

**FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
MINISTRY OF LIVESTOCK AND FISHERIES**



**NATIONAL STRATEGY ON
PROSOPIS JULIFLORA MANAGEMENT**

**JANUARY 2017
ADDIS ABABA
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ACRONYMS

EIAR	Ethiopian Institute for Agricultural Research
EDRR	Early detection and rapid response
ETB	Ethiopian Birr (approximately 20 ETB: 1US\$)
FAO	UN Food and Agriculture Organization
FPMC	Federal Prosopis Management Council Secretariat
GEF	Global Environment Facility
GIS	Geographical information system
IAS	Invasive alien species
IGAD	Inter-Governmental Authority for Development
KM	Knowledge management
MOANR	Ministry of Agriculture and Natural Resources
MOEF&CC	Ministry of Environment, Forests and Climate Change
MOFPDA	Ministry of Federal and Pastoral Development Affairs
NGO	Non-governmental organization
NISSAP	National IAS Strategies and Action Plan
NPMC	National Prosopis Management Council
NSTAG	National Scientific and Technical Advisory Group
PRM	Participatory rangeland management
PCDP	Pastoral Community Development Project
PMC	Prosopis Management Council
PSNP	Productive Safety-Net Project
PRIME	Pastoralists Areas Resilience Improvement and Market Expansion
RPMC	Regional Prosopis Management Council
SLM	Sustainable Land Management
TOR	Terms of reference
IUCN	World Conservation Union
UNEP	United Nations Environment Program
WPMC	Woreda Prosopis Management Council

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Members of National Technical Taskforce

Mr Gifawessen Tessema	MOLF
Mr Rezene Fisseha	EIAR
Dr kidane G/Meskel	EIAR
Dr Lemma Gizachew	FAO
Mr Dubale Admassu	USAID
Dr Daniel Temesgen	ESAP
Ms Fiona Flintan	ILRI
Mr Alemayehu Mengistu	ESAP

Preface

In Ethiopia *Prosopis juliflora* (henceforth called *Prosopis*) is an invasive alien species (IAS) causing, economic and environmental harm. It has inflicted hurt to rangelands and farm lands and in particular is threatening pastoral and agro-pastoral livelihoods. *Prosopis* has invaded parts of wildlife reserves and National Parks threatening biodiversity. There are small scale initiatives in the utilization of the species and limited systematic efforts in its control, and management. The Government of Ethiopia (GoE) recognizes the importance of a strategic approach to control and manage this invasive species particularly in pastoral areas. In this regards the GoE has developed this document as strategic guidance for dealing with the problem.

The objectives of the Strategy are to i) prevent the expansion of *Prosopis* to un-invaded areas, ii) to reclaim and restore invaded areas after *Prosopis* clearance and iii) sustainably manage *Prosopis* for productive use and increasing biodiversity through the regulation and coordination of *Prosopis* management initiatives. This Strategy was produced through a consultative process including federal and regional representatives, academia and researchers, private sector, NGOs and civil society. A Rangeland Management Platform established by the Ministry of Livestock and Fisheries under the Pastoral Areas Livestock Development Directorate facilitated a series of technical forums and two national workshops to provide the opportunity for policy makers, development partners and practitioners to give their input and opinions, which have been incorporated in the final document. A national Taskforce of experts in pastoralism and the management of *Prosopis* coordinated the development of the document.

The end beneficiaries of the Strategy are pastoralists and agro-pastoralists in the rangelands, who will benefit economically from more productive livestock resulting from more productive rangelands. Development partners, government experts and other practitioners will support pastoralists and agropastoralists to implement the Strategy for collectively benefit from improved understanding and a more harmonized approach to *Prosopis* control and management.

On behalf of the Ministry of Livestock and Fisheries and myself, I am very glad to thank the National Technical Taskforce members, Regional Agricultural and Pastoral Development Bureaus (specifically the Afar Regional Government, Afar Region Agricultural Pastoral Development Bureau, Oromia Pastoral Areas development Commission, the then Somali region Livestock and Crop, Rural Development bureau, and SNNPR Pastoral Affairs Bureau), Ethiopian Institute of Agricultural Research,

Ethiopian Institute of Biodiversity, Development partners and civil societies and participants of the different consultations and national and regional workshops.

