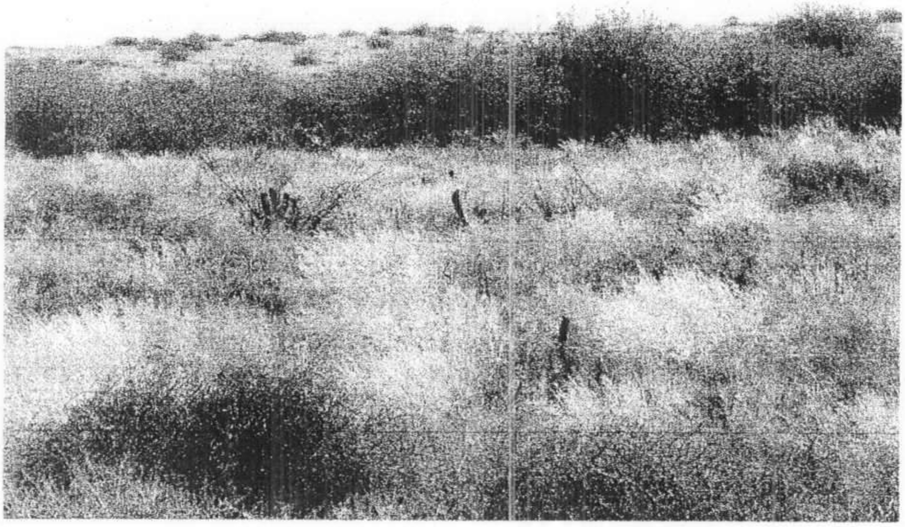
# MANAGEMENT AND CONTROL OF *PROSOPIS* SPECIES: EXPERIENCES FROM SOUTH AFRICA

**Trip Report to South Africa on 26th April – 8th May 2005**

**Under**



**TCP/KEN/3002 (A)**



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## Executive summary

South Africa has one of the biggest problems with alien plant invasions than any other country in the World. It is also one of the earliest countries in Africa where *Prosopis* was first introduced in the late 1800s; hence considerable experiences in management and control of the species exist. It is for this reason that the Government of Kenya, in collaboration with the Food and Agricultural Organization for the United Nations (FAO) under the TCP/KEN/3002 (A), organized a study tour of two officers (in April/May 2005) to document these methods for possible adoption in Kenya.

Management and control of invasive species (including *Prosopis spp.*) is one of the most successful flagship programmes in South Africa carried out under the Working for Water (WfW) Programme. It has received generous support from the government's special poverty relief fund as well as re-construction and development fund, a budget of about US$ 70 million per year, making it the largest environmental programme on the African continent. The working of this programme has been described, and forms an ideal model for possible adoption in Kenya to address the problem of invasive plants exemplified by *Prosopis* species.

From the time of introduction, *Prosopis* is considered as one of the worst aggressive invaders, and has now covered over 1.8 million hectares in South Africa. A combination of mechanical (clearing), chemical and biological control methods have been adopted and the results are very encouraging. These methods have been well documented, and are highly recommended for use in Kenya. Appropriate recommendations for adoption of each of the methods are provided for consideration by the Government of Kenya.

**Cover Photo: Management and Control of *Prosopis* in South Africa is being achieved by integrating the mechanical (clearing), chemical and biological control methods. Note the total kill of the *Prosopis* stumps and seedlings (foreground) by use of chemicals.**

**Acknowledgement**

This study trip could not have proceeded without the goodwill and co-operation of many people. In particular, the authors would like to thank:

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- The Government of Kenya through the Director, KEFRI for providing the opportunity to conduct the study tour.
- Dr Helmuth Zimmermann, our host, for his patience, enthusiasm, ability to inspire, and sharing his knowledge in the field. Teamwork with him and long drives in the countryside was a pleasure and definitely memorable.
- The Working for Water coordinating teams at Kimberley and Cape Town for providing the necessary information on the programme.
- Professor J. Hoffman and Anthony Roberts at the University of Cape Town for sharing their knowledge on *Prosopis* biological control.
- Several land owners whom we interviewed during the course of our tour.

To all these organizations, groups of people and individuals whom we consulted, the authors would like them to take this note as a humble indication of our appreciation since it is difficult to list all of them individually. If we succeeded in our assignment, we owe it in part to the support we received from all of them.

# 1. Introduction

South Africa is one of the earliest countries in Africa where *Prosopis* was first introduced in the late 1800s. It had been widely planted for fodder mostly in the arid and semi-arid interior by 1930s, and is now one of the commonest trees in the northwestern regions of the country.

In 1960s, concerns about the impacts of *Prosopis* invasions in South Africa both on the agricultural productivity of the land, on water resources and biodiversity. Over the years, several control methods have been attempted where different levels of success have been achieved. However, it was not until 1995 that an elaborate initiative was formulated through the establishment of the Working for Water Programme by the new government. The main objective of the programme is to address the threat of invasive alien species in South Africa while contributing to economic empowerment and social equity. It is the largest environmental programme in Africa. The experiences gained from the programme in managing and controlling invasive species (including *Prosopis* species) is commendable.

Kenya has had similar problems with invasive species, especially *Prosopis* species in the recent years. However, its management and control has been largely constraint by lack of knowledge and experience to deal with the species. As part of capacity building initiative to address the *Prosopis* problems in the country, the Government of Kenya in collaboration with the Food and Agricultural Organization for the United Nations (FAO) organized a short learning tour of two senior officers to the Republic of South Africa. The tour was organized through the TCP/KEN/3002 (A) Project on management and control of *Prosopis juliflora* in Baringo District of Kenya.

This report therefore presents the findings of the learning trip, and the results will be used to enrich not only the project activities but also to help in formulating a national strategy towards enhanced management and control of *Prosopis* in Kenya.

## 2. Objectives

The objectives for the study tour to South Africa were as follows;

a. To document the methods of integrated management and control of *Prosopis* and other invasive species in South Africa,

b. To establish the success and failures of the integrated management and control methods used,

c. To provide recommendations for consideration by the Government of Kenya on how to address the problem posed by *Prosopis* and other invasive plants in Kenya.

