that of Gallawater A is likely to be a result of browsing and fuelwood harvesting. In both areas, any palatable shrubs were observed to be browsed very heavily, but individuals of *Grewia occidentalis*, for example, were completely stunted in Zweledinga due to heavy browsing pressure, thus not providing as much browse as taller specimens. *Acacia* trees, we observed and were told by people, are diminishing in size and abundance around villages in Zweledinga due to the demand for fuelwood.

The cluster analysis (Figure 7) and MDS ordination plot (Figure 8) performed on bush abundance data show that Gallawater A and Zweledinga sites form largely separate groups, that is, unlike the grass component, the bush component differs significantly (p<0.001) between Gallawater A and Zweledinga. SIMPER analysis showed that *Rhus undulata*, *Acacia karoo* and *Grewia occidentalis* contribute most to the similarity within Gallawater A sites, while similarity among Zweledinga sites is largely accounted for by *Acacia karoo*, *Protasparagus* sp. and *Euryops floribundus* The key species differentiating the two areas are *Grewia occidentalis* and *Rhus undulata*, which are more common on Gallawater A. Other species whose abundance differs between Gallawater A and Zweledinga include *Aloe ferox* (which is more common on Gallawater A), *Clutia pulchella* (which is absent on Gallawater A and very common in some Zweledinga sites) and *Maytenus heterophylla* and *Rhus longispina*, both of which are more common in Zweledinga. *Cussonia spicata* and cycads (*Encephalartos* sp.), which can be found



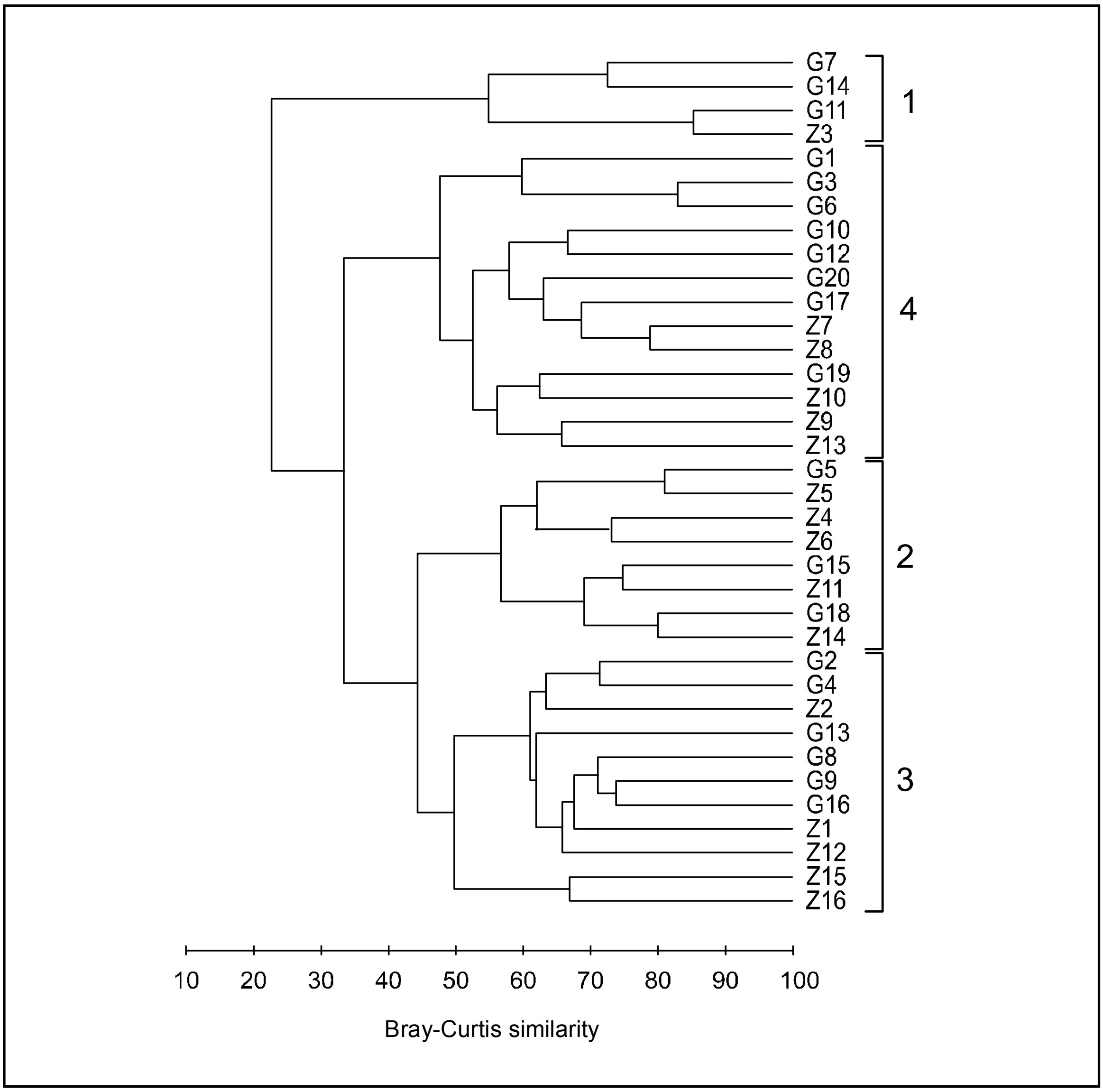



**Figure 3. Dendrogram showing sample sites in Gallawater (G) and Zweledinga (Z) clustered according to the similarity of their grass composition.**

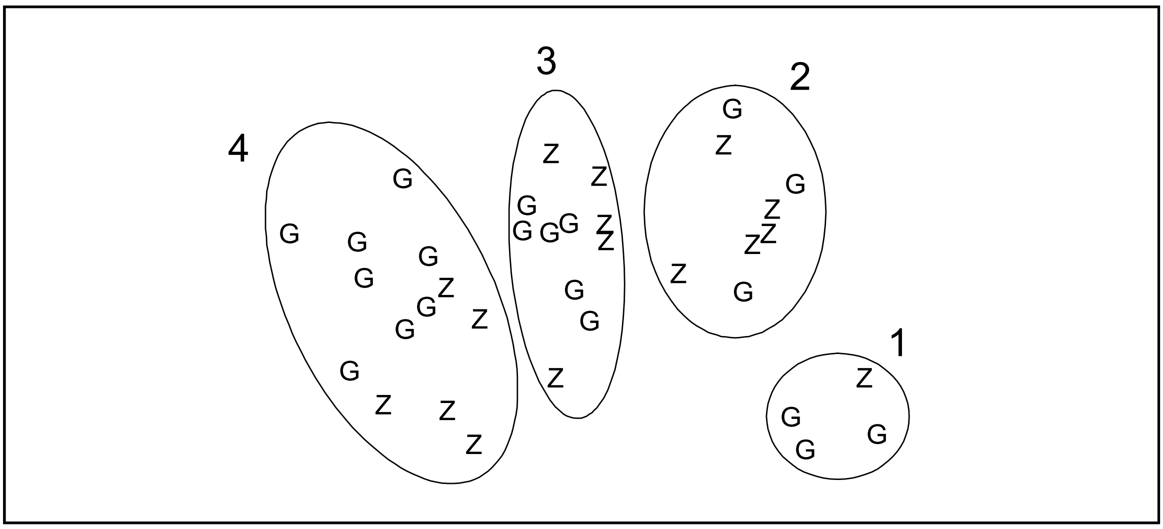



**Figure 4. MDS ordination plot showing the grouping of sites in Gallawater (G) and Zweledinga (Z) according to their grass species composition (Stress = 0.15).**

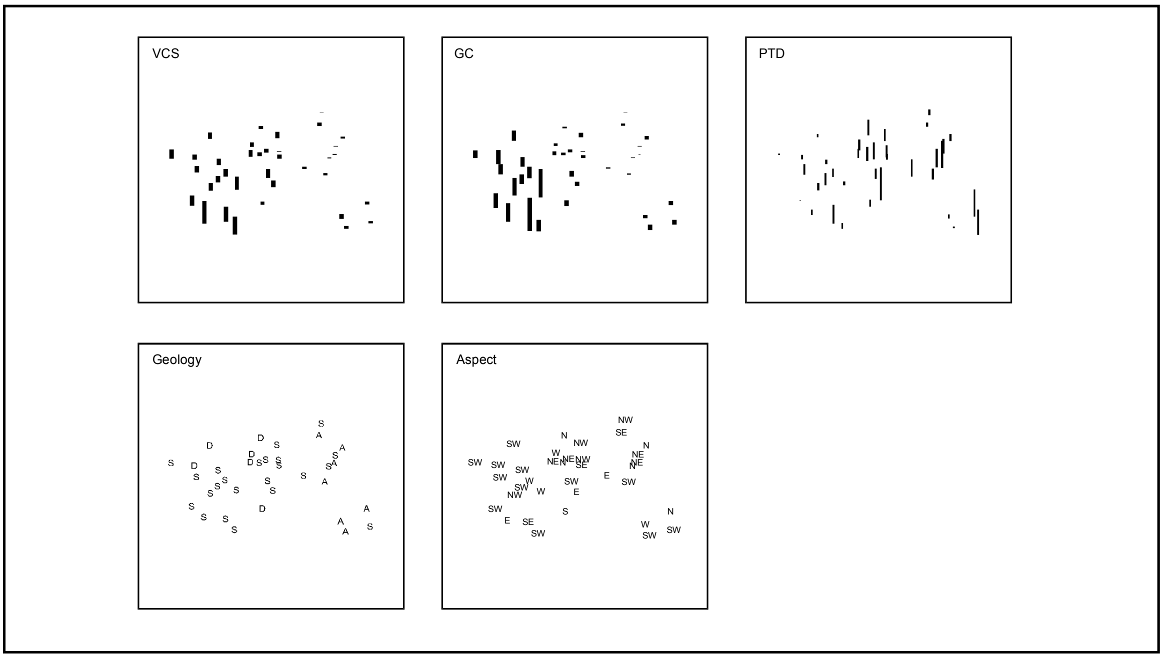
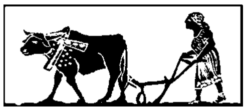



**Figure 5. The MDS ordination plot shown in Figure 4 with veld condition score, grazing capacity, point-to-tuft distance, geology and aspect superimposed on each site. Bigger bars indicate higher values of VCS, GC and PTD. Note that grazing capacity in this figure is expressed in LSU/ha and higher values thus indicate more animals per hectare. In the geology plot, D denotes dolerite, S = sandstone and A = alluvium.**

scattered throughout the mountains on Gallawater A, used to grow in Zweledinga but are now no longer found there. *Cussonia* is very heavily browsed by goats, while cycads are sensitive to fire and were also, according to some farmers, harvested because their leaves are thought to protect homes from lightning storms. Succulent plants (mostly *Crassulaceae*, which are not palatable to livestock) are found on slopes, especially on dolerite, across Gallawater A but are very scarce in Zweledinga. *Acacia karoo* and *Euryops floribundus* are equally common on Gallawater A and Zweledinga sites.