Dr Gebreegziabher G/Yohannes
State Minister
Ministry of Livestock and Fisheries

1.0 INTRODUCTION

1.1 Background

Invasive Alien Species (IAS) are species that are non-native to a particular ecosystem and whose introduction causes, or is likely to cause, economic or environmental harm. Invasive species are characterized by rapid growth rates, extensive dispersal capabilities, large and rapid reproductive output and broad environmental tolerance. IAS displace natural vegetation, reduce biodiversity, and compete for resources with crops and livestock so reducing productivity of agricultural systems. They can also cause physical harm to humans, livestock and wildlife. The loss of infested land means that land uses are displaced to elsewhere, so contributing to general pressures on land and conflicts related to land and land use. *Prosopis juliflora* (hereinafter referred to as Prosopis) is one such invasive species, which has become a significant problem in rural areas, and in particular in rangelands. In 2000 IUCN rated Prosopis as one of the world's top least wanted species (Lowe et al 2000).

Prosopis was introduced into Ethiopia in the 1970s as a soil conservation measure, with high drought tolerance. This was done without due attention to the invasive nature of the plant, and as a result it rapidly spread throughout the country and in particular in drylands and along water courses overtaking critical dry season grazing areas and irrigable land.

In Afar region the plant has spread from its original sources across the Middle and Upper Awash River Valleys and is now covering over 1.2 million hectares with 20 out of 32 woredas invaded (FARM Africa 2012). The plant continues to spread at a rate of between 20-50,000 hectares per year in Afar region alone (Tilahun and Asfer 2012). The plant is also invading from neighboring countries, and is now found in South Omo zone, SNNPR, southern Oromiya and Somali regions. Pockets of additional distribution are found in Raya Azobo and Kob Alamata Plains in southern Tigray as well as the northeastern part of Amhara Region, amongst many.

Some benefits have been realized from Prosopis through its use in for example, charcoal production, house/fence construction, livestock feed (through mixing ground pods with livestock meal), and it also has played a role in soil conservation (the original purpose for which it was planted) and in the fixing of nitrogen in the soil. Prosopis can result in a cooler local micro-climate, and where the plant is able to grow to a tree, shade is provided. There is also an understanding of the potential for developing other uses including using the wood for apiculture, woodchips,

flooring, and timber, and for using the biomass for fuel and the pods for livestock feed on a commercial basis.

However, in Ethiopia, *Prosopis* tends to grow as impenetrable thickets that have completely blocked access to vast tracts of land, particularly riverine areas. Palatable species in grasslands and indigenous multi-purpose (including fodder) shrubs and trees are lost. Sharp and poisonous thorns cause injury to humans and livestock. The incidence of malaria is said to have increased due to a moister microclimate than before. As a result livelihoods have been compromised and biodiversity has been lost. A study on the economic impacts of *Prosopis* on agropastoral households of Dire Dawa Administration showed that invasion had significantly decreased annual income of agropastoralist households from livestock and their products sale by 781 Birr (28.82%). People have turned to crop farming instead – where land had been cleared from *Prosopis* the soil was fertile (Haji and Mohammed 2013).

Pastoralists and agropastoralists in particular are complaining of *Prosopis* invasion in their lands, the adverse negative effects on their livelihoods, loss of understory grass growth and forage, its negative impact on animal health (when they consume large amounts of seed pods) and unforeseen effects including harboring cattle rustlers in rustling-prone areas or wild animals such as hyenas that have attacked women and children). Communities have invested time, energy and resources in clearing *Prosopis* with little effect on its spread. Studies conducted in parts of Afar and Somali region have confirmed that the pastoral community favors complete eradication of *Prosopis*.

Prosopis invasion has also displaced native trees and plants, with both biodiversity and economic implications. Invaded sites have been shown to include significantly less plant (grass, herbs, shrubs, trees) diversity and species richness than less or non-invaded sites (Getachew et al 2012; Alemayehu et al 2010). This includes in National Parks and other conservation areas, not only threatening conservation goals but also negatively impacting on tourism.

As such, and after careful consideration of the effect of *Prosopis*, there is general agreement amongst government, technical experts, communities and practitioners¹ that the disadvantages and costs of *Prosopis* for local livelihoods, rangeland health

¹ As reflected in the conclusions of the national Rangeland Management Platform in June 2014, which brought together government, technical experts and practitioners.

and biodiversity, and for the national economy due to reduced livestock production, outweigh the benefits.