## 3. Findings

### 3.1 Overview of management of invasive alien species in South Africa

#### 3.1.1 Working for Water Programme

South Africa has one of the biggest problems with alien plant invasions than any other country in the World (Richardson and Wilgen, 2004). The influx of alien plant species into South Africa began in 1600s when the Cape of Good Hope was a major stop for ships coming from all over the world, bringing with them thousands of plant species for cultivation and other purposes (Zimmermann *et al.*, 2004). Of the estimated 9,000 plants introduced to South Africa, 198 are currently classified as being invasive, and covers over 10 million hectares or 7% of the country, and the problems of their effects on biodiversity and devastation of habitats is growing at an exponential rate.

In 1860s for example, various species of *Eucalyptus, Pines, Hakea* and *Prosopis* were introduced and planted over wide areas in South Africa for wood products and shade. By 1909, plantations of *Eucalyptus* and *Pines* had shown evidence of reduced stream flow within the catchments, hence impacting negatively on the nation's water supply (Macdonald, 2004). In addition, other species had invaded grazing lands thus reducing their value to stock farmers. In 1970s, more intensive research on excessive water use by invasive plants were conducted by the South African Forestry Research Institute and Water Research

Commission, and showed that an estimated annual loss of between 1,400 million $m^3$ to 3, 300 million $m^3$ or between 3% and 6.7% of the country's run-off. (Gorgens and Wilgen, 2004).
In the last two decades, detailed synthesis of the ecology and management of invasive species have been produced in South Africa, and the transformation of these results to suitable forms for large scale implementation to conserve the lost water.

In 1995, the Working for Water Programme (WfW) was launched to control alien plants invading the nation's water catchments, with a primary goal of increasing water supplies. This is a Government initiative whose name captures the programme focus on job creation in support of important ecosystem service – the protection of water supplies threatened by invasive species. The programme targets woody alien plants and is conducted in a labour intensive manner so as to double as a public works programme aimed at poverty alleviation. By 2003, over 15 million person- days had been generated, and over 1.2 million ha of infestations or 12% of the estimated 10.5 million ha of infestations, had been cleared (Macdonald, 2004). By the end of 2002, the programme had invested about US$ 0.3 billion during the first seven years of existence, making it the largest environmental programme on the African continent.
The programme currently implements over 200 projects spread across the country. It is administered through the Department of Water Affairs and Forestry, and works in partnership with other Government departments such as the Department of Environmental Affairs and Tourism, Agriculture, and Trade and Industry including research foundations, private companies and local communities who provide the labour.

The programme considers the development of people as an essential element of environmental conservation with emphasis placed on women (50%), youth (20%) and the disabled (5%). In addition, implementing HIV/AIDS projects and other socio-economic development initiatives are important objectives. The programme enjoys sustained political support for its job creation efforts and the fight against poverty.
As part of its integrated strategic approach to the prevention and management of invasive species, Working for Water programme invests about US$ 2.5 million per year in research to

expand the knowledge needed for making informed decisions on management and control of invasive species.

**The Working for Water coordinating team for the Northern Cape Province at Kimberley in South Africa. Note the gender and racial representation as part of the requirements for the programme**

### 3.1.2 The *Prosopis* problem in South Africa

The first records of introduction of *Prosopis* to South Africa (*Prosopis pubescens*) dates from 1879. This was followed by other species such as *Prosopis chilensis, P. glandulosa* (variety *torulosa*) and *P. velutina* (Keet, 1929; Poynton, 1988). They were introduced particularly in the dry areas of the country to provide fodder for livestock and fuel. In 1930s, the Government carried out an extensive programme to promote the planting of *Prosopis* by providing seeds to the ranchers for several decades (Brown and Gubb, 1986). Between 1976 and 1985, a significant increase in *Prosopis* density in many areas of South Africa was noted, where the spread is thought to have been caused by the wet years of the 1970s (Macdonald, 1985; Henderson, 1991a). The spread of *Prosopis* has had serious impacts on both the agricultural productivity of the land (mostly for livestock production), ground water resources and biodiversity (Scott and Le Maitre, 1997).

Regeneration of *Prosopis* species appears to be strongly dependent on the amount of rainfall such that unusually high populations are recruited during wet years. Analysis of the rate of expansion in the Northern Cape Province was estimated at about 18% annually (Versfeld *et al.*, 1988), and the transition from an open stand to a dense one takes between 10 – 24 years (Harding and Bate, 1991).

A recent national survey in South Africa has shown that over 1.8 million hectares have been invaded by *Prosopis*, and mostly in the Northern Cape Province (Sak River system, Vanwyksvlei and Britstown- De Aar area). Other areas of the country that have also been affected are the North West Province (along upper Limpopo and lower Vaal River catchments), Western Cape and Free State Provinces in that order (Henderson, 1995; Versfeld *et al.*, 1988).

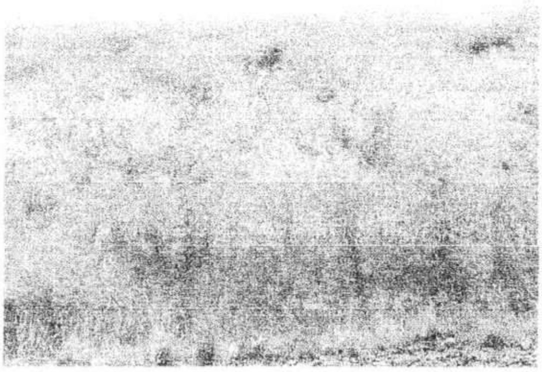
Recent studies carried out in South Africa using biomass-based models have shown that total water use by *Prosopis* species (particularly in the arid areas it invades) is over 480 million $m^3$ per year (Le Maitre, 1999). However, this was later adjusted to about 191 million $m^3$ per year (Versfeld *et al.*, 1988). In the most affected Northern Cape Province alone, the unadjusted biomass model show that *Prosopis* could be using about 380 million $m^3$ per year or about 2,800 $m^3$ per densely invaded hectare per year more than the natural vegetation (Versfeld *et al.*, 1988). This has a direct impact on both the surface and ground water reservoirs, hence critically affecting the survival of many farmers and rural communities.