It is possible that some of the differences in the bush component of the vegetation precede communal tenure, as commercial farmers have different strategies of managing bush. They usually try to eliminate excessive bush, but the strategies and success vary from farm to farm. However, information from Zweledinga and Gallawater A residents consistently indicates that there have been changes in the bush component as a result of resource

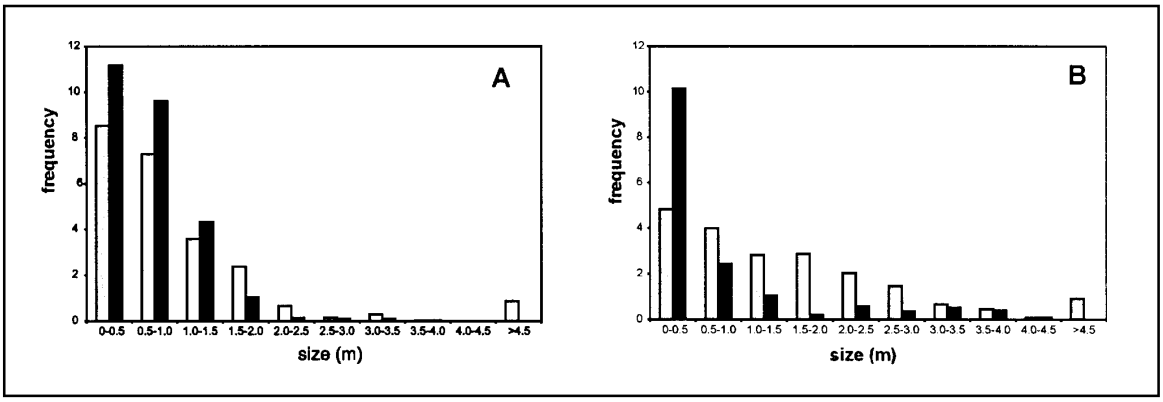
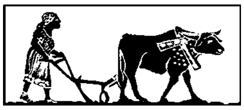



**Figure 6. Size frequency distributions of the number of unacceptable (A) and acceptable (B) browse species per 100m[2] in Zweledinga (solid bars) and Gallawater (shaded bars).**

| Group | Environment | Dominant grass species | Soil erosion | Biomass/ Cover | VCS/GC |
|---|---|---|---|---|---|
| 1 | Flat, sandy, low-lying. Much bare ground | *C. dactylon* | Moderate -severe | Very low | Very low |
| 2 | Flat, sandy, low-lying. | *A. congesta* *C. dactylon* *T. berteronianus* | Moderate -severe | Very low | Very low |
| 3 | Low to mid- slopes | *C. plurinodis* *A. congesta* *E. chloromelas* | Slight to moderate | Low | Low-medium |
| 4 | Mid- to high slopes; tall grass | *T. triandra* *C. plurinodis* *A. diffusa* *E. chloromelas* | None or slight | Medium-high | Medium-high |

**Table 1. The four groups distinguished in the ordination described in terms of their habitat, key grass species, grass cover and veld condition.**



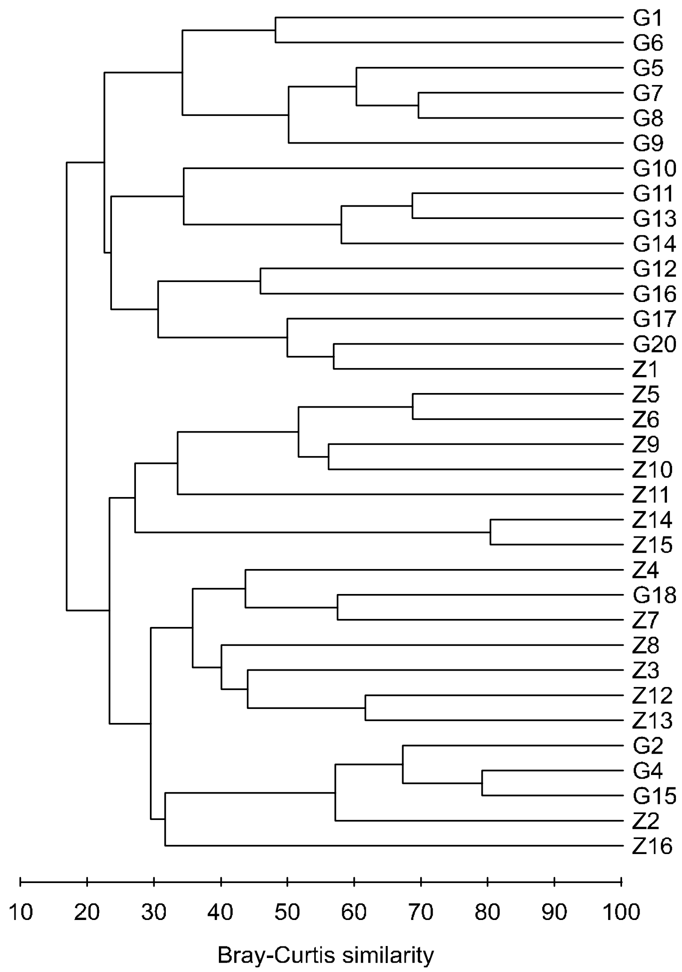



**Figure 7. Dendrogram showing sample sites in Gallawater (G) and Zweledinga (Z) clustered according to the similarity of their bush composition.**

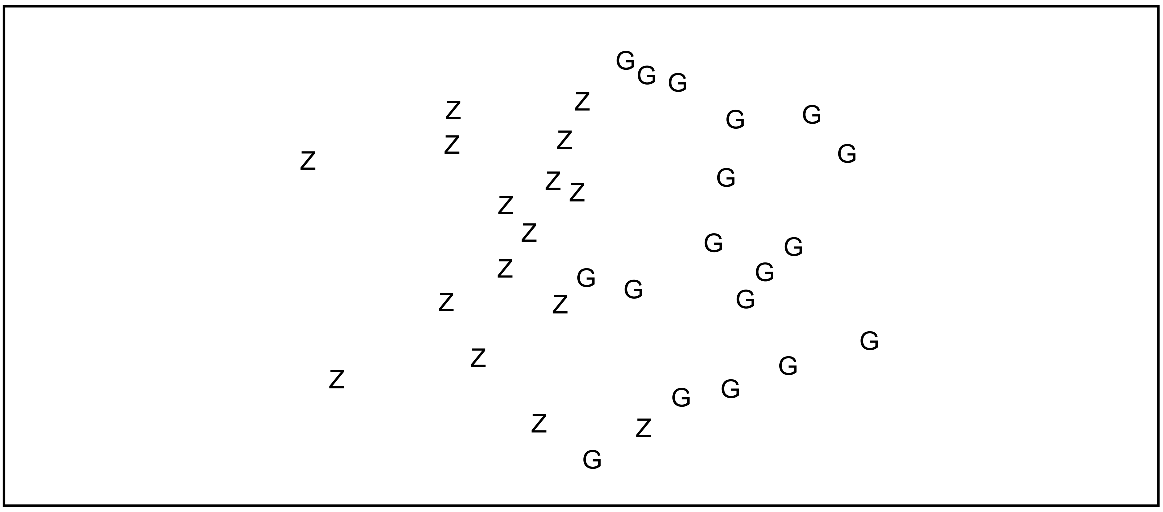
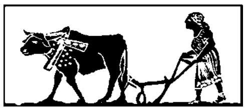


**Figure 8. MDS ordination plot showing the grouping of sites in Gallawater (G) and Zweledinga (Z) according to their bush species composition (Stress = 0.23).**

use, most notably the loss of *Acacia karoo* near villages.

### Observations in communal areas beyond Zweledinga

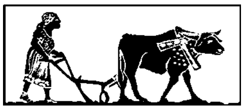
The vegetation and soils of Zweledinga, after about 20 years of heavy utilisation under communal tenure, are becoming degraded near villages in the low-lying areas, while the more mountainous areas still seem to be largely unaffected by heavy grazing. In areas beyond Zweledinga, which have been under communal tenure for much longer, even mountainous areas far from the villages show signs of degradation. While the mountainous areas on Gallawater A and in Zweledinga generally have fairly tall grass and good basal cover, the mountains of other communal areas have little grass biomass and bare ground, much of it eroded, is visible even from a distance. Encroachment by *Euryops floribundus* is widespread and severe throughout these communal areas, making mountain slopes appear black from a distance as if they had recently burnt. *Euryops* is not browsed by goats and it reduces grass cover due to shading and its resin-rich leaf litter. Invasion by this shrub reduces the grazing potential of the effected areas and is very difficult to reverse.



# 8. Farmers' interpretation of the vegetation

The classification of desirable and undesirable vegetation elements is fairly well developed for commercial farming purposes, based on different plant species' palatability and productivity, as well as competitive interactions with other plant species and the ability to invade habitats. An assessment of the desirability of a species is dependent on the land user's objectives and how the plant in question affects these.

Since the objectives of communal rangeland users and commercial livestock farmers differ in certain respects, farmers from Zweledinga and Gallawater A were asked to interpret the vegetation to avoid an assessment based on inappropriate criteria.



### The bush component

One of the major differences in perception of vegetation elements lies in the interpretation of the bush component. *Acacia karoo*, for example, is usually considered to be a nuisance by commercial farmers and is seen as an indicator of resource degradation when it forms dense thickets, a process referred to as bush encroachment. This is due to the fact that commercial farmers have little use for *A. karoo* as they are not reliant on fuelwood and do not usually keep goats, the main species of livestock which utilises *A. karoo*. When not browsed or harvested, and in the absence of fires, *A. karoo* can form impenetrable thickets that make access to grazing areas difficult, especially for cattle. Allowing bush to proliferate reduces grass cover due to competition and shading, which in turn reduces the area's grazing potential and increases the erosion risk. Heavy grazing is thought to exacerbate the bush encroachment process as it reduces the ability of grasses to compete with bush.

When asked to comment on the condition of rangeland resources on Gallawater A and/or in Zweledinga, the species that was usually mentioned first was *Acacia karoo*. Unlike commercial farmers, farmers in communal areas see it as an extremely valuable resource which provides browse for goats, fuelwood and shelter. Dense stands of *A. karoo* are seen as an asset while the loss of *Acacia* trees (as has happened around the villages of Zweledinga, largely as a result of fuelwood harvesting) is seen as a form of degradation. Most people see rules regulating the harvesting of *A. karoo* (for example, prohibiting the cutting of live wood) as necessary, and the failure to implement such rules as leading to irreversible deterioration of the resource.

Other bush species are seen as either useful, neutral or a nuisance. Useful species include *Maytenus heterophylla, Grewia occidentalis, Cussonia spicata* and *Rhus longispina* which provide browse for goats. Species that are seen as neither useful nor particularly undesirable include *Aloe ferox, Rhus undulata, Rhus erosa, Protasparagus* sp. and various succulents, many of the *Crassulaceae* family. *Aloe ferox* is browsed slightly by goats, and its dry lower leaves were observed to be harvested as fuel in Zweledinga where other sources of fuelwood are becoming scarce. *Rhus undulata* and *R. erosa* are not browsed but are considered to be valuable in holding the soil and providing shelter for livestock. *Protasparagus* sp. is browsed, though it is not considered to be as valuable as the bigger browse species. *Euryops floribundus* is seen as a major nuisance as it invades heavily grazed areas quickly and forms dense stands of unpalatable bushes. *Euryops* is also described as killing the grass with its resin-rich leaf litter.

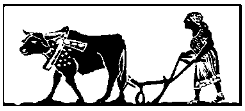
From farmers' comparisons between Gallawater and Zweledinga and their reports on vegetation change in Zweledinga, it is apparent that the changes in the bush component under communal management are considered to be undesirable by most farmers. The loss of *A. karoo* and the increase in *E. floribundus* are the most important changes according to farmers.

### The grass component

Communal farmers assess grass in a different way to commercial farmers. Traditional veld condition assessments are primarily concerned with grass species composition, as the forage value in terms of quality and quantity are fairly well known for different species in different environments under commercial farming conditions. The primary indicator for communal farmers appears to be whether livestock like going to different areas, and whether the animals are in good condition when they graze there. The communal farmer's assessment of grazing resources therefore appears to be made at a landscape level rather than on the basis of species composition.

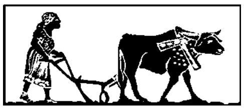
Farmers see the grazing on Gallawater A as being better than that in Zweledinga, as the grass looks taller and denser, and their livestock are fatter and reproduce more frequently. Our own observations of livestock on Gallawater A and in Zweledinga support this. However, the grasses found in the mountains on Gallawater A are described as being bitter. One farmer said that it was obvious that livestock did not like to graze in the mountains on Gallawater A and preferred the lowlands or tried to cross the fences to neighbouring farms. The grasses in the mountains in Zweledinga on the other hand, are considered to be sweet and valuable as forage; this was reported by Zweledinga and Gallawater A residents alike. The vegetation data gives an explanation: *Cymbopogon plurinodis*, which has a strong turpentine smell and is unpalatable, is found throughout most of the areas visited, but it is dominant in the mountains on Gallawater A, possibly as a result of selective grazing even before the farm became communal property. In Zweledinga, the more remote mountain slopes are dominated by *Themeda triandra* and other palatable grasses.