1.2 Past interventions and lessons learned

There have been a number of positive initiatives that have tried to control and/or utilize *Prosopis*. Important lessons have been learnt from these initiatives, which guide further developments and actions.

Between 2006-2008 local expert studies coordinated and lead by the Ethiopian Institute of Agricultural Research (EIAR) through a GOE – UNEP/ GEF Project “Removing Barriers to Invasive Plants Management in Africa”, developed six national IAS management guidelines that include: National IAS Strategies and Action Plan (NISSAP); Cost Recovery Mechanism Procedures for IAS Management; National IAS Communication Strategy; Risk Assessment, Early Detection and Rapid Response Procedures for IAS Management; Generalized Training Modules and Guideline for Integrating IAS Issues into Curricula of Learning Institutions by targeted and extensive stakeholder input for invasive plant species including *Prosopis*. These guidelines are in the process of approval and not enacted yet. The NISSAP have been used as a key input into this document.

Development agencies and NGOs have also supported activities to eradicate and/or utilize *Prosopis*. However, these have been fragmented in their approach and done little to stem the rate of *Prosopis* invasion. Cost-effectiveness is also an issue – an initiative by the Awash Basin Authority (1995-2002) to clear *Prosopis* regularly over 36-km lengths of irrigation and drainage canals using bulldozers cost around ETB188,100 per year). In order to try and improve the cost-effectiveness the Authority changed to manual labor (2002 to present), which helped reduce the cost to ETB 54,000 per year in 2008. At a larger scale, such as in the entire district, an assessment concluded that the cost of clearing, even using local labor, is unaffordable to the local government or other nongovernmental development organizations operating in the region (Haregeweyn 2013). In addition these initiatives have paid insufficient attention to the rehabilitation of the land afterwards and to preventing *Prosopis* reinvasion. The land needs to be used immediately after *Prosopis* has been removed. Where the *Prosopis* has only been cut, and the root left in the ground, the stump has quickly coppiced and in many cases has resulted in a worse situation than before. As such there is a need for a local regulatory body to ensure that plant is properly removed, and that the re-invasion is prevented.

Initiatives that have supported income generation have shown that some economic benefits can be derived, and this can be quite substantial in some cases. However, it is not usually those who have lost the land to Prosopis that gain from these initiatives. Rather it tends to be traders, urban dwellers or youth who benefit: it is the individual who tends to accumulate the money raised, rather than shared with others in the community. Some success has been shown in mobilising community labour for clearing Prosopis through public works of PSNP or through NGO-supported projects – however these have been shown to be of greater success when they are part of long-term community development or rangeland management plans, and where communities have committed to the implementation of these without payment.

In parts of the country where larger-scale clearing operations are launched, it costs land users over 3,500 ETB to reclaim a hectare of Prosopis infested land (Gizachew and Muhie 2012). However though these activities have had some successes, they have been scattered, uncoordinated, lacked urgency and ultimately failed in controlling Prosopis spread. Reasons for this include:

- A lack of coordination in the response so that that activities have been haphazard, one-offs and fragmented.
- There has been a lack of integration of Prosopis control into inter- and intra-sectoral initiatives and activities.

Afar region issued a regulation for the control of Prosopis invasion, however it has not been implemented due to insufficient awareness and capacity of the regional government and local communities, lack of human as well as logistics resources within the government system to implement the regulation and lack of coordination, and commitment among stakeholders. Better implementation of such regulations require, among others, critical awareness creation on the invasion and control strategies particularly in areas at risk of invasion, capacity building on the control strategies, allocating the required financial, human, and material resources to woreda offices for the control initiative requires higher attention and commitment from the government and development partners. Moreover, the judiciary system should be sufficiently exercised to discipline local people/users of Prosopis who do not comply with the requirements of the strategy.

1.3 A strategic framework for Prosopis management

The Government of Ethiopia (GoE) has declared Prosopis to be a dangerous plant, which should not be cultivated or planted, and requires containment, control, management and ultimately its removal. The government at federal and regional levels is committed under international conventions to protect its biodiversity and environment. In 1992 the then Ministry of Agriculture was given extensive powers to control imports and exports, disposal, inspection and survey and treatment of land with regard to imported plants and plant products (under the Plant Quarantine Council of Ministers Regulation No. 4/1992).