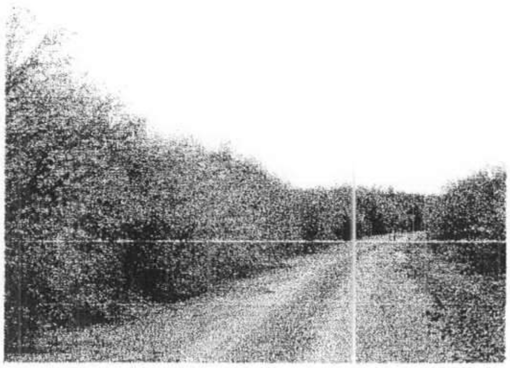
Several studies have been also been conducted to establish the evidence of interaction between *Prosopis* and ground water (root systems, xylem water potential, transpiration and isotopic studies) as well as the estimates of water use at various levels (leaf, tree, stand and catchment levels) (Le Maitre, 1999). These studies have clearly demonstrated the capability of *Prosopis* to develop extensive and deep root system to a depth of at least 15 m or extra-ordinary depths in certain circumstances.

Isotopic analysis have shown that invading *Prosopis* uses ground water and available soil water, but its effects on ground water recharge is still not certain. Large-scale studies in the areas on invasion suggest that water use by *Prosopis* ranges from 350 to 500 mm per year. Given the low rainfall of the affected areas (about 250 mm per year) and low ground water recharge rates (4%) and the use of all the rainfall that infiltrates the soil, the net loss of 350 to 500 mm per year is likely to have a significant short and long term impact on the amount of water in the aquifers.

It has also been established that the invading *Prosopis* not only uses more ground water than the natural vegetation they replace, but also replace valuable grazing lands with impenetrable thickets that cost more to clear than the market value of the land, making these lands economically valueless.

These studies have therefore been used to justify that need to invest in *Prosopis* management and control in South Africa. It is considered one of the 44 species legally declared as noxious weeds (hence removal required by law), and one of the 10 most invasive plant species in the country prioritized for urgent management and control.





**Massive scales of *Prosopis* infestations can be seen in Northern Cape Province of South Africa. Major grazing areas, river flood plains and roadsides have been greatly affected**

## 3.2 Methods for management and control of invasive alien species in South Africa with focus on *Prosopis* species

There are five basic methods of managing and controlling invasive plants in South Africa, namely; biological control, mechanical, chemical and indirect control. There is also a combination of some of these methods - the integrated control.

### 3.2.1 Biological control

#### 3.2.1.1 General principles of biological control and their application in South Africa

Biological control consists of the use of natural enemies (insects, mites or pathogens) to reduce the vigour or reproductive potential of the invasive target plants (Klein, 2002). The biological agents used attack the vegetative parts (leaves, stem or roots) or the reproductive parts (flowers, fruits or seeds). In its native range, every plant is attacked by numerous species of insects, mites and pathogens that have evolved with it for millions of years, thus preventing the plant from becoming a weed. If introduced to new areas without their natural enemies, the plant gains tremendous competitive advantage over indigenous vegetation, now exemplified by *Prosopis* species. Biological control is therefore a practice that involves the transfer of the natural enemy of the plant from their country of origin to the new country where the plant has become invasive, or the re-unification of the plant with its natural enemy (Zimmermann, 2004).

Globally, biological control has been practiced since 1865 against 350 weed species in over 75 countries such as the USA, Australia, Hawaii, South Africa, Canada, and New Zealand among others. For example in the USA, of the 38 target weeds attempted since 1945, about one third have been substantially or completely controlled (Julien and Griffiths, 1999).

Before biological control agents are considered for release, they are subjected to a period of quarantine for careful screening to ensure that they will attack only the target plant, and that they can complete their life cycles and reproduce only on the target species.

In the history of biological control, host shifts have not occurred in over the 350 recorded cases worldwide where properly tested biological control have been used, particularly after the second half of 20th century where species testing became mandatory (Waterhouse and Norris, 1987). According to Klein (2002), earlier introductions of biological control agents may have had more risks on crops or indigenous plants but were released based on arguments that were valid at that time.

The first biological control programme in South Africa started in 1913 for the control of drooping prickly pear (*Opuntia monacantha*) using plant feeding Cochineal insects. The control was an outstanding success to date, with indefinite cost-free control of the prickly pear that had devastated vast areas of grazing and farming lands in the country.

More focused development of the biological control programme in South Africa started through an intensive capacity building strategy in 1960s such that by 1970s, there were 22 releases of new biological agents against invasive alien plants. These increased to 30 in 1980s and 43 by 2003, all with different levels of success (Zimmermann, 2004). Currently South Africa is regarded as the third most active country in biological control of invasive plants after USA and Australia, and the leading in Africa (Wilgen *et al.*, 2004).

A biological control project is considered complete successes if no other control measures are required to keep the invasive plant under control. 44 (25%) of the target plants have been completely controlled biologically in South Africa, examples of which include red water fern (*Azolla filiculoides*), water lettuce (*Pistia stratiotes*), Port Jackson acacia (*Acacia saligna*), red sesbania (*Sesbania punicea*) and Australian pest pear (*Opuntia stricta*) (Klein, 2002).

The degree is regarded as significant (or substantial) if methods other than biological control are still needed to reduce the invasive plant to acceptable levels, but less effort and costs is required. 16 species (36%) have been substantially controlled in South Africa such as jointed cactus (*Opuntia aurantiaca*), prickly pear (*Opuntia ficus-indica*), Parrot's feather (*Myriophylla aquaticum*), water hyacinth (*Eichhoria crassipes*) and silky hakea (*Hakea sericea).*

In addition, the biological control project may be considered negligible if, in spite of obvious damage to the target species by the biological control agent, a management effort still heavily reliant on other measures besides biological control, and *Prosopis* is one such example. On the other hand, the biological control is considered uncertain if the impact of the agent is still unknown either for lack of follow-up evaluation programme or it may be too early for meaningful evaluation after release of the agents. In South Africa, negligible impact on 12 target species (27%) and 5 (or 11%) uncertain biological control cases have been recorded respectively to date (Zimmermann, 2004).

According to Klein (2002), biological control has several advantages, namely;

- Environmentally friendly because it causes no pollution and affects only the target species,
- Self- perpetuating or self sustaining, hence cost effective,
- Does not disturb soil or create large empty areas where other invaders could establish.