Farmers recognise that grass becomes shorter and sparser under heavy utilisation, and that desirable species become increasingly scarce. According to the men interviewed, the grass cover in the low lying areas of Gallawater A has already been reduced by heavy grazing, although the species composition (mainly *Cynodon dactylon*, *Aristida congesta*, *Eragrostis chloromelas*, *Tragus berteronianus* and some *Digitaria eriantha*) has remained the same. For sheep grazing, these species (with the exception of *T. berteronianus*) are considered to be suitable and desirable. The disadvantage of *A. congesta* is that it has a very shallow root system and is easily pulled up during grazing, and areas dominated by this species are easily denuded. *Cynodon dactylon* on the other hand is highly tolerant of heavy grazing and also binds the soil with its long stolons.



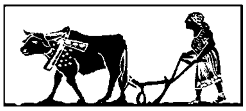
Some farmers displayed considerable understanding of different grasses and their response to grazing. For example, small grasses such as *A. congesta* and *C. dactylon* have very limited root reserves for regrowing after drought, and are therefore sensitive to grazing at such times. One man demonstrated this with a piece of *C. dactylon* which had sprouted tiny leaves despite very low rainfall this winter; he pointed out that if sheep were allowed to graze such a plant, it would die as it did not have the reserves to grow new leaves. Despite such reservations, farmers think of *C. dactylon*, *A. congesta* and other species common in the lowlands as 'sweet', desirable species which need careful looking after.

By comparison, commercial farmers see *Aristida congesta* as a nuisance species because of its low biomass production and its awned seeds which stick to animals' furs. *Cynodon dactylon* is considered to be a poor forage species because although it is tolerant of heavy grazing and forms lawns which stabilise the soil, it produces very little biomass and therefore contributes little to animal nutrition. In a traditional forage potential assessment, *A. congesta* is given a forage score of zero, while *C. dactylon* scores only two out of ten. In the veld condition assessments on Gallawater A and in Zweledinga, the sites dominated by *C. dactylon*, *A . congesta*, *E. chloromelas* and *T. berteronianus* have the lowest veld condition scores, despite the fact that Gallawater A farmers see these areas as good grazing, especially for sheep. Thus in terms of species composition, conventional veld assessment techniques do not always reflect communal farmers' criteria for assessing grass. The loss of grass cover, however, is a cause of concern to farmers on Gallawater A.



# 9. Resource management on Gallawater A: Comments and recommendations

Vegetation data from Gallawater A and Zweledinga, observations from neighbouring communal areas, district-level environmental data and farmers' own observations and opinions strongly suggest that a lack of grazing management in communal farming systems in the region around Gallawater A leads to increased soil erosion, loss of grass cover, a reduction in desirable bush species and encroachment by *Euryops floribundus*. The district-level survey suggests that high animal numbers as such are not necessarily the main factor responsible for this degradation: the Queenstown district, according to agricultural census figures, has higher stocking rates than Hewu but has far less soil erosion.



It is thus necessary to develop a better understanding of the impacts of high human population densities, which directly or indirectly place pressure on natural resources, and to understand how different management systems (for example, veld resting, rotational grazing) can be used to reduce the risks of resource degradation.

Areas of cultivation also need to be protected from grazing animals. Several women are planning to grow vegetables for sale in neighbouring areas, but are worried that livestock, particularly goats, will destroy their investment. Several people who bought shares in Gallawater A and contribute towards maintaining the farm do not own livestock. Their interests (for example, cultivation) are not protected if animals are allowed to roam free.

The risk of degradation, the need to protect cropping areas and vegetable gardens and the potential for improving the contribution of livestock farming to livelihoods are all factors that support the implementation of a simple grazing management system based on existing infrastructure.

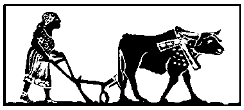
### Management options

South Africa has a long history of research, extension services and incentives aimed at reducing soil and vegetation degradation. This has, however, largely served the commercial farming sector, where these strategies have on the whole been successful. In situations where veld management strategies have been enforced in communal areas (for example, during betterment planning), they were unpopular and soon abandoned. Since Gallawater A is effectively a communal farming system, it is likely that conventional veld management strategies will meet with a similar lack of success. However, since the condition of communal areas in the area is considered to be unsatisfactory by the land users themselves, there is a need to develop management strategies which are appropriate and acceptable in terms of their objectives and available resources.

The main options available for managing grazing are controlling animal numbers (for example, by selling livestock) and regulating the use of different grazing areas through herding and fences. What follows is a discussion of the function and potential use of different practices to manage grazing on Gallawater A.

#### Controlling stocking rates

Stocking rates are regulated on most commercial farms with two main aims: to prevent veld degradation, and to ensure there is enough forage to keep livestock in good condition. This is important to commercial farmers who make a living from selling livestock and livestock products. There is an ongoing debate about whether controlling stocking rates according to some measure of the carrying capacity of the environment has any benefits to offer communal farmers (for example, Sandford 1983).



While some researchers have dismissed the carrying capacity concept as totally useless for communal rangelands, others have pointed out that the optimum stocking rate in any system is dependent on the producer's objectives, and that the criteria against which communal rangelands have been judged to be overstocked have been inappropriately chosen. Behnke (1997) maintains that 'our interest in and need for the concept remains undiminished' as stocking rate is the most important management variable affecting productivity and stability in rangelands. It is therefore worth discussing the bearing of different production objectives on optimum stocking rates, and what the constraints are in implementing any such strategies. Behnke identifies six criteria that could be used to identify different optimum stocking rates on the basis of producer objectives. These are, in order of increasing animal density:

- '*Maximum nutrition*': This is the stocking rate at which feed availability first becomes a constraint, and up to which individual animal performance is optimised. Total production of the whole area is lower than at more heavily stocked rangelands, and stocking at this level only makes economic sense when the value of individual animals is very high, for example, in stud breeding.
- '*Maximum profit*': This is the stocking rate at which the margin of total income from production over total production costs is maximised. This is the most advantageous stocking rate for a commercial producer; the precise location of the commercial optimum is sensitive to changing cost levels and output prices.
- '*Maximum yield*': This marks the density at which total production per unit area is maximised. This is the optimum stocking rate in a system where production costs (of land and inputs into animal production) are low or non-existent, and it is argued that this is the stocking density which is most consistent with communal farmers' production objectives.
- '*Open access equilibrium*': This is the stocking rate at which the number of independent operators in an area is maximised. Stocking densities at this level are possible when access is not limited to certain land users. This 'open access equilibrium' can occur at high livestock densities which depress yields and is not a desirable stocking target for any group of producers except the very poor. In extreme cases, it approaches the 'ecological carrying capacity' (see below).
- '*Ecological carrying capacity*': This marks the limits of what is biologically possible; at this density, births equal deaths, and net production is zero.
- *Exceeding ecological carrying capacity*: This may occur temporarily, for instance when a new herbivore species is released in a favourable habitat, and is by definition unsustainable.

In the communal areas of Hewu, and the way Gallawater A is managed at present, stocking rates approach the open access equilibrium or even the ecological carrying capacity. While this may be affordable to people who are not paying for the use of their resource, the optimum strategy in Gallawater A depends on the investment farmers make in the farm. This is not easy to calculate, as the investments made (including money, labour, risk and the sacrifice made by leaving their old homes) and benefits derived (including cultivation, the use of other natural resources and non-material benefits) from Gallawater A are not measured simply in terms of animal production. However, unlike communal farmers living in Zweledinga, Gallawater A shareholders need to cover expenses such as the purchase and maintenance of the farm, paying for electricity and water and the planned purchase of farming equipment. Thus ‘maximum yield’ or ‘maximum profit’ would be more suitable stocking rates to aim for.

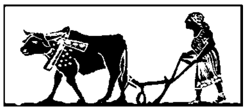
Many farmers on Gallawater A had hoped to invest in a farm where they could improve their income from animal production, but this is difficult to achieve at very high stocking rates because animals reproduce poorly, produce little milk or wool, and are usually too thin to sell. These farmers’ aims are frustrated by the fact that they have no more control over the use of their resources on Gallawater A than they had in Zweledinga.

### Rotational grazing and resting

In a system where animals are left to graze where they want, area-selective grazing results in some areas becoming overgrazed while others are underutilised. The latter areas often become dominated by unpalatable grass species (such as *Cymbopogon plurinodis*) while good forage species (such as *Themeda triandra*) form dense masses of dead grass which is less palatable to livestock. This reduces the grazing potential of these areas and further discourages livestock from grazing there. As animals avoid these areas, pressure on the other grazing areas is increased and can lead to degradation.

Communal farmers are generally reluctant to force their animals to use grazing camps in rotation as they are concerned for the nutritional status of their livestock. Among researchers, the merits of rotational grazing *per se* are still debated, particularly in terms of its benefits for animal performance. Grass usually benefits from rotational grazing, but communal farmers consider themselves to be ‘animal farmers, not grass farmers’. Ensuring a more even use of the grazing resource (by forcing animals to use all camps in the course of the year) would however enhance the overall productive potential of the farm and probably improve the nutrition of animals in the longer term.

There are several areas in the former homeland areas which have maintained a simple rotational resting system based on the grazing camps established during betterment planning. This was found in some villages around Alice (Goqwana 1998), where rotational resting had led to a more even use of the resource, less variability in veld condition and an overall higher grazing capacity. In different villages in the Herschel District, where severe land degradation has led to losses in productivity and an increased need for expensive inputs to keep livestock (Vetter & Bond 1999), farmers are trying to implement rotational resting to maintain a forage reserve and to improve the condition of grazing areas. This is based on the traditional grazing system where, under the chief’s authority, beacons were placed around croplands and different grazing areas which had to be spared the whole summer to provide a grazing resource in winter.

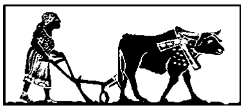


Traditionally, communal livestock farmers in Africa have buffered themselves against drought risks by being mobile, thus being able to access resources in other areas if necessary. Gallawater A is a small farm and access to surrounding areas (particularly the neighbouring commercial farms) is severely restricted. Closing certain grazing camps, for a year or a season at a time, provides farmers with a forage reserve for drought years, which is important given the variable and dry climate in the region. Periodic resting also allows grass to recover its stored resources (which are needed to survive and regrow after dry periods) and set seed. Many communal livestock farmers understand these processes, and several farmers on Gallawater A said they would like to have a system of periodic resting in place.

### Veld burning

Veld burning is generally considered to be damaging to the grazing resource by communal farmers, on Gallawater A and elsewhere. Apart from the fact that forage which could be eaten by animals is destroyed by fire, farmers also feel that fire kills the grass. In communal areas which border on commercial farms, conflict arises when fire spreads into the neighbouring farm. It is true that frequent fires can damage the grazing resource, especially when fires are started at the end of the dry season and the green grass that sprouts after the fire is grazed immediately.

However, fire can be a useful tool for eliminating unpalatable grasses and bushes and for removing dry, nutrient-poor grass which often accumulates in areas which are seldom grazed. On the high slopes on Gallawater A, the amount of *Cymbopogon plurinodis* which grows there can be reduced by burning the area and grazing it heavily as soon as the grass regrows. *Cymbopogon* is palatable to livestock when it is still young, and species such as *Themeda triandra* will outcompete it as they are more tolerant of grazing. Because of the risk of the fire spreading out of control, veld burning should not be done when it is hot or windy, and it should preferably be done with the consent of the neighbouring farmer and with the help of extension officers. Enough people from Gallawater A should be available during burning to control the fire.