To date, the government has attempted to fight Prosopis invasion at different levels however, there has been a gap in a strategic approach to control and manage invasive species particularly in pastoral areas. Therefore, there is an urgent need for coordinated, well-planned and strategic action to deal with the problem.

This document provides policy and strategic direction for the control of Prosopis invasion, technical guidance and lays out the institutional arrangement and human and physical resources required for the implementation of the Strategy. It provides different responses for different activities including preventing establishment, control and removal, and utilization of Prosopis either as part of its removal or where it is currently economically inefficient to invest in its removal. It is anticipated that it will guide the production and implementation of more context-specific strategies at national, regional and local levels and their implementation.

The objectives of the Strategy on Prosopis Management are:

1. To prevent expansion of Prosopis to un-invaded areas.
2. To reclaim and restore invaded areas after Prosopis clearance and sustainably manage for productive use, and increasing biodiversity.
3. To regulate and coordinate Prosopis management initiatives for complimentary and synergy.

This Strategy was produced through a consultative process including federal and regional representatives, academia and researchers, private and commercial sector, NGOs and civil society. A stocktaking and consolidation of information was carried out including unpublished research reports, the NISSAP and National IAS Communication produced by EIAR, and other relevant documentation. A Rangeland Management Platform meeting organized by the Pastoral Directorate provided an

opportunity for practitioners and those who have carried out pilot or small-scale initiatives to control *Prosopis*, to give their input and opinion.

This Strategy should be updated as new information becomes available that can guide the best management practices for *Prosopis*. An adaptive approach should be used in implementation, with flexibility to incorporate new information or lessons learned. Data and feedback gathered from the community and other land users and stakeholders² will be used to refine and improve future management decisions and ultimately, *Prosopis* management plans. Continuous improvement can only be achieved if investments in *Prosopis* control and management are resulting in progress towards the identified objective of *Prosopis* eradication; and are achieving the most effective and efficient outcomes.

² Stakeholders include federal development and environmental protection institutes, pastoral development bureaus and offices, agricultural and biodiversity research and higher learning institutes, NGOs, civic organization and professional bodies, local communities, private sector, UN agencies and donor communities.

2.0 STRATEGIC ACTION FOR PROSOPIS MANAGEMENT

2.1 Biological characteristics of Prosopis

Fast-growing, drought and salt-resistant, and with remarkable coppicing power, Prosopis has succeeded in colonizing large swathes of land across Ethiopia, and particularly drylands.

Prosopis is a thorny evergreen tree often reaching a height of 12 meters. In good soil and water conditions it can grow to a tree. Prosopis is tolerant to saline and alkaline soil conditions but is sensitive to cold weather and frost. It grows well in low rainfall areas with annual precipitation of less than 250mm. Prosopis has a well-developed taproot, which can extend up to 53 meters, which helps to source groundwater reserves, especially during the dry season. Young trees start fruiting 3-4 years after planting and the tree sprouts vigorously after coppicing. Flowering can be continuous throughout the year, although there is a period of maximum flowering, usually following the rainy seasons. The evergreen leaves of Prosopis are not liked or eaten by livestock.

Prosopis propagates through seeds and root suckers, requiring insects for pollination. It produces many, small sized and hard seeds which are able to pass the digestive system of animals. One pod can contain 10-25 seeds. There are about 4,000-12,500 seeds/kg of pods while one tree can produce 35-75 kg/year of pods. Taking the lowest estimate one tree can produce about 140,000 seeds per year. Prosopis seeds have a high level of dormancy; seeds can stay viable in the soil for 2-10 years, until they get a favorable condition for germination. The hard seed coat will be broken mechanically or degraded through time to allow water penetration and germination to occur.

Animals consume the somewhat nutritious seedpods and excrete viable seeds in their droppings, so helping spread the plant across their grazing areas. Livestock, particularly cattle, are mainly responsible, although wild ungulates are also capable of spreading the seeds. The process of digestion actually helps germination as long as the seeds are not damaged during chewing, especially since the expelled seeds are deposited in moist, nutrient-rich dung.