In South Africa, biological control alone has reduced the overall budget for management of invasive plants by about 20 % or a saving of US$ 276 million. This is expected to rise in future as biological control becomes more effective and widespread (Le Maitre *et al*., 2000).

Recent studies have shown that cost-benefit analysis of biological control programme generally indicates positive returns to investments. For example, McConnachie *et al*., (2003) reviewed nine biological control projects in South Africa undertaken from 1939 to 2000, all of which indicate positive returns ranging from 1: 1.9 to 1: 53, with a mean of 1: 18. Other projects in South Africa have shown cost-benefit ratio estimates ranging from 1: 8 to 1:709, and projected ratios ranging from 1: 34 to 1: 4,333 respectively, depending on the weed species controlled, thus demonstrating the wisdom of investing in biological control (Zimmermann, 2004). Similar studies in Australia have shown the cost – benefit ratio between 1: 14 to 1: 20.7 (Nordblum *et al.*, 2001).

### 3.2.1.2 Biological control of *Prosopis* species

The purpose of introduction of *Prosopis* species to South Africa was to provide fodder in the form of nutritious pods, fuel wood and shade, particularly in the areas of the country where very few other trees could survive. The objectives for the introduction have therefore been met, and the tree is still useful in those respects in many situations. However, its powerful invasive potential and uncontrollable spread qualifies it as a conflict of interest species.

In biological control principles, a conflict of interest situation warrants for very careful choice of control agents by avoiding those that have the ability of causing damage to the useful parts of the plant, and instead, using only seed reducing agents. These will reduce the reproductive potential of the plant, curb their dispersal and reduce the amount of follow-up work needed after clearing while still allowing for the continued utilization of the plant. Due to the several useful properties of *Prosopis* as well as becoming invasive, consideration has only been given to seed feeding insects for biological control. Agents that destroy seeds can reduce its invasiveness without significantly affecting nutritional value of the pods or prevent pods or seed production.

Biological control of *Prosopis* in South Africa started in 1987 through the importation and release of a seed feeding bruchid beetle, *Algarobius Prosopis* (Coleoptera: Bruchidae), imported from Arizona in USA. Further importation and release of two additional seed feeding beetles has been done. These are *Algarobius bottimeri* and *Neltumius arizonensis*. Unfortunately, *Algarobius bottimeri* failed to establish in South Africa, and presumably died out. The larva of the two successful beetles destroys the seed embryos and prevents the seeds from germinating. These beetles have now dispersed widely and are found in abundance in all *Prosopis* populations in South Africa, gradually reducing the seeds being added to the seed bank in the soil. Their effect will not be noticed for many years until the seed bank is completely exhausted. The current level of seed destruction is estimated at 90 –95 % in livestock and game excluded areas and about 70% in open grazing areas.

Field observations have shown that livestock and game often ingest most seeds before being fully colonized by the beetles, leaving a significant number for continued dispersal. This problem is being addressed by introducing another seed feeder, the *Apion spp* that attacks immature seed in green pods. The effect of the three seed feeders will ensure that very high proportion of seed is destroyed before livestock eats the pods. *Apion spp* is being considered for release by next year (2006).

There are fears that the seed feeders alone may not attain the desired objective of effective biological control of *Prosopis* in South Africa. There may be a need to introduce additional agents to destroy specific plant components such as flowers or immature pods while not affecting the growth and vigour of the trees. The need for importation of the additional agents will probably be known after the *Apion spp* post- release evaluation.

According to Hoffman and Zimmermann (2004), the acquisition of additional agents other than the seed feeders would require consensus that some, or even all attributes of *Prosopis* are expendable in the light of its devastating effects on biodiversity, landscape and livelihoods. This is the position that has been decided in Australia.

They have further argued that while the line of least resistance would be to sacrifice the pods in order to attain effective control, biological control will not be able to contribute anything more to the management of *Prosopis* problem in South Africa unless decisive moves and sacrifices in this direction are made.

The overall strategy is to attain complete control of *Prosopis* in the country, and to retain them only in special demarcated areas where their continued presence is considered useful. Where they have to be cultivated or retained, the landowners have to be licensed to do so, and to ensure that their spread outside the demarcated areas is completely curtailed or controlled. The landowners can protect the cultivated *Prosopis* plantations from seed feeders or biological control agents using the standard crop protection methods as desirable. In future, high quality propagation material may only be sold to land owners in areas demarcated and licensed for cultivation of *Prosopis*, or for the establishment of scientific biological control reserves. This strategy has already been demonstrated using the black wattle (*Acacia mearnsii*) and it is very successful.

### 3.2.2 Chemical control

#### 3.2.2.1 Policy on the use of chemicals to control invasive species

Chemical control involves the application of registered herbicides to the invasive plants or to the soil surrounding them, with the aim of killing or suppressing the plants. The choice of herbicides, the correct application method, dosage, time of application and follow-up actions are very important.

Only herbicides registered in terms of the Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act 36 of 1947) are used to control alien invasive plants in South Africa. Before they can be registered for use in South Africa, all herbicides have to comply with stringent environmental and health standards relevant to South African conditions. In addition, most of these registered chemicals were developed from overseas and are used by developed countries that have set very high standards for their herbicides. Therefore, all registered herbicides are environmentally friendly, provided they are used according to the guidelines provided by the manufacturer.

The Working for Water Programme has developed an elaborate policy on the use of herbicides for the control of invasive vegetation. The policy provides the objectives for the use of herbicides for invasive species control, criteria for the methods of control with respect to species, selection of herbicides, training, equipment, storage and handling as well as environmental and public safety. The policy also provides a summary guide to the control method and herbicide selection for specific invasive vegetation.

The Weeds Research Division of the Plant Protection Research Institute (PPRI) undertakes research on chemical control of invasive plants, and aims at developing safe, selective and affordable herbicide treatments that will provide effective control in a wide range of environmental conditions, and which are compatible with biological control. The division also tests herbicides for registration purposes.

The examples of the active ingredients and the trade/brand names for the major herbicides in use in South Africa to control invasive plant species are given in Table 1 below.