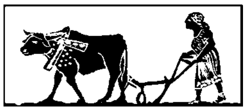
## Management recommendations

Based on our experiences on Gallawater A and in other communal areas, we feel that a simple management regime, based on rotational resting and the use of grazing camps, is needed and appropriate for Gallawater A. We recommend that two camps of the farm should be rested every year to allow these camps to recover and reseed. This is especially important for the low-lying areas which are very heavily used and are already showing signs of degradation. The rested camps would also serve as an emergency grazing resource in drought years. The rest of the farm should be used in such a way that animals are kept from straying into cultivated areas. Animals should preferably graze the high grazing camps in summer, when the forage there is in palatable condition and they are far away from the cropping areas, giving the low lying areas a chance to grow during the summer rains. The lower areas could then be used in winter when the grasses in the mountainous areas lose their nutrient content.

In the interest of improved animal production, it would be ideal to adjust stocking rates to a level that allows for good animal nutrition ('maximum yield' or 'maximum profit') rather than the ecological carrying capacity. It is, however, as difficult to decide on the ideal stocking rate as it is to enforce it. This is illustrated by the huge variation between the grazing capacities calculated from the vegetation data, those recommended by the Department of Agriculture and Prof. Antrobus, and the actual stocking rates found on Gallawater A, in Zweledinga and surrounding areas. If a veld resting system were implemented, the overall livestock numbers would automatically be reduced as the total area available for grazing is smaller than if no camps were closed. We therefore feel that implementing a resting system would be the most appropriate way in the communal system to improve animal nutrition and reduce the risk of degradation.

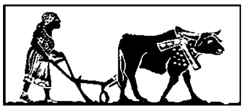
Marketing opportunities for livestock and livestock products can increase household income and provide an economic incentive to make the livestock production system more output-oriented, which in turn is an incentive to manage the grazing resource to ensure good animal nutrition. In Herschel, for example, a wool marketing system was developed over the last 10 years with the help of the Environment and Development Agency (EDA), an NGO working in the area. In this system, sheep are shorn and the wool is sorted and marketed communally (through the commercial marketing system rather than selling it as 'Transkei wool' which fetches a fraction of the price), but each farmer receives payment for his or her own wool. This enables even people with a few sheep to access the marketing system and make an income from wool. The wool marketing system is run by the Herschel Farmers' Union, which represents farmers from all parts of the district. Access to such a marketing opportunity has resulted in increased inputs into farming and a renewed interest in veld management in Herschel.

The idea of some Gallawater A farmers that there should be a committee in charge of making grazing management decisions is a good one, provided such a committee gets the support of the farming community, particularly its more powerful members. The grazing management committee could also access help from extension services, co-ordinate marketing, keep livestock records, organise veterinary medicines and dipping, and decide on interventions such as burning. Of course, any management system can only be implemented if farmers agree that they want it and that it would be useful for them. This depends on their objectives and opportunities, as well as on how effective and trustworthy the institutions in charge of farm management are. Information on different management options and their effects, extension services to help design and implement a management system, and a sound institutional framework in the Gallawater Trust are prerequisites for this. Unfortunately, these seem to be largely lacking at present.



# 10. Economic sustainability of land reform projects

It is not clear – from the side of the authorities in charge of land reform or from the side of the farmers who bought shares in Gallawater A – whether the purchase of Gallawater A farm was aimed at enabling people from Zweledinga to make a living from farming, or whether it was simply a way of expanding residential areas with some surrounding commonage so that residents can keep some livestock.



The previous owner of Gallawater A used to rent an additional 1 000ha of farmland (Gallawater B farm) to have enough land for a sustainable commercial farming enterprise. The 900ha Gallawater A farm does not provide 102 households with the opportunity to be agriculturally self-sufficient. With some resource management and improved marketing opportunities, Gallawater A residents have the possibility of supplementing their income from the farm with the consumption and sale of crop and livestock products. However, if the farm is managed the way it is at present, the contribution farming can make to livelihoods on Gallawater A will not be very different from Zweledinga in the medium to long term. People living in the former homelands of South Africa have long been dependent on migrant labour to make a living as the homelands were, from their inception under the 1913 Land Act, known to be too small and densely populated to be economically self-sufficient. The system was summed up by South Africa's Native Affairs Department in 1943:

South African policy has been to give the native a little land, not sufficient to make him independent of the labour market but sufficient to enable wages to be fixed on the assumption that the native's earnings are augmented by what he gets from the land.

If land reform projects are aimed at improving farming opportunities rather than simply extending residential areas, there should be fewer shareholders per farm. The way Gallawater A is managed and organised, people have as little control over the use of their resources as they did in the areas they left behind. The fact that there are as many people per unit of land on Gallawater A as there are in Zweledinga means that average livestock holdings per household will be the same in both places, which is too low to fulfil even the basic requirements of all but a few of the wealthier households. The economic returns from farming per household are in most cases too low to motivate farmers to invest in the purchase or maintenance of farming infrastructure. This has already led to the deterioration of fencing and water provision, which is frustrating to those farmers who saw buying the farm as an opportunity to improve their agricultural production.

If land reform is to benefit the poor, there must be more attention to equity. On

Gallawater A, livestock holdings are highly skewed, decision-making power is not equally shared, and access to resources such as electricity and water is not equitable, despite the fact that everyone has to contribute equally to the purchase and maintenance of the farm. There are several farmers who feel they are not benefiting from having invested in Gallawater A, and some even feel they would have been better off in Zweledinga.

There is clearly a lack of communication between government and land users, as well as among the land users themselves, about the aims of land reform, the objectives and expectations of the people buying the farm and the responsibilities of the different parties concerned. While farmers have received substantial support towards the purchase of the farm, there has been little or no input from government towards the running of the farm. Farmers have until now been unable to purchase farming equipment, and they are expecting a grant or loan to do this because no one has sufficient financial resources. There seems to be little or no access to extension and veterinary services. Most Gallawater A shareholders seem to be under the impression that the maintenance of roads, the repair of water pipes, pumps and dams and similar services are the government's responsibility. In future land reform projects, it should be made clear at the outset what the responsibilities and resources of the government and the farmers are so that farmers can make an informed decision when committing themselves to purchasing a share in a farm.

## Notes

1 Botany Department, University of Cape Town

2 Department of Livestock and Pasture Science, University of Fort Hare

3 large stock units.

4 Rhodes University, South Africa.

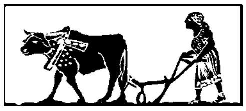
5 Unless otherwise stated, animal number were converted to large stock units (LSU) using the following relationships:
Cattle: 1.1LSU.
Sheep: 0.14LSU.
Goats: 0.17LSU.
Stocking rates are expressed in LSU/ha rather than the commonly used ha/LSU, as the former increases with increasing stocking density and is thus conceptually clearer.

6. District-level data on stocking rates and recommended carrying capacities from data sets that were compiled for the nationwide degradation audit (Hoffman et al. 1999). They were made available to us by Timm Hoffman (National Botanical Institute, Cape Town).

7. Statistics South Africa, 1996. Census South Africa: Community profile database.

8. Note that GC is expressed in ha/LSU, that is, a higher value indicates that fewer animals can be supported per hectare.

9. Bigger bars indicate higher values of VCS, GC and PTD. Note that grazing capacity in this figure is expressed in LSU/ha and higher values thus indicate more animals per hectare. In the geology plot, D denotes dolerite, S = sandstone and A = alluvium.



10. NAD commentary for JH Hofmeyr [acting Prime Minister] on memo from H. Basner dated 19.11.43, cited in Potts (1999).

11. About 400 LSU are presently kept on Gallawater A, and this is approaching or even exceeding the long-term carrying capacity of the farm. With 102 households sharing the farm, every household has on average just under 4LSU. According to Bembridge (1979), 10 head of cattle (11LSU) are considered to be the minimum number necessary to fulfil subsistence and socio-cultural needs before and secondary income can be generated. Some researchers maintain that as many as 18 head of cattle are necessary to fulfil primary needs (Tapson & Rose 1984).

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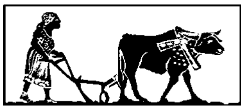


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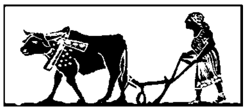

Research Report No. 5
Volume 2

# Section two:

# Land use management, sustainability and environmental impact of cropping in a Land Reform Pilot Project: A case study of Gallawater A farm, Eastern Cape

Joseph Bobo and Alan Marsh

Tikologo Trust[1]

Programme for Land and Agrarian Studies

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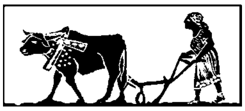
# Section two contents





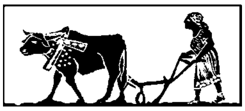
# 1. Background

The White Paper on Land Policy specifies the need for incorporating environmental concerns into project planning, recognises the need for involving beneficiary communities in identifying environmental concerns and acknowledges that inappropriate norms have often been imposed by officials (Department of Land Affairs 1997). The land policy does not, however, clearly prioritise objectives and there is the potentially contradictory requirement to fast track land delivery while simultaneously undertaking the invariably slow process of participatory planning for sustainability.

In reality there has been relatively little participatory planning for post-transfer land use in land reform and environmental sustainability has not featured overtly in the process nor has it been treated as a priority by the beneficiaries and the government agencies (Turner et al. 1997). In consequence, any attempt to enhance the environmental sustainability of a land reform process is largely a reactive process that is invariably compromised by existing settlement size, composition and locality, by existing land use practices and by the beneficiary selection criteria applied (or lack thereof).

Resettlement for a community may have significant negative socio-economic impacts resulting in reduced income opportunities. In the worst case scenario, poorly planned and implemented land reform could condemn beneficiaries to a situation where they have lower living standards and livelihood opportunities than they had as migrant labourers. In short, there exists the very real danger that land reform projects become poverty traps unless careful and appropriate planning, implementation and follow up have taken place (Turner et al. 1997).

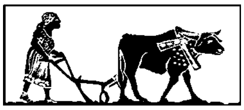
There is a great deal of speculation about how former, privately-owned commercial farms can be communally managed to significantly improve the livelihoods of the beneficaries in the short and the long term. Debate ranges over issues such as management capacity, appropriateness of existing infrastructure, availability of credit, resource opportunities and constraints, marketing of produce, the merits of subsistence versus commercial production, mixed farming-multiple livelihood strategies versus specialist production systems, polyculture versus monoculture, animal versus machine traction and orthodox tillage versus minimal-tillage approaches. The degree of environmental sustainability of the system of land use management that is adopted will play a major role in determining the long term success of the land reform programme.



Under the land reform programme, the 905ha farm Gallawater A became the property of 102 beneficaries who primarily were, and in some cases remain, residents of Zweledinga. Gallawater A is located within the Klipplaat River valley approximately 5km from Whittlesea. This case study presents an opportunity to explore some of the land reform issues mentioned above, to gain insights into the problems encountered, and to identify some possible solutions.

In many respects it is too early to enable a detailed investigation of land use management practices of the beneficiaries. In fact, the approach of the beneficiaries towards management of the land is still emerging but it clearly involves both livestock and crop production. The focus of this report is on crop production, including existing practices, planned practices and the environmental implications of these practices.

This study is intended as a technical component that supports the Programme for Land and Agrarian Studies, School of Government, University of the Western Cape's more comprehensive research project documented in the report *Land reform, sustainable rural livelihoods and gender relations: A case study of Gallawater A farm.* The focus of the study has been on the environmental sustainability of existing and planned cropping practices. Environment is a broad concept and where appropriate social and economic issues as well as the traditional 'green' biophysical issues have been considered.



# 2. Approach

## A number of issues were investigated.

### Natural resource and climatic constraints and opportunities on Gallawater A

The most important natural resource and climatic constraints are the physical and chemical properties of soils, locality of arable soils in relation to water sources, homesteads and natural fertilisers (manure, ash and so on), precipitation and temperature regime.