Seedpods are also spread by flooding and/or along irrigation channels. The establishment of Prosopis tends to meet its peak after periods of high rainfall, when conditions for germination and growth are particularly favorable.

The plant is very difficult to remove once established. Cutting the trunk at ground-level will only result in more aggressive growth as coppicing. In order to prevent re-growth at least 20-30cm of root below the soil surface needs to be removed (i.e. below budding area).

2.2 Interventions for Prosopis control and management

2.2.1 Deciding which interventions should be done where and by whom

Different interventions are required for i) Prevention of Prosopis establishment, ii) Removal of Prosopis, iii) Restoration, rehabilitation and use of cleared areas, iv) Containment and prevention of further spread. Different interventions will be required for a) highly invaded areas, b) moderately invaded areas, and c) areas at risk of invasion.

In some areas it is appropriate to utilize the biomass once it is removed. There might also be the case for controlled utilization of biomass from areas that are temporarily contained. The use of biomass can bring economic benefits to local communities, government and businesses, however a dependence on these benefits should not be encouraged because ultimately, the resource (the Prosopis) will be eradicated.

Mapping invaded areas of Prosopis and areas at risk of invasion: A first step in Prosopis management is to identify which interventions are suitable for which places and conditions. Information required for this identification will need to be gathered through a detailed analysis across the nation of the distribution of Prosopis, and its degree of establishment. Mapping the areas invaded and others that are at risk will help visualise the problem for both government and communities, and serve as a benchmark to measure changes and impact of interventions. Some work has already been completed in this regard (see Wakie et al 2014). Then decisions need to be made through a participatory consultation process of different actors, as to which interventions will be used in the different areas, and which areas demand attention first.

1. Immediate actions to prevent Prosopis establishment will be required in the following areas:
 - Lands at risk of invasion due to their close proximity to already infested areas e.g. access roads or resting/camping areas.

- Areas that have been removed of their natural vegetation or experienced recent soil disturbance such as embankments along newly built roads.
- River banks, primary and secondary irrigation canals.
- Along livestock routes and in resting places and in particular those that provide passage for long migrations to markets, including those that cross regional and national borders.

These areas should receive regular surveillance to ensure that invasion has not occurred and if it has, then immediate action to remove *Prosopis* should be taken

2. Priority actions to remove *Prosopis* will be required in the following areas:
 - In *Prosopis*-invaded high-value lands including dry season grazing, agricultural lands, or conservation areas.
 - Along livestock routes where livestock are regularly migrating from one place to another.
 - Lands close to residences where people and livestock are at threat from physical injury and/or harbouring of wild animals such as snakes.
 - Where *Prosopis* is blocking access roads to grazing, agricultural areas, water points, settlements etc.

3. Priority actions to restore, rehabilitate and use lands will be required where:
 - *Prosopis* has been cleared from the land and immediate restoration/rehabilitation and use of the land is required to prevent re-invasion.
 - In degraded areas at high-risk of invasion – if the land is restored, rehabilitated and used then there is less likelihood of invasion.

4. Actions to contain and prevent further spread will be required where:
 - Land has been invaded, but the land is not considered an absolute priority for clearance i.e. the land is not as high-value as above. The containment/enclosure will be a temporary measure until the top-priority areas have been cleared.
 - Resources are not currently available for clearance – so the area should be enclosed/contained until resources are made available.
 - Land has been invaded by *Prosopis* but the land is not a priority for clearance.

Decisions about what land should be used for after clearing, should be decided by those who used the land prior to the Prosopis invasion. This should be facilitated through a consultative process.

Action point: A multi-stakeholder consultative decision-making process will be facilitated to set priorities in different areas, and to decide on strategies and activities for prevention, clearance and rehabilitation for those areas.

The management and control of Prosopis needs to be led by consistent and enabling policy and legislation. The Special support and Pastoral Areas Development directorate in the Ministry of Livestock and Fisheries is best-placed to coordinate this work, but will ensure that policy, legislation and guiding frameworks are multi-sectoral and developed with relevant actors. The Directorate will establish a secretariat/office with full-time staff and an allocated budget to implement the Strategy. Roles and responsibilities of different actors should be defined and communicated. Regional and local governments will work at their designated levels of jurisdiction to ensure that the national strategy is rolled-out across the country.