**Table 1: Active ingredients and brand names of registered herbicides in South Africa**

| Active ingredients | Examples of Brand/Trade names |
| --- | --- |
| Triclopyr (Butoxy ethyl ester 480g/l) | Garlon, Triclon |
| Triclopyr (Amine salt 360g/l) | Timbrel 3A, Lumberjack |
| Glycophosphate 360g/l | Mamba 360 SL, Round Up, Round Up Max, Enviro Glycophosphate 360 |
| Glycophosphate 500g/l | Volcano Kilo WSG |
| Imazapyr 100g/l | Chopper, Hatchet |
| MSMA 720g/l | MSMA |
| Fluroxypyr 200g/l | Starane 200 |
| Glyphosate trimesium 720g/l | Touchdown |
| Picloram (K-salt 240g/l) (MANCO approved) | Access, Browser |
| Metsulfuron-methyl 600g/l | Brush –Off, Climax |
| Triclopyr (amine salt, 270 g/l) + Clopyralid (amine salt, 90g/l) | Confront 360 SL |

Note: Common adjuvants for these herbicides include Bp Crop Oil, Actipron and Volcano 90.

#### 3.2.2.2 Use of chemicals to control *Prosopis* species

Clear felling in combination with chemical treatment of the cut *Prosopis* stumps to prevent re-growth is still the most reliable method of its control in South Africa. Up to 1997, only one chemical, Tordon Super, was registered for this purpose. Tordon Super is a 1% mixture of Picloram (120g/l OL) and Triclopyr (240g/l OL) in diesel as a carrier.

By 1997, there were indications for the withdrawal of Tordon Super from the world market. In addition, its requirement for diesel as carrier makes it undesirable for large-scale use in watercourses, where the main invasions of *Prosopis* occur.

The Weeds Research Division of the PPRI therefore undertook a pilot project to evaluate alternative herbicide formulations for chemical control of *Prosopis*. Over 6 different herbicides of varying concentrations and carriers were investigated for their suitability for stump control. The following alternative herbicides were found to be effective;

(a) Triclopyr (480g/l EC), at 2% in diesel or in 2% kerosene. The 2% formulation was registered in 2000

(b) Triclopyr (480g/l EC), at 3% mixed with water and 1% 1000g/l polyether-polymethylsiloxane- copolymer (Ester formulation)

(c) Triclopyr (360g/l SL), at 5% mixed with water and 2% 822g/l mineral oil (Amine formulation)

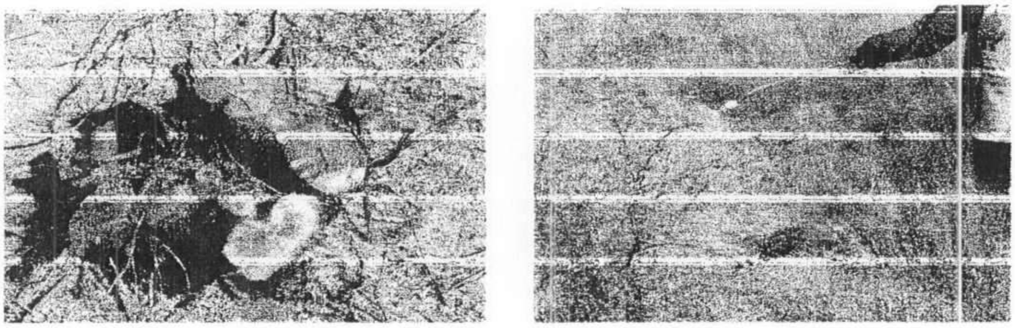
(d) Picloram (240g/l SL), at 3% mixed with water and 2% 822g/l mineral oil (Amine formulation)

(e) Clopyralid (100g/l SL), at 7% mixed with water and 2% 822g/l mineral oil (Amine formulation)

The study recommended that the registration of (c) above should be pursued to reduce dependence on kerosene and diesel formulations, as well as further testing of the efficacy of (d) above for control of stumps.

Observations made during the field visits showed that two different Triclopyr amine formulations are used to treat the stumps. These are Triclopyr Amine salt (480g/l, mixed with water at the rate of 300ml/10 litres) and Triclopyr Amine salt (270g/l) added to Clopyralid amine (90g/l) and mixed with water at the rate of 400ml/10 litres of water.

In most of the areas observed, foliar application is probably much easier where only Glyphosphate Trimesium (720g/l) is used at the rate of 1.5 litres/8.5 litres of water, and is very effective.



**Application of chemicals on the stumps must be done within 15 minutes after felling. Follow-up programmes involving foliar spray on coppices and young regenerating seedlings must be sustained to gain complete control of *Prosopis* in invaded areas.**

### 3.2.3 Mechanical/clearing

#### 3.2.3.1 Organization of the clearing processes in South Africa

Mechanical control or clearing involves removing the invasive plants or damaging them severely by physical actions such as uprooting, clear felling, slashing, mowing, ring barking or bark stripping or by hauling aquatic weeds out of water (Klein, 2002). Felled trees often coppice, and the soil disturbance caused during the control action often stimulate the seeds of invasive plants to germinate after clearing. This underlines the need for follow-up actions. Mechanical control is a labour intensive and a costly undertaking.

Before clearing operations are began, the target area is mapped using the GIS-based information system to give the accurate cover, species involved, the density classes of the infestations, hence the total costs of clearing estimated. The costs considered include clearing operations, supervision, labour, equipment, protective dressing, transport and other administrative costs. The infested areas are sub-divided as appropriate and contractors are asked to tender for specific units competitively.

The local administration offices where the names of all the needy people in the respective areas are registered give successful contractors the required number of workers. Local committees (Working for Water local Steering Committee and Project Advisory Boards) select the needy people in their respective areas.

The newly hired workers are enrolled and taken through a short–term intensive training programme on three main areas, namely; work related activities (skills of machine and herbicide use and safety issues), health (focusing on HIV/AIDS) and entrepreneurial or contract skills. These skills are aimed at addressing the workers' need to secure meaningful work after leaving the programme. It attempts to wean them off a daily wage approach to independence, with the potential to apply for contract work to assist private landowners to clear their land as well as to set their own enterprises focusing on the by-products of clearing projects such as charcoal and firewood trading, or secure employment elsewhere.