Climatic data was obtained from the Agricultural Research Council's Institute for Soil, Climate and Water in Stutterheim. As there are no meteorological records for Gallawater, data was obtained from neighbouring meteorological stations. Gallawater A is situated approximately 6km north of the Waterdown Dam meteorological station and 6km south of the Whittlesea Police Station meteorological station. The Waterdown Dam meteorological station has been operating since July 1954, that is, for the past 35 years and a 28 year set of data exists for the Whittlesea Police Station, although these records contain many interruptions; only 15 years being uninterrupted. The most reliable and longest set of data are from Queenstown, located approximately 40km to the north east. Queenstown records extend from January 1900 to March 1999, a span of 98 years.

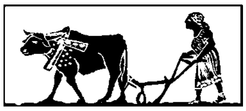
Soil fertility tests were carried out by Dohne Analytical Services at the Dohne Agricultural Research Centre, Stutterheim. Two soil samples were collected from each of the two irrigation fields and the dryland cropping area and submitted for analysis. Sample sites were selected randomly and each sample comprised a mixture of soil taken from four positions within a radius of 10m. All soil samples were taken from the top 15cm of soil. The concentration of critical nutrients, especially phosphate, potassium, calcium and magnesium, and soil pH were determined. The recommended fertiliser treatment to support the commercial production of a variety of crops, ranging from fodder, grains and vegetables, is the end product of the fertility tests.

### Irrigation infrastructure constraints and opportunities

The state of existing irrigation infrastructure was assessed and two irrigation options, including cost estimates, were developed by Border Irrigation Pty Ltd.

### Farmer support constraints and opportunities

Interviews with the Agricultural Extension Service staff at Whittlesea and other experts were used to gauge the level and nature of farmer support available in the area.



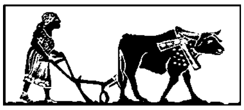
### Local knowledge, understanding and practices

Interviews with practising beneficiary farmers at Gallawater A were used to establish the level of farmer understanding about crop farming in a dryland and irrigation situation, what farmers were currently doing and what they were planning to do in the future. Interviews were held with six beneficiaries (practising farmers) and the Gallawater A Development Committee.

### Existing environmental status of crop lands including likely environmental impacts of existing and planned cropping practices and mitigatory measures to minimise negative environmental impacts

Site inspections were used to gauge the extent to which crop lands had been degraded through, for example, soil erosion, salinisation from poor irrigation practices etc. Discussions with farmers concerning their use of agro-chemicals (fertilisers, pesticides and so on) were used to gauge likely pollution impacts.

The above information was supplemented by interviews with a neighbouring commercial farmer, agricultural researchers, agriculture, water affairs and meteorological officials and reviewing the literature.



# 3. Results and discussions

## Climate

The most significant climatic determinants of agricultural potential are rainfall and temperature (especially frost conditions). In this particular region, strong winds and hail can also limit production potential.

### Rainfall patterns

Examination of the three data sets (Waterdown Dam, Whittlesea and Queenstown) indicates that rainfall is spatially and temporally highly variable. Although it is reasonable to expect the local climatic conditions at Gallawater A to be similar to those from surrounding areas, unique features on the property, for example mountains, will invariably produce some modifications from the patterns recorded at the nearby meteorological stations.

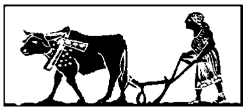
### Temporal variability in rainfall

At any given site, cumulative annual totals of rainfall vary enormously from year to year. Thus, at Queenstown, the minimum annual rainfall on record is 296.7mm (1904) whereas the highest on record is 791.6mm (1985); rainfall totals differing by a factor of 2.7. At Waterdown Dam, rainfall was more variable, going from a low of 168.3mm (1992) to a high of 815.6mm (1974), that is, differing by a factor of 4.8. Corresponding information from Whittlesea reveals even greater variability going from a low of 130.4mm (1980) to a high of 1 326.7mm (1982), that is, a ten-fold difference. The 1982 and 1983 (1 219.9mm) rainfall figures for Whittlesea are out of character with the rest of the data set bringing their reliability into question, especially in view of the fact that for the same years, the nearby Waterdown station recorded fairly modest values, 524.0mm and 409.4mm, and Queenstown recorded corresponding values of 498.5mm and 399.8mm. Nevertheless, even if these unusual Whittlesea (1982/83) values are disregarded, rainfall varies from 130.4mm (1980) to 692.6mm (1976), that is, by a factor of 5.3. Thus, one conservative conclusion is that, for all sites, rainfall varies dramatically through time.

### Seasonality and drought

Superimposed on this variability is a degree of rainfall seasonality. Although rainfall can occur in any month of the year, May, June and July tend to be the driest months and the wettest months typically occur during the summer. Summer rainfall, in particular, is normally in the form of high energy thundershowers in which runoff and concomitant soil erosion is frequently high as opposed to the more gentler rainfall events of the other months when infiltration is relatively high.

Drought is normal in this region. Although rain can fall in all months of the year, there are periods when rain may not fall for several consecutive months. For example, in 1980 Whittlesea experienced a seven month rain-free period. Waterdown Dam recorded rain-free periods that covered two consecutive months in both 1991 and 1998 and Queenstown has records of three month long rain-free periods in the years 1912, 1916 and 1931.



Contrary to commonly held perceptions, there are no discernable trends that support the notion of increasing drought over time. Ten year rainfall averages for Queenstown indicate a relatively stable situation with the 1980s and 1990s being no drier than previous decades. The data also reveal that exceptionally dry years are often bounded by above average, wet years. For example, at Waterdown Dam the values for the three year period 1991–1993 were 584mm, 168.3mm and 592.1mm respectively.

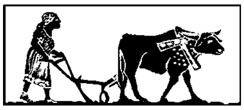
In conclusion, seasonal trends in rainfall exist with winter being relatively dry and summer relatively wet. Other than this, however, there are no obvious patterns or trends to rainfall and it fair is to say that rainfall events, in terms of amount and frequency, are highly unpredictable.

### Spatial variation in rainfall

Rainfall varies considerably on a spatial basis. Thus, in any given year or month, rainfall values vary considerably between the three recording stations.

The data suggest that Gallawater A is situated in an area that receives a more varied and more unpredictable rainfall than Queenstown. This may be due to the proximity of Gallawater A to mountain ranges and especially the Amatola range which intercepts much of the moisture bearing air from the south resulting in orographic rainfall on the southern slopes of the range and a rain shadow across the range in the Gallawater area.

An example of spatial variation can be found by comparing rainfall amounts from all three stations for the 15 years in which complete sets of data exist for all stations. Such a comparison reveals no obvious, consistent patterns; rainfall at each place seeming to be independent of the other places. Thus, while one station may record a high rainfall year, another can simultaneously be recording a low rainfall year, a moderate one or a high one. For example, 1982 was the wettest year at Whittlesea, 1974 the wettest at Waterdown and 1980 the wettest at Queenstown.



The available data are not segregated into daily rainfall totals but incidental observation reveals that spatial variation is very marked at the level of individual rainfall events. Thus it is quite normal for one locality to receive a heavy downpour while the other receives a minor shower or even remains totally dry.

Spatial variations and unpredictability in rainfall are typical in arid and semi-arid climates and spatial variation can be expected to occur on a much finer scale even within the boundaries of a relatively small farm such as Gallawater.

### Frost

Reasonably long-term temperature data could only be obtained for Queenstown. However, in view of the fact that the altitude of Queenstown and Whittlesea are more or less the same (1 099m as opposed to 1 052m) the temperature regime should also be similar at both places. The data indicate that 94.7 per cent of years experience a moderate to severe frost (grass minimum of less than -2.0 degrees) and the average frost season extends for 84 days. A typical year experiences 12 frost days with the first frost expected by the 30 May and the last date for frost being 22 September. 'Unseasonable' early and late frosts do, however, occur. The earliest recorded moderate frost is 29 April and moderate frosts have been recorded as late as 2 October.

### Hail

Detailed records of hail have not been maintained for the area in question although some information exists for

| | P | K | Ca | Mg | pH |
|---|---|---|---|---|---|
| Dryland | 6.5 | 263 | 877 | 397 | 5.9 |
| Dryland | 9.7 | 769 | 976 | 492 | 5.8 |
| NW irrig. | 10.7 | 254 | 1 161 | 457 | 6.0 |
| NW irrig. | 4.8 | 278 | 969 | 423 | 6.0 |
| SW irrig. | 1.9 | 147 | 1 630 | 415 | 5.4 |
| SW irrig. | 0 | 200 | 2 764 | 414 | 6.2 |

**Table 1. Concentrations of critical nutrients (mg/l) and pH of soil from the three arable fields at Gallawater A**
**P = phosphate, K = potassium/potash, Ca = calcium, Mg = magnesium.**

Queenstown. Thunderstorms are sometimes occasionally accompanied by hail and some hail is experienced in most years in the area. For example, on average, Queenstown experiences 3.3 hail events a year. Hail is most likely to be encountered during summer, that is, during the growing season when crops are vulnerable to mechanical damage.

### Wind

The area is subject to particularly strong northerly winds in late winter-early spring. This is the driest time of the year and the winds can be particularly stressful to plants both in terms of mechanical stress and desiccation of soil and plants and can contribute to erosion, especially as crop lands are barren at this time of the year.

### Aridity

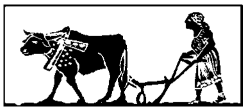
Overall, the region is classified as semi-arid (aridity index of 0.25). The extent of aridity can be gauged by comparing evaporative losses with precipitation. At Queenstown, the average rainfall is 500.4mm per annum whereas the average evaporation is 2 012.4mm per annum, that is, evaporative water losses are approximately four times the gains occurring through rainfall events.

### Cropping implications of the climate of Gallawater A

Highly variable rainfall patterns that are difficult to predict spatially and temporally ensure that the risk of crop failure for dryland schemes is high. This suggests that a strategy to maximise the benefits from dryland cropping would involve:

a) low input management practices, that is, the use of saved seed rather than purchased, certified seed, the minimal use of purchased fertiliser linked to a good, labour-intensive weeding programme which reduces crop competition for both water and soil nutrients, planting crops that do not have very high fertiliser requirements, the use of communally-owned animal traction rather than hiring external tractor services especially for soil preparation
b) a focus on drought-tolerant crops
c) the use of multi-purpose crops, for example, a failure for maize to yield grain is not necessarily a total loss as the residue can still serve as fodder
d) cropping practices that maximise the harvesting and storage of runoff water as free standing water to extend the growing season using irrigation
e) practices that maximise runoff infiltration into the soil, for example, contour ploughing and building earth or rock bunds on contour
f) soil moisture conservation practices, such as weeding and mulching.

From a production perspective, a higher proportion of the summer rain will be ineffective, especially on compacted and denuded range lands, than is the case for winter rains. This is largely because high energy summer rains will be accompanied by a high proportion of runoff. The effectiveness of rainfall on crop fields will depend especially on plant cover, soil structure (especially organic content) and landscape, all highly modifiable through agricultural practices. High runoff from the rangelands could be of benefit to crop production if some of the runoff is channelled onto the crop fields.



The unpredictable nature of rainfall events makes planning difficult in terms of when to plough, sow, weed and so on. A late start to the rainy season can significantly reduce the growing season, especially for long-growing crops, essentially resulting in crop failure or reduced production.

Furthermore, the high evaporation rate in relation to rainfall considerably reduces the availability of soil moisture to support plant production. This in turn may reduce the length of growing season.

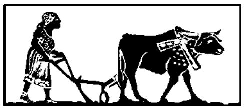
Although the timing and severity of hail events are not known and therefore the potential risks for cropping cannot be reliably estimated, hail storms are bound to occasionally wreak havoc with crop yields. Nevertheless, the relatively low frequency of hail storms is insufficient to justify the use of expensive crop protection methods.

Late and early frosts are likely to be encountered and this can reduce the growing season for frost-sensitive crops and certainly will increase the risk of crop failures for such crops. Crops that require a long frost-free growing period, such as sweet potatoes may be too risky to grow at Gallawater A.