Action point: National policy and legislation is required to provide the clear policy direction and enforcement mechanisms for supporting action on Prosopis. This should involve different sectors to ensure a coordinated and integrated approach. Within this, roles and responsibilities of different actors should be further detailed. All land users are responsible for playing a role in Prosopis eradication – both individually and collectively. Prosopis management should be included within all land use planning at different levels, reflecting national and regional Prosopis intervention plans, and within community rangeland management and action planning.

2.2.2 Proposed interventions and actions - general

a) Improve knowledge about Prosopis and build capacity and commitment to address the problem

Strengthening the national capacity and commitment to solve Prosopis problems and to create benefits where possible, is essential to ensure that appropriate action takes place. Capacity must be built at all levels – national, regional and local/community. Awareness needs to be raised on the dangers of Prosopis and how it can be controlled, including with some benefits. The majority must agree and

commit to addressing the Prosopis problem at a large scale – it has been shown that individual and piece-meal action has done little to curb Prosopis spread.

Actions to be taken include:

i) Raising public awareness on the dangers of Prosopis

Improved awareness and understanding of the issues surrounding Prosopis invasion is key to ensuring the engagement of the public in decision-making and for gaining wider support for relevant policies, programs, and activities. The public can play several roles in fighting Prosopis including reducing the spread, assisting detection and monitoring status. In order to reach different groups of actors, different awareness activities will be carried out and different communication channels used to reach different audiences. These can include dissemination of messages through traditional channels of communication, through village leaders, through websites, mass media, and posters e.g. at points of entry/exit from Prosopis-invaded areas, information leaflets, and codes of practice, identification guides, public talks and face-to-face meetings.

Action points:

The following are action points for raising public awareness:

- Develop and implement a national plan for raising public awareness through different communication channels.
- Develop and implement nationally consistent, regular and targeted Prosopis awareness activities through national bodies such as radio, the press, posters, leaflets.
- Train local government staff working in areas where Prosopis has invaded or is at risk of invasion, about the dangers of Prosopis and actions that can be taken, so that they can ensure the issues are mainstreamed within local government activities, whilst also informing communities to do the same.
- Raise the awareness of local communities living in invaded areas or areas at risk, as to what measures are most effective in the control of Prosopis (including at different stages of the growth cycle) (see below), and where they can obtain support to carry these out.
- Provide information to industries and the private sector about Prosopis, and opportunities to for example utilize Prosopis as a fuel during removal and control activities.
- Set up an emergency ‘hotline’ to register new invasions that require immediate attention to prevent their establishment.

- Give national recognition and awards to community achievements in Prosopis management.
- Establish annual campaigns where the public are mobilized for actions which contribute to Prosopis management.
- Support the development of networks for community-based action on Prosopis ensuring information exchange and coordination of activities, and monitoring of new invasions.

ii) Strengthening national and regional research extension programs on Prosopis

Strong research extension is required on Prosopis prevention, management and rehabilitation of lands after clearance. It is vital that policy and action on Prosopis is underpinned with a strong evidence and information base on what works best and how. Research outcomes will be a key component of risk assessment, surveillance, detection, monitoring, and control and eradication strategies. Action research is particularly important to generate information used to refine control methods as well as for assessing the feasibility of proposed action (for example, eradication attempts). Feasibility studies, often involving modeling, are a key tool for assessing the likely costs and probability of success for larger-scale control or eradication efforts. Research could also provide technological solutions to help address problems, including how best to rehabilitate land after clearing. Organizing various task teams to review control and management, detection and early warning will be required. There is a need for better strategic coordination of this research effort involving all members of the national agriculture research institutes, higher learning institutions, international research organizations, NGOs and other stakeholders. Storing information and making it accessible to different actors will also be required – see Section 3.6 on Knowledge Management.

Action points:

- Prioritize Prosopis research needs and identify, develop and initiate new research programs based on these. In particular research is required in effective rehabilitation and restoration of cleared lands and prevention of re-invasion.
- Encourage funding of research from donors that will provide the scientific basis to support Prosopis management and control decisions.
- Strengthen collaboration between research institutions, higher learning institutions, industry and development actors on Prosopis research issues.

- Ensure that research results and particularly those