Training is conducted by the relevant Government departments, provincial conservation agencies, South African National Parks, Water Boards, municipalities and forestry companies located within or near the affected areas.

Mechanical removal of invasive plants in South Africa using hand labour fits very well to the objective for the Working for Water Programme - to develop effective approaches to the control of invasive species and to contribute to social development. One stated goal for this community based initiative is to invest in the most marginalized sectors of the society, enhance their quality of life and ensure that benefits would target those people who needed them most – the poor, women, the disabled, youth, single headed households, individuals infected with HIV/AIDS, ex-offenders and rural communities, all of whom contribute to the 41% unemployment levels in South Africa (Magadlela and Mdzeke, 2004).

Besides the Working for Water Programme, several private landowners are also actively involved in *Prosopis* control programmes. For example, a visit was made to Chris Venter's farm at Jacobsdal area near Kimberley. He has invested over US$ 83,000 to clear about 800 hectares of *Prosopis* infestations within his farm in the last three years. He combines clearing and use of chemicals to kill the stumps. Other visits were made to other farmers at Kenhardt and Van Wyksvlei who have also made attempts to eradicate *Prosopis* within their farms using their own resources, with some measure of success.

#### 3.2.3.2 Utilization of *Prosopis* wood and non wood material

The large-scale clearing of *Prosopis* infestations results in the production of large volumes of wood biomass. In 1998, the Plant Protection Research Institute Council was commissioned by the Department of Water Affairs and Forestry to investigate the potential for exploiting the woody biomass generated by these clearing operations. The objectives were to seek ways of minimizing the costs of clearing operations, to maximize the economic impacts of the programme through job creation and to minimize potential negative environmental impacts such as fire damage, by leaving less biomass after clearing.

This has led to the initiation of a Secondary Industries Programme (SIP) within the larger umbrella Working for Water initiative. The SIP was charged with the responsibility of identifying the potential industrial opportunities and the necessary research gaps. SIP has since been divided into two components, one dealing with large scale industrial initiatives with potential for public-private partnerships (PPP), while the small business initiative (SBI) focuses on entrepreneurial development at small, medium and micro-enterprises.

As part of the recommendation by the SIP, several studies on *Prosopis* biomass assessments and their prediction/estimation of the wood availability for use in different productions lines using regression equations were undertaken. This was done in different geographical locations for accuracy. Studies of wood characteristics were also done. *Prosopis* biomass was identified as a source of large-scale industrial material. As a demonstration, various *Prosopis* wood products were manufactured on a small scale, such as smoking chips, charcoal, paper pulp, flooring and small furniture items. As a result, a public-private partnership was established with a local entrepreneur to further explore the production of these *Prosopis* products on a commercial scale.

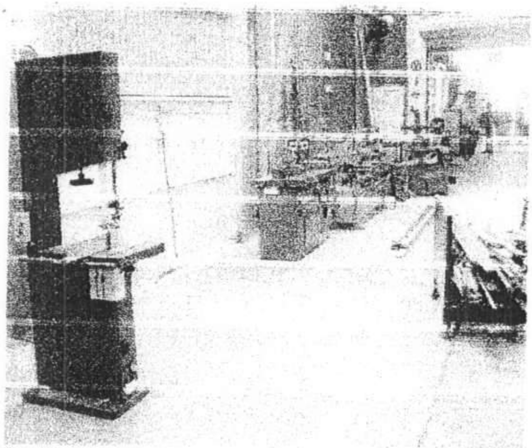
A visit was made to the factory (Biolog *Prosopis* Utilization Factory) located in Prieska town in the Northern Cape Province, the heart of major *Prosopis* infestations in South Africa. The owner has invested in wood sawing machines for making short timber segments for various purposes such as chairs and utilitarian articles.

He sells the products to major towns but his main problem is poor market response to purchase the items. The main problem, according to him, was the conversion of small stems to useful timber. The poor market of the products that have been produced at very high costs makes this worse. From his experience, there is much more value in *Prosopis* pods (70%) than the wood (30%). For this reason, he has gradually shifted his business focus to the manufacture of human food supplements and animal feeds using *Prosopis* pods. However, the high costs of collection of *Prosopis* pods and processing puts the final market price for the animal feeds much higher than that for the conventional feeds, hence not economical in every sense of the word. According to him, the market price for food supplements is more attractive and profitable for *Prosopis* products.

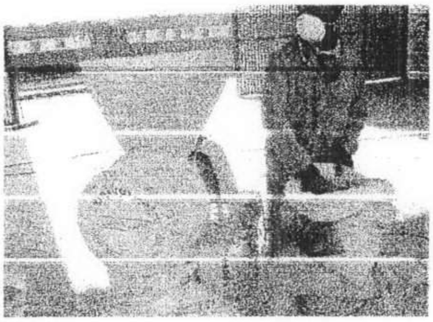
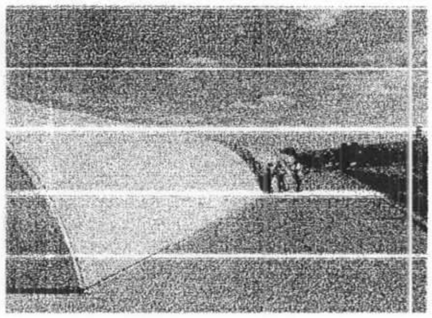
A visit was made to his storage facility for the *Prosopis* pods where several tons of dried pods were found. However, most of the pods were heavily infested with the biological control beetles. This gave a new dimension of the conflict of interest on *Prosopis* utilization with the choice of the control methods, in this case, the biological control. In principle, infested pods will take away all the opportunities of using them to manufacture the human food supplements despite being the only lucrative market segment preferred by the investor. However, he aggressively argued that he only uses clean pods after sorting them out, an exercise that obviously appears impractical considering that pods that look clean could have larva embedded in the seed embryos.

From his experience, control of *Prosopis* by utilization is not possible, particularly in the light of the current technology where small diameter stems are difficult to process.