## Soils

### Physical characteristics

A fairly detailed soil survey of the physical properties of the soil of the arable land on Gallawater was conducted in 1994 as part of the planning process for the current beneficiaries (Fenn 1994). The study focused on those physical characteristics that influence irrigation potential such as soil depth, texture, drainage, stone or gravel content, slope and erosion status. The study indicated that of the 60ha surveyed there are 39ha of highly suitable soils and 17.9ha of moderately suitable soils. Only 2.1ha were regarded as not suitable at all. The physical characteristics of soils suitable to dryland agriculture will not differ substantially from irrigable soils. Thus, Gallawater is endowed with a reasonable abundance of soils that have high cropping potential in terms of their physical characteristics.



The majority of good soils do, however, have a higher than optimum clay content which will reduce water infiltration, increase evaporative water losses and be difficult to cultivate when wet (Fenn 1994). This is not regarded as a major problem provided sound irrigation management practices are followed.

22.5ha of land in the north western corner of the property below the ley dams, are regarded as having a high commercial irrigation potential (Annexure 1). That is to say the potential benefits from cash cropping would, under good management, exceed the costs of establishing and maintaining an appropriate irrigation scheme after a realistic period of time. An appropriate irrigation system would involve pumping water either directly from the river or from the furrow fed ley dams via a permaset grid of hydromatic valves to sprinklers situated on draglines (Annexure 1).

A further 3ha, that is, the field situated close to the river in the south western corner of the farm, could possibly be put under flood irrigation using water directly from the furrow. The distance of these lands from the nearest electrical outlet mitigates against them being irrigated via a high-pressure sprinkler system. It should be noted, however, that the soils of Gallawater A are not ideally suited to flood irrigation owing to inappropriate gradients and soil type. The soils next to the river are too sandy and the higher areas are too steep and lack the necessary expansive clays. These factors make it impossible to apply water to the lands uniformly using flood irrigation, some areas will receive far too much water and others insufficient. Even on the Fish River, where the soils and gradient are relatively good and well suited to flood irrigation, motivated commercial farmers are achieving at best a 30 per cent variation in water coverage across their fields (B How, personal communication). A further factor that mitigates against flood irrigation is expense. Appropriate landscaping will cost approximately R2 000.00/ha (B How, personal communication) and it is doubtful that the highly variable production that would ensue would justify this cost.

### Chemical characteristics

Given good physical characteristics and adequate water, the fertility of the soil is dependent upon the chemical composition of the soils, the type of crop to be grown and the desired yield. Table 1 presents the results of fertility tests for the arable lands at Gallawater.

It should be understood that the results of the fertility tests are based on a small sample size and that they are, therefore, merely indicative of their suitability and fertiliser treatment required. Ideally, before any major cropping takes place, more comprehensive soil sampling and fertility tests should be conducted.

In general, all the soils were extremely low in phosphate. The irrigation fields in the south west have the lowest phosphate values recorded, the irrigation fields in the north west, below the ley dams and the dryland fields are both somewhat higher but nevertheless (from an agricultural perspective) very low. Phosphate is thus the most limiting factor in terms of soil fertility.

The other nutrient levels are, generally speaking, within the normal tolerance range of most crops and should not constitute any significant barrier to plant production. Likewise, soil pH is within the normal range for most crop plants.

Nitrogen levels were not determined because they are inherently unstable and dissipate rapidly. Nevertheless, nitrogen is, for most crops, one of the major limiting factors and substantial amounts must be added regularly to sustain crop production.

#### Implications for crop production at Gallawater A

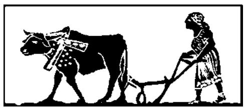
No matter what crops are grown, whether under irrigation or dryland schemes, some phosphate will have to be added to the soil in order to obtain anything more than a very low yield. Initially, fairly large amounts of phosphate, in the form of super-phosphate and/or rock phosphate and/or bone meal will be needed. In subsequent years, regular but lower additions of phosphate will be required. For example, the recommended amount of phosphate that needs to be added to support commercial dryland maize production is 120kg/ha whereas most vegetables will require 200-241kg/ha. Crops with lower requirements include dry beans (24–82 kg/ha), sunflower (20–79 kg/ha and winter wheat (20–64 kg/ha).

With the exception of nitrogen fixing crops such as lucerne and cow peas, nitrogen will have to be added to the soil to guarantee reasonable yields. Indeed, for many crops, for example, maize and sunflowers, provided there is adequate water and other plant nutrients, yield is directly proportional to the amount of nitrogen in the soil. Nitrogen needs to be added every year. Kraal manure is a reasonable source of nitrogen, although the amount of nitrogen in kraal manure can vary quite substantially. Kraal manure is thus especially useful if the crops are largely being produced for subsistence purposes where a low-input approach is adopted. The recommended nitrogen additions for Gallawater A soils for commercial production include: maize (45–120kg/ha), potato (175kg/ha), cabbage (200kg/ha) and most vegetables (50–150kg/ha).

The level and type of fertiliser regime followed will to a large extent be dictated to by the rationale of cropping. If the rationale is largely for commercial production, where relatively predictable quantities of crop need to be produced to serve a specific market, a higher input and more predictable fertiliser regime may be justifiable. To minimise the risks of crop failure and hence financial losses from the high input approach, a secure and predictable water supply is essential, that is, commercial cropping that uses high input fertiliser regimes should ideally be based on irrigation fields.

If the main rationale for cropping is for subsistence purposes it would be prudent to adopt a low-input fertiliser regime that is based primarily on the use of local resources, especially kraal manure.

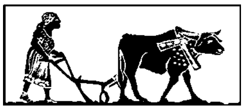
## Farm layout



In terms of improving the livelihoods of beneficiaries through agricultural production, the location of the settlement area in relation to dryland and irrigation fields is unfortunate. No farmers live close to their fields and this results in reduced vigilance and hence crop losses to theft and mammalian pests such as porcupine and baboon. The layout also reduces farmer time, energy and motivation for working the lands. A low-input cropping system that is probably most suited to impoverished farmers, can give relatively high yields provided the low inputs of fertiliser and herbicides are compensated for by a regular and effective weeding programme. This practice, however, requires dedicated and enthusiastic farmers who are able and prepared to devote the necessary time and effort to weeding. Unfortunately, the fragmentation of crop lands (farmers currently having access to small fields in two separate areas on the farm and in the future destined to having three such fields) and the spatial separation of the fields from the settlement area significantly reduces the prospects for land care. The farm layout divides farmer time and energy between three fields, each with different management requirements, and to commuting between them on foot.

A Gallawater A planning document (Fenn 1994), pointed out much of the above limitations of farm and settlement layout and, on production grounds, advocated a situation in which farmers were settled on their own fields. Similar sentiments have been expressed for agricultural production here and elsewhere in the world (Bernstein 1992; Wildschut & Hulbert 1998).

The planning document also noted that the beneficiaries needed to be the final decision makers in terms of layout. It is unclear, however, to what extent the planning document was used to guide settlement planning. The current study revealed that not all beneficiaries were involved in the original planning of the farm layout and especially in the designation of settlement sites. In particular, it is of concern that the most progressive farmers that were identified in the current study had not been involved in the planning process. Furthermore, it is noteworthy that none of these relatively progressive farmers agreed with the layout chosen. All were aware that the existing layout mitigated against crop production. At the risk of sounding paternalistic, it is also possible that many beneficiaries will lack the necessary experience to make informed choices of settlement pattern. The one selected closely resembles the 'betterment planning' design of the apartheid regime which is probably the only design that the beneficiaries had previously experienced and hence were predisposed to selecting this rather than going for an unknown option.



## Irrigation infrastructure

### Weir and furrow system

In the past, the farm was irrigated with water from the Klipplaat River via a weir and a 9km long furrow that delivered water into ley dams from which water was delivered under pressure via metal pipes onto 15ha in the north western corner below the dams and by flood irrigating 3ha of lands on the south western border of the farm. Much of the furrow is located upstream of Gallawater A. In general, the predominantly earth-lined furrow is in good condition. Where appropriate the furrow has been lined with bricks and plaster. Several well-designed aquaducts cross ephemeral water courses and the most impressive section traverses a rocky cliff face. For much of its length, the furrow supports a linear stand of trees on either side of it; primarily indigenous trees, especially *Acacia spp* and *Ziziphus mucranata* (Buffalo thorn) but also scattered peach trees and a grove of poplars.

Since ownership has shifted from a single commercial farmer to the land reform beneficiaries, the water carrier scheme has fallen into disuse. Infrequent maintenance has resulted in unrepaired breaches and water has not been delivered into the ley dams for several years although it has reached the 3ha flood irrigation fields on the south western boundary of the farm in the recent past. Beneficiaries are aware of the breaches and have partially implemented plans to repair these using mortar and rock. The beneficiaries have apparently jointly purchased the estimated 27 pockets of cement required, used 20 pockets in partial repair, but in the meanwhile lent seven pockets to one of their members who has failed to replace the cement. The absence of the last seven pockets is the reason given for the work remaining incomplete.

In consequence of the reduced functioning of the furrow, many of the trees that line it have recently died. A further consequence of the inadequate supply of water is that the ley dams have developed leaks. If the system is managed in such a way that the dams are not allowed to dry out for extended periods, the leaks should disappear and hopefully not recur. Restoration of the water carrier system will not be technically very difficult nor expensive. A concerted effort will be necessary to clear dead wood from the furrow, remove very modest blockages of silt and repair the existing breaches. Maintenance requirements thereafter should not be too high. The most important input to secure regular flowing water is vigilance and an ability to anticipate problems or at least a willingness to react promptly when problems emerge. Thus, the most important management element required is that of organisation.

### Local runoff water harvesting system

The farm contains a dam designed to capture local runoff and this was used to irrigate some lands in the past. At best, this system could be used to supplement rainfall for essentially dryland cropping. The size of dam and catchment and rainfall patterns ensure that there will be considerable variability in the volume of water trapped. This in turn mitigates against this being sufficiently reliable for the irrigation of high-value crops.

### Plans and costs of establishing a commercially viable irrigation scheme

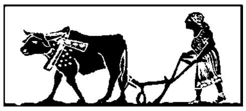
Two possible irrigation schemes could be viable on Gallawater A (Annexure 1). The designs take into account the properties of the soil, their elevation and slope and the proximity of the Klipplaat River, the furrow, ley dams and power points. As mentioned elsewhere, 22.5ha could be put under irrigation either by pumping directly from the river or by pumping from the ley dams. Both schemes would utilise an electric pump and a permaset grid of hydromatic valves that are linked to sprinklers via draglines.

The direct river pumping option involves a capital outlay of R111 060 (excluding value-added tax) and an annual operating cost of R8 900 (excluding VAT).

The canal-ley dam option would require a smaller pump and lower electricity costs; capital costs of establishment being R92 000 (excluding VAT) and running costs of R5 900 (excluding VAT). This option assumes that the canal is repaired and maintained but does not include the costs for this work. The prices given are cost estimates only, based on 1999 values and not an actual quote. All information is stored on the Border Irrigation data base, making future quotations and scheme modifications very easy.

On economic grounds, the choice between the options depends upon the cost of canal repair and maintenance. Border Irrigation was of the opinion that direct river pumping would be the first choice. This, however, was based on the perception that the canal was in bad repair. Subsequent reconnaissance has shown that the canal is in reasonably good condition and Mr How of Border Irrigation indicated that, under those circumstances, he would favour pumping from the canal-ley dam system. Such a decision rests on the assumption that the beneficiaries concerned are willing and sufficiently organised to undertake the required regular inspection and repair of the canal. It also assumes that upstream dwellers do not deliberately sabotage the water carrier and that they allow Gallawater A residents unhindered access to the canal (as they are required by law to do).

The capital and recurrent costs incurred for an irrigation scheme mean that the beneficiaries will have to shift from their current uneconomic and largely subsistence cropping practices to viable commercial production. Without such a shift, it would be impossible to justify the costs of re-establishing an irrigation scheme of the magnitude envisaged.



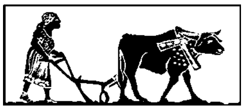
An alternative lower cost option would be to use the canal-ley dams in a flood irrigation scheme. Without adequate landscaping, however, this would be a highly inefficient scheme. Landscaping the 22.5ha would cost approximately R45 000. Thereafter recurrent costs would be low, no pumping and hence power would be required. Such a scheme may be more appropriate given the current level of beneficiary understanding, skill and aspiration. Certainly the demands for offsetting input costs with outputs would be lower. One possibility would be to develop the lands for flood irrigation as an intermediate step. Later, if and when, the beneficiaries are able to manage the operation on more commercial grounds, the scheme could be upgraded according to the designs mentioned above. Such a phased approach would be more costly as landscaping for sprinkler irrigation is not necessary.

As pointed out previously, however, the soils are not ideal for flood irrigation and yields would be much more variable than is possible under a sprinkler system.

## Management practices

Beneficiary farmers are practising traditional subsistence agriculture, namely the summer production of an intercrop of maize, beans, pumpkins and melons. Farmers had used the same crops on both their dryland fields and the south western irrigation fields. Most farmers claimed that they were primarily growing crops to sell but in reality it seemed that they consumed most of their produce and would only sell if they had a surplus above their own needs.

A major problem with the current setup is the apparent attempt to spread highly variable resources equitably. Thus, each farmer is granted access to a small portion of both irrigation fields, the dryland area and the settlement area. Each has been endeavouring to produce the same crops on each type of land irrespective of its suitability. Thus, all arable land is treated in the same way and for the same purpose. In this system, farmers are unable to adopt a fine-tuned management approach.



Only one farmer was doing anything to enhance the structure of the soil and improve upon its natural fertility via manuring (see following paragraph). No one was practising green manuring or mulching. Indeed none of the interviewees seemed to be aware that such practices were desirable for ensuring sustainable production.

Only one interviewee deliberately added fertiliser to the soil in order to enhance crop production. This was done within the settlement on the ground adjacent to her home. This progressive farmer kraaled goats at her home and then used the manure on a small fenced-off garden adjacent to the kraal. She was also the only farmer who had deliberately planted some peach trees within her home garden and was using chicken manure as fertiliser for these trees. She had not used kraal manure on her allotments in the dryland or irrigation lands because of the logistical problems of transporting the manure.

Most interviewees were unaware that kraal manure could be used on their fields to enhance fertility and hence crop yields. There was a widespread perception that kraal manure would invariably damage crop plants. Only one farmer distinguished between old manure and fresh manure. No one was aware that if fresh manure was suitably mixed into the soil that it would no longer 'burn' the plants.

No farmers were using purchased fertilisers on their fields.

Some farmers used pesticides to control perceived insect pests. The pesticides were purchased in small amounts and applied directly to the affected plants. Farmers did not appear to discriminate between different insects; regarding all insects as pests and hence applying pesticides indiscriminately. None of the interviewees knew the name of the pesticide they had used the season before and apparently take whatever they can afford and are available from Whittlesea and Queenstown outlets.

One farmer deliberately added old wood ash to the soil surrounding specific plants in order to reduce cutworm damage.

No farmers practised crop rotation or left any land fallow. The traditional polyculture cropping means that crop rotation as a means of maintaining soil fertility and controlling pests and disease organisms is not as important a practice as would be the case in an orthodox commercial monocropping practice. Similarly, fallow periods are probably not as crucial in a traditional cropping system.

No one has adopted water conservative practices in terms of soil dressing and treatment, landscaping and crop selection.

Spacing of plants varied but most tended to have too high a density of maize, resulting in high levels of competition for scarce water and soil nutrients, stunted plants and low yields.

Based on the above it seems fair to conclude that the level of local knowledge and understanding of crop production in general is at a very basic and low level amongst the beneficiary members. At best only one or two farmers seem to be the custodians of a significant amount of reasonably important knowledge that if more widely spread and practised would significantly improve the lot of other beneficiaries. Certainly, in relation to other Southern African cultures where crop production plays an important role in supporting rural communities, the Gallawater A community has very poor cropping knowledge, understanding and practices. Furthermore, the prospects of useful local knowledge and practices being spread more widely through the community are diminished by the fact that the most innovative farmer is a woman and hence has a low status in the community.

## Cost/benefit analysis

The beneficiaries interviewed did not appear to perform any overt cost/benefit analysis of their farming activities. In general, they did not appear to be aware of the ratio of inputs to outputs and whether this was favourable or not. All expressed reasonable satisfaction with the yields they had obtained and felt that their yields were entirely dependent on rainfall and hence out of their control. To get an indication of farming performance, an attempt was made to quantify inputs and outputs of one of the most successful male farmers interviewed. Although monetary values and quantities for certain inputs and outputs were not possible to gather, the table that follows gives an indication of the inputs and outputs of this farmer for the 1998/99 growing season.

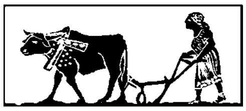
Based on those elements for which economic values could be assigned, this farmer's activities were reasonably profitable. Furthermore, the analysis is conservative. If a value was placed on the green mealies harvested before the end of the growing season, and on the pumpkins, melons and crop residue (used as fodder) produced and provided the farmers own labour costs are ignored, the benefits would have outweighed the costs by an even greater margin. Unfortunately, with current practices, especially the non-addition of fertiliser to the fields, given the same rainfall regime as the 1998–99 season, subsequent seasons will yield less and profits will decline accordingly.

It should be borne in mind, however, that most of the farmers interviewed achieved substantially less success than the abovementioned farmer. It is thus probably fair to conclude that many farmers at present are only just breaking even or even operating at a loss.

## Demographic considerations

The elderly sector of the beneficiary community is the most productive, providing much of the money through pensions and some food that they grow on the land, that is, livestock and crops. Young adults are not involved with crop production and do not appear to be interested in this work, presumably because they think that the costs outweigh the benefits. Unless younger people become fully involved with agriculture, especially young people who do not have access to other income sources, it is difficult to perceive how the current situation can be seen as a positive long-term development. Likewise, it is difficult to see how good agricultural practices will be sustained.

## Traction

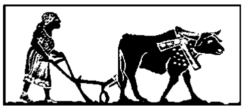


All farmers to date had hired tractor services to plough their fields in preparation for planting. The costs involved, in relation to the outputs obtained, were high and the service unreliable, making planning difficult. Despite the fact that numerous beneficiaries have cattle, there does not appear to be any thinking about using a span of oxen to perform draught functions, especially ploughing but also the transport of manure from kraal to field and of produce from field to settlement and so on. The reasonably low clay content of the soils ensures that fairly modest power outputs would be required to plough the lands, outputs that animal traction could easily meet. Furthermore, it would not be essential to wait for the first soaking rains before fields can be prepared.

## Support environment

Formal farmer support services exist in the form of the local Agricultural Extension Service of the Department of Agriculture, the Mpofu Agriculture Training Centre and the Whittlesea Farmers' Association. In addition, several non-governmental organisations offer agricultural support in the Hewu District, perhaps most notable is the presence of Africa Co-operative Action Trust (ACAT) that offers training courses of potential benefit to Gallawater A beneficiaries. The Animal Traction Unit of the Department of Agriculture at the University of Fort Hare would be able to offer guidance and training to select farmers in animal traction.

It was difficult to ascertain what type of support the Whittlesea Department of Agriculture could offer and whether it would be appropriate. What was clear was that there had been relatively little contact between the Gallawater A community and the agricultural extension officers and what little contact had occurred had created a great deal of mistrust on both sides. There appears to exist some confusion as to whether Gallawater A, which was located outside the boundaries of former Ciskei, should be served from Queenstown or Whittlesea offices. This needs to be clarified before any meaningful extension-farmer relationship can be established.



None of the beneficiaries had attended any crop production courses at Mpofu Agriculture Training Centre. Similarly, the Gallawater Development Committee was not a member of the local Whittlesea Farmers' Association. Benefits of joining the association include collective purchasing to ensure the best prices on agricultural inputs, such as seed. Another benefit would be exposure of Gallawater A farmers to progressive farming initiatives in the Hewu District.

## Primary environmental impacts and mitigatory measures

### Pesticides

*Impact*: Extremely modest amounts are being used by some farmers and these are focused on specific plants and not broadly and indiscriminately dispersed. Thus, ground and surface water contamination and fodder contamination (for example, maize stowe) and food contamination is minimal. Farmer understanding of toxicity and the ability to discriminate between one pesticide and another is, however, very low and hence people and livestock remain at risk.

### Fertilisers

*Impact*: Excessive use of fertiliser can become a major source of surface and ground water pollution. Currently, no fertilisers, commercial or from local sources (manure, ash and so on) are being used and thus there is no impact on water resources. There is a notable buildup of kraal manure at the settlement but this is unlikely to be a serious contaminant of surface or ground water in the area. The lack of use of available kraal manure is, however, severely reducing crop yields which in turn has a negative impact on the socio-economic status of the beneficiaries.

| INPUTS | VALUE (RANDS) | OUTPUTS | VALUE (RANDS) |
|---|---|---|---|
| Tractor hire | 350.00 | 300kg maize | 270.00 |
| Seed | 75.00 | Green mealies | ? |
| Pesticide | 30.00 | 50kg beans | 450.00 |
| Water | 22.00 | x pumpkins | ? |
| Labour | ? | x melons | ? |
| Fertiliser | nil | Crop residue | ? |
| **TOTAL** | **477.00** | | **720.00** |

### Soil erosion

*Impact*: Current farming practices result in the croplands being largely devoid of any vegetation cover (rooted living and/or moribund) for most of the year. Furthermore, there is no practice of covering the soil with mulch. These bare soil agricultural practices expose the soil to dessication from sun and wind and to erosion from wind, rainfall and flood irrigation runoff. The fact that the soil is loosened up by plough and that rain frequently falls in short, high energy bursts and that stormy winds are normal during the dry season means that soil losses are inevitably hastened through existing cropping practices. In relation to the entire farm, however, the crop lands are relatively small and erosional losses from these lands are probably not too significant.

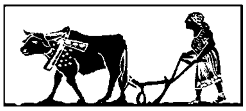
The lack of careful landscaping on the dryland fields will also definitely enhance erosion. The areas involved are, however, relatively small and unplanted, undisturbed strips of natural vegetation have been retained as a boundary between different fields. These strips of natural vegetation should reduce soil losses from the area as a whole.

### Soil fertility

*Impact*: No crop rotation, fallow periods, green manuring or fertiliser regime is practised and thus current farming practices will gradually be reducing the nutrient levels of the soil. Nutrient losses will inevitably be differential, some nutrients being lost at greater rates than others thus shifts in nutrient balance will be occurring. These shifts in nutrient balance will, to a certain extent, be mitigated by the polyculture practices (that is, intercropping of several crop species on the same field). The polyculture practices will not, however, reduce the overall nutrient loss rate. This change in nutrients is not regarded as being a particularly significant negative environmental impact as it can be reversed very easily and relatively cheaply. It certainly would enhance livelihood opportunities substantially if soil fertility was addressed in a positive way.

*Mitigatory measures*: Current cropping practices are not having major negative impacts on the biophysical environment. The practices, however, are not sustainable and if continued without any modification will lead to secondary impacts including reduced yields and increased poverty of the beneficiaries. Thus the negative environmental impacts are essentially of a socio-economic nature. Linked to the above, there are numerous opportunities to positively enhance the environment that have not been taken up. Environmental enhancement would positively impact on the socio-economic status of the beneficiaries and would make cropping more sustainable.