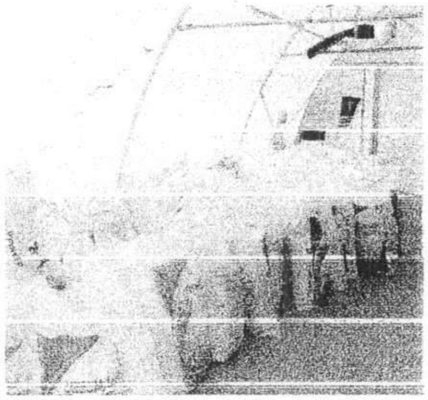
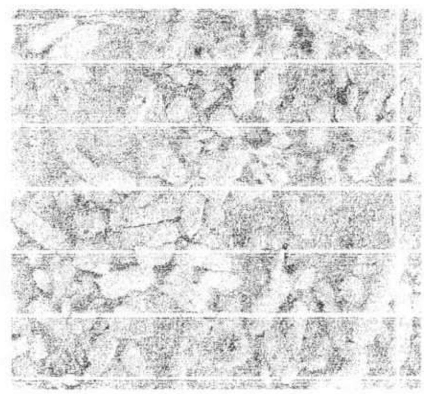
Another visit was made to an active landowner near Bristown who has been trading in *Prosopis* firewood for several years. He sells about 1,500 bags (weighing about 30 kg each) per year. The firewood market is fairly lucrative, but Cape Town (several hundreds of kilometers away) would have offered better values only that transport is limiting. He alleges that black wattle (*Acacia mearnsii*) is usually a more preferred choice of firewood than *Prosopis* in most urban areas in South Africa.



**Specialized machines able to convert small diameter stems are required for effective utilization of *Prosopis* wood. Furniture industry is the most convenient outlet for these products, but still heavily constraint by poor marketing**

***Above*: Processing of *Prosopis* pods to make human (and livestock) food supplements is a potentially lucrative business in South Africa. However, the effect of biological control beetles is gradually complicating this component. The storage/drying facility offers excellent breeding grounds for the beetles, making the pods virtually unfit for human consumption. *Below*: The inside of the storage/drying facility and sample of pods that have been attacked by beetles during storage.**

### 3.2.3.3 Management of natural stands of *Prosopis*

Experiences in South Africa and elsewhere have shown that large areas of *Prosopis* invasions are unsuitable for economic exploitation in comparison with the conventional timber industry because of the multi-stemmed nature of the plants and the associated small log dimensions.

Part of the research recommended by the SIP was to explore the possibility of converting such stands into plantations that would in time provide better quality logs for utilization. This is a popular proposition based on universal silvicultural principles in forestry.

Several natural stands were thinned and pruned at varied levels and intensities with the aim of concentrating the growth of few stems. Observations made for over five years showed that the trees did not respond to the treatments as expected. Instead, pruning triggered profuse resprouting from the lower bases of the stems, leading to high tree mortalities. Efforts were also made to graft superior scions onto existing rootstocks, but these also failed due to very high mortalities.

In the final analysis, the following are the main constraints facing the management and utilization of *Prosopis* wood and non-wood products in South Africa;

- The *Prosopis* variety in South Africa (*Prosopis velutina*) seems to respond very poorly to management interventions aimed at improving the wood quality. It is not yet very clear if the problem is specific to the species, or the season when the trial was carried out. More trials may need to be carried out for conclusive results
- Market information for *Prosopis* products seems to be lacking both locally within South Africa and internationally. More aggressive efforts are needed to fill this knowledge gap
- The areas with most *Prosopis* biomass are far removed from the major settled areas and urban centers. Scarcity of labour and long distances to potential markets makes the product harvesting a very costly undertaking
- Private land owners are making significant contributions towards control and management of *Prosopis* using their own resources. However, owing to the high cost of inputs, the State (through the Working for Water Programme) is gradually providing the initial costs of clearing and treating with chemicals for the first three years, after which time the farmers are able to sustain the operations at far cheaper costs.
- There are plenty of alternative sources of wood products from other invasive woody species that are less thorny, hence much easier to handle.

- Biological control agents have complicated the use of *Prosopis* pods in the manufacture of food supplements for human consumption. The component aimed at human food supplements may have to be sacrificed altogether

### 3.2.4. Indirect control

This refers to methods that are not primarily aimed at killing invasive plants, but that contribute indirectly towards their control. Such methods include use of fire, utilization of parts of the plant or over sowing the affected areas with beneficial vegetation or grasses

### 3.2.5 Integrated control

Often, a combination of two or more of the control methods is necessary to achieve optimum results. These include biological control, mechanical, chemical, use of fire and manipulation of plant succession. Other methods are modified management practices and profitable utilization of the invasive species where possible, to defray control costs where possible.

The most common combination is that of mechanical (clearing) and chemical control. In the control of *Prosopis* for example, the target areas are cleared by use of a chain saw. The stumps that have been cut as close to the ground as possible are treated with herbicides. The herbicide treatment must be done within the first 15 minutes after cutting to ensure maximum penetration of the herbicides to stump tissue (vascular bundles) before they close. Usually after about a year, a proportion of the treated stumps may still develop new coppices depending on the effectiveness of the original treatment. The opening up of the canopy during clearing also encourages regeneration from the underground seed bank.
The follow-up programme therefore mostly constitutes foliar herbicide application to the juvenile leaves and branches and sometimes a repeat cutting and treatment of the coppicing stumps. Follow-up programme must be sustained for several years to achieve total control (or eradication) of invasive plants from unwanted areas.

# 4. Major recommendations for integrated management and control of *Prosopis* in Kenya

## 4.1 General issues

(a) There is a wealth of experience and valuable information in South Africa for dealing with *Prosopis* problems, both by virtue of the long time the species was introduced into the country (over 100 years) and the state intervention programmes to manage the species. Most of the information now available has been obtained at a very high price. Kenya should therefore benefit by making the best use of the information at the least cost.

(b) Managing *Prosopis* is a very expensive undertaking and requires a high level of state intervention. In South Africa for example, landowners are assisted by the government to clear *Prosopis* (and treat it using chemicals) for the first three years. It is only then that the farmers are able to sustain the control measures desirable to keep the species from spreading to new areas. The communal land ownership in Kenya may complicate the adoption of such a model in the country, unless a working strategy is identified such as the use of group ranches or a form of privatization of infested areas. As it is now, the Government has to take a lead to mobilize people and resources in the *Prosopis* control programme.

(c) *Prosopis* population build up in any country seems to be characterized by an initial slow latent rate that goes fairly unnoticed for several years (or decades). This is followed by a sharp exponential rate (triggered by an unusually wet period) that takes everybody by a big surprise, during which time large areas are covered and much damage caused to habitats and the environment in general. There is need therefore to initiate an active programme on invasive species so that a problem similar to that of *Prosopis* may not arise again from another species. Working closely with international networks on invasive species (such as Global Invasive Species Programme, GISP) should be an important priority by the Government to ensure that sufficient awareness is made on emerging global issues on invasive species.

(d) *Prosopis* is the best example of a conflict of interest species. The list of merits is as long as that of its demerits, and a very thin line separates the two extreme viewpoints. What must be understood is the fact that most of the infestations seen today are hybrids that have lost most of their valuable properties, and now mainly characterized by reduced potential for any meaningful scale of utilization, unlike most of the pure varieties that were originally introduced. Continued hybridization and selective utilization is likely to further degrade the current gene pools to make them more invasive and much less useful.

(e) Australia has made the decision to completely eradicate the existing varieties of *Prosopis* in their country. South Africa has made a 20-year vision to bring the 1.8 million hectares of *Prosopis* in the country under control, and confined only to areas where they can be managed, to deliver sustainable benefits but only using pure (benign) varieties of the species (non invasive). This is being achieved through the elaborate Working for Water Programme (with a budget of about US$ 70 million per year) by integrating biological, mechanical and chemical control methods. Utilization is only considered as a secondary activity aimed at salvaging the cleared biomass, and in the process creates employment and partly off-sets the clearing costs.

(f) Some people are advocating utilization as an option to manage *Prosopis* and therefore an excuse to continue cultivating the current varieties. From experience, this is not practical, except in academic realms.

(g) Although the area invaded by *Prosopis* in Kenya is expanding rapidly, they are still in the early stages of expansion, hence manageable only if the necessary interventions are made at this point in time. What is now required is the initiation of a well focused management programme similar to the Working for Water model used in South Africa.

## 4.2 Specific issues

### 4.2.1 Biological control

i. The need for *Prosopis* biological control in Kenya is not only necessary but also imperative if total control of the species is to be achieved. However, exhaustive standard host-specifity tests and other safety issues of the biological agents must be done as a pre-condition.

ii. The communal land ownership in most of Kenya's dry areas (where *Prosopis* is mostly found) is likely to complicate short and long-term efforts necessary to sustain the high demand for labour to manage the invasions. Under these circumstances, biological control would be most ideal option

iii. The resistance for the use of biological control of *Prosopis* by some people is largely due to the lack of the necessary information about its safety, particularly on other related and highly valued native tree species. In this regard, the following steps are recommended in preparation for introduction of the biological control agents for *Prosopis* in Kenya;

   1. Preparation of the biological control of *Prosopis* dossier to initiate the introduction of the biological control agent in Kenya
   2. Quarantine research initiated
   3. Internal consultations within Kenya Forestry Research Institute, Forest Department and the Ministry of Environment and Natural resources
   4. Meeting of all stakeholders convened to discuss the biological control of *Prosopis*. This must include the Forest Department, National Environment Management Authority (NEMA), Kenya Plant Health Inspectorate Service (KEPHIS), environmental conservation agencies, International organizations, representatives of local communities among others. The meeting must arrive at a consensus on biological control and own the biological control

process as one of the recommended national strategies to control *Prosopis*

5. Quarantine research results disseminated to the relevant people
6. Launching of the biological control if stakeholders are in agreement.

### 4.2.2. Chemical control

(a) The local equivalents of herbicides that have been registered for use to control invasive plants in South Africa and other developed countries needs to be sought
(b) The relevant safety information for the herbicides may be requested and tested by the authorized organs of the Government of Kenya
(c) Sample field testing for their efficacy may be done as appropriate
(d) Large scale use of the herbicide recommended and approved
(e) Identity of the main manufacturer and purchase of the desired chemicals on discounted prices as facilitated by the Government of Kenya. Possibilities of duty and tax exemption must be explored if the commodity will be purchased off-shore

### 4.2.3. Mechanical control and utilization

(a) An elaborate programme for systematic clearing of *Prosopis* infestations needs to be formulated based on the model used in South Africa. Such a programme could be managed at the district level because districts are the viable administrative units in Kenya. Besides heavily invaded districts such as Baringo, Turkana, Tana River, Garissa and Taita Taveta, other districts have minor pockets of invasions that could be brought under total control in a few months.
(b) In South Africa, several things came together almost instantaneously to create the conditions for the inception and success of the Working for Water Programme in clearing *Prosopis* and other invasive species from 1995. These include the inspiration of a new democracy following a new administrative transition, unique climate of change that accompanied the new government, massive scales of unemployment levels among the

rural communities hence the need for job creation, availability of the necessary research data needed to guide implementation among others. The need for job creation made the programme politically attractive. With the President as the programme's Patron-in-Chief, the necessary funding was easily secured from the state's special poverty relief fund as well as re-construction and development fund. This is all a question of laying down a strategy to mobilize funds towards a programme such as *Prosopis* management and control, and making the programme popular among the political class. These are challenges and food for thought for a possible Kenya programme that must be considered now rather than later.

(c) In Kenya today, a number of initiatives to address *Prosopis* issues are increasing every year. Unfortunately, these efforts are scattered and often isolated, and are characterized by opportunistic and desperate scramble for funds whose spending is done just for the sake of it. In 2003, a national workshop on integrated management and control of *Prosopis* recommended the formation of a National *Prosopis* Task Force to coordinate all the work being addressed by different organizations in the country as well as to prioritize the work. This is aimed utilizing the available funds in the best way possible by minimizing duplication of efforts. There is need therefore to activate the Task Force as a first step to initiate a united force and overall strategy to address the *Prosopis* issues in Kenya. The results from the pilot project funded by FAO will be used as a springing board to reach the other frontiers of the country and the region.

#### 4.2.4. Integrated control

(a) Combination of all the control methods for *Prosopis* must be made as far as possible in order to achieve the desired results
(b) The most popular combinations are the mechanical, biological and chemical control methods, and needs to be used in every opportunity possible.

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