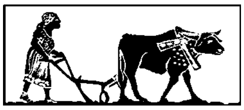
Essentially, there is an urgent need to raise the levels of awareness and understanding of farmers and to equip them with skills and offer them regular, ongoing support concerning a wide range of agricultural issues. Without a comprehensive, integrated package that primarily focuses on hands-on training there is little hope of enhancing the sustainability of crop production. As a precursor to developing an appropriate training programme, training needs will have to be identified using participatory methods. Some of the issues that need to be covered in a training programme would include, but not be limited to:



a) the importance of soil nutrients and how to enhance and thereafter maintain soil fertility using appropriate fertilisers, especially kraal manure
b) landscaping, mulching and flood irrigation
c) different pesticides, their toxicity and correct usage. Alternative approaches to pest control such as companion planting and other permaculture/organic farming techniques
d) the pros and cons of animal versus machine traction
e) monitoring and evaluating crop production.

Linked to the above points, it is important to capitalise on existing local knowledge and practices and to develop mechanisms which would facilitate the replication of some of the skills and understandings of local agricultural innovators. Indeed the training programme might best be developed around improving the skills and understandings of existing agricultural innovators. These innovators could be developed into a locally- based extension service to support the other farmers on Gallawater A.

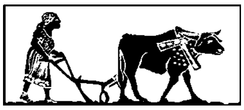
Beyond the training needs, however, there needs to be a rethink of such basic issues as beneficiary selection, the allocation of fields and settlement patterns. For example, do all beneficiaries have to have access to arable land? Do all beneficiaries have to have an allotment in the dryland fields and the two irrigation fields? Do all beneficiaries have to settle in the existing village? Can sustainable agricultural development and land reform be reconciled with beneficiaries that choose to live elsewhere?



# 4. Recommendations

- Contact between consultants and beneficiaries raises expectations amongst beneficiaries. It is therefore recommended that the results of this report and the other associated reports are presented to the Gallawater A beneficiaries in an appropriate way to facilitate an open discussion. Simply handing out the report will not suffice as most beneficiaries would have great difficulty with the language and format of a written report. Probably some kind of oral presentation is required.
- A vision is essential for any agriculture enterprise, that is, exactly what the beneficiaries want to achieve from their cropping. From such a vision will flow a management plan and strategy which includes an approach to outsourcing where necessary. None of this is currently well articulated and it is probable that there will be several schools of thought once/if these issues are dealt with. It is recommended that participatory rural methods are used to assist the community to develop a vision, management plan and strategy. A major challenge is to ensure that there is significant dovetailing of the community versus individual choices. A strategy to involve the younger generations in agriculture is essential for the long term future of the programme. Some tough choices need to be made including the choice between subsistence and commercial farming, what sort of irrigation scheme, if any, should be developed, the issue of beneficiary selection and performance criteria for farmers allocated scarce arable land and access to costly water.
- Local knowledge and understanding is not evenly distributed amongst beneficiary farmers and most are in desperate need of support. Sufficient support is, however, unlikely to be obtained from outside sources, including government. Thus, it is recommended that participatory rural methods are employed to identify agricultural innovators within the beneficiary pool and to focus attention on these innovators to develop them into a local extension service for the other beneficiaries.
- Local beneficiaries have limited exposure to alternative cropping practices and hence are poorly equipped to make informed decisions that lead to sustainable cropping practices. It is recommended that agricultural innovators are supported to the extent that they can develop viable, sustainable models on their own fields. These models will form the basis for a continuous dialogue with the other beneficiaries. The models should probably include the use of animal traction. The models should include regular monitoring of production costs and benefits.
- In order to promote the development of sustainable cropping practices, it is recommended that an approach is developed to enable selected beneficiaries to participate in exposure visits to other innovative farmers and initiatives in the region.
- Crop farming should be capable of making a significant contribution towards the livelihoods of the beneficiaries. Realising the full potential of crop farming will, however, require the efficient use of the irrigation water that the beneficiaries currently pay for. If the irrigation water is going to be used effectively, a more commercially-oriented approach is critical, primarily because the capital and recurrent costs for the irrigation scheme will have to be met. It is recommended that a phased approach be adopted to move the beneficiaries gradually from dryland subsistence farming to irrigated, commercial farming.

- The current farm layout mitigates against crop production. It is recommended that the Gallawater Development Committee reconsiders its existing settlement and land allocation policy.



## Notes

1. PO Box 2592, Komani, 5322. Tel: (045) 839 2880

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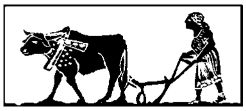
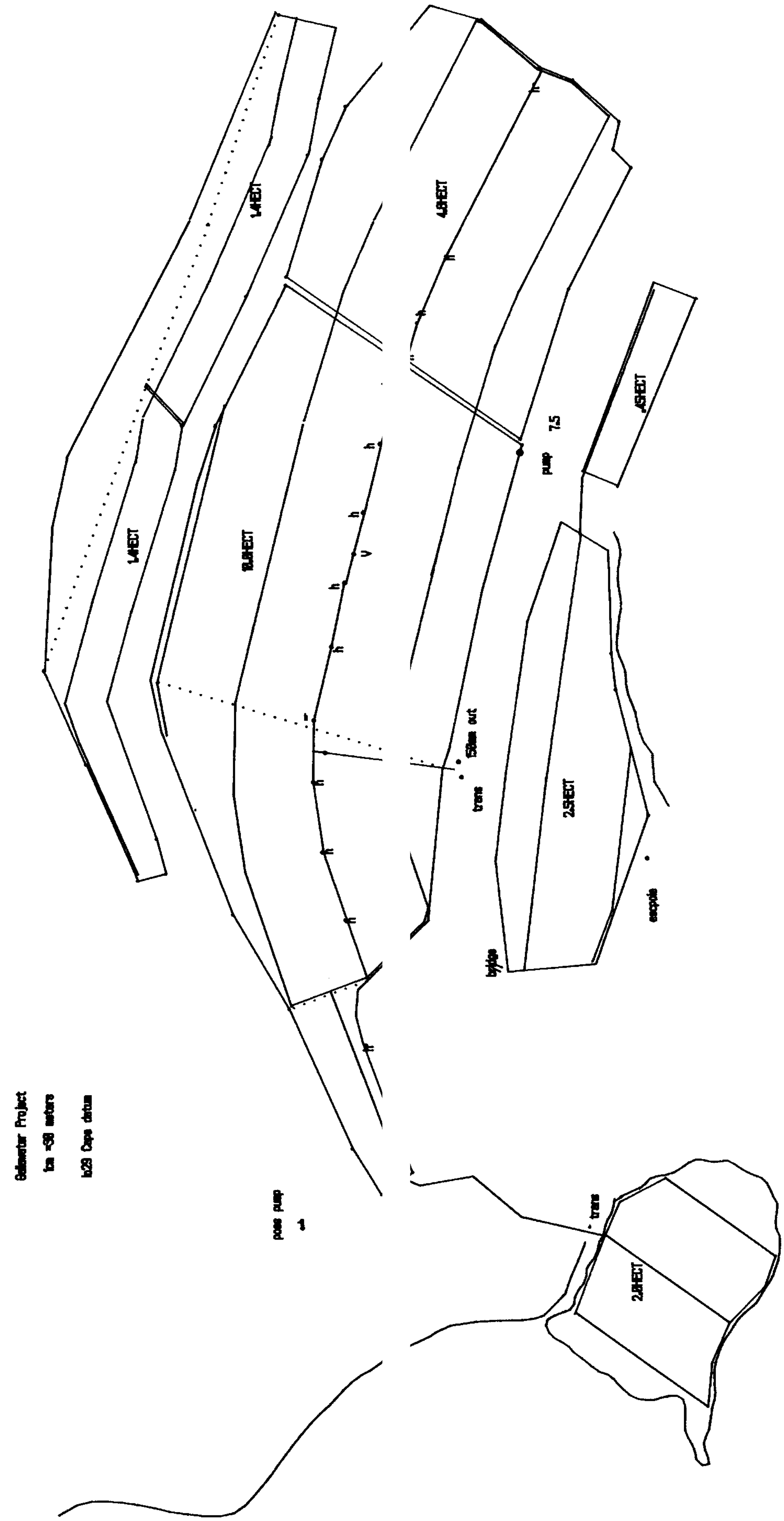
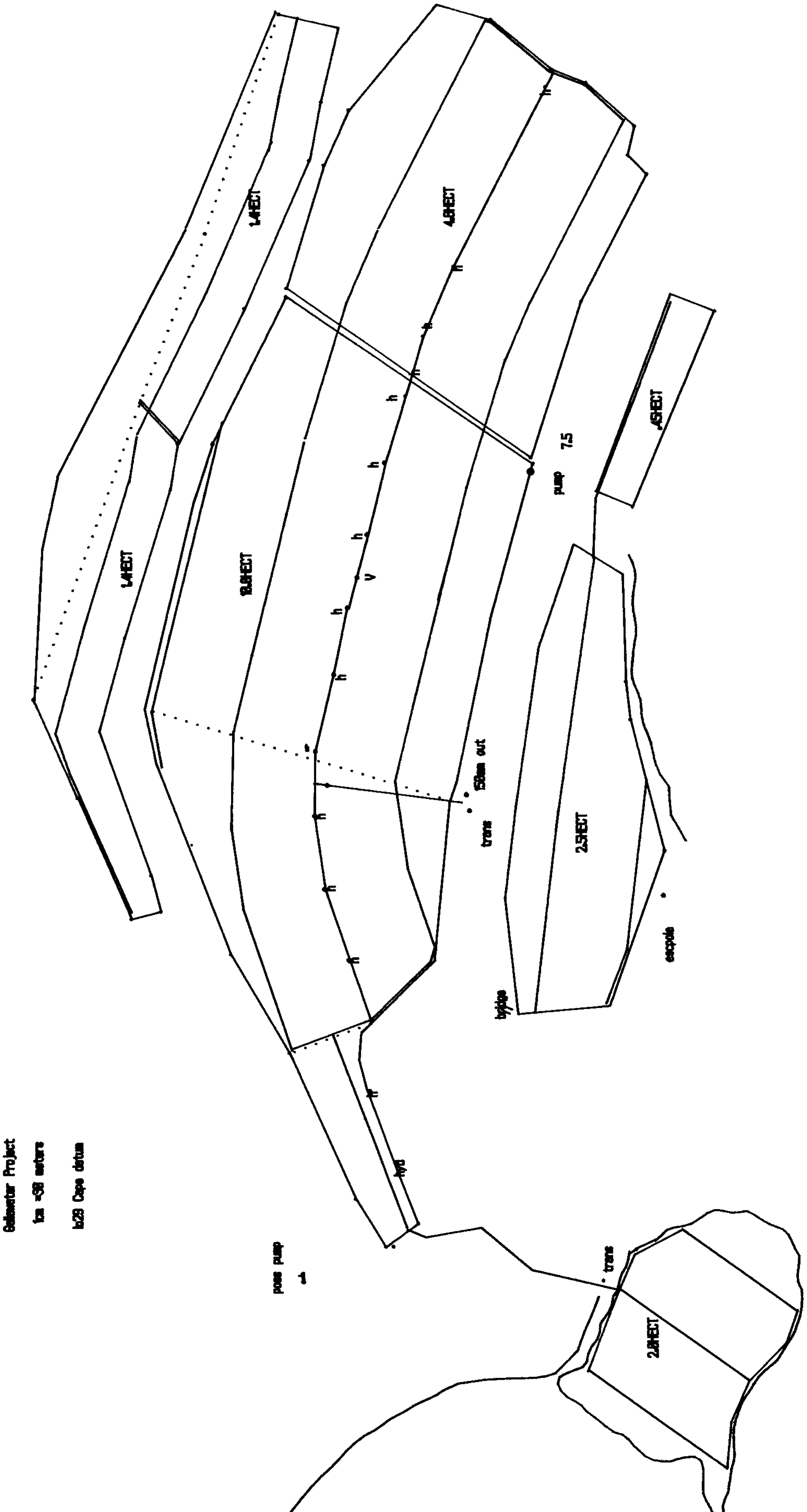


# ANNEXURE 1 Irrigation scheme options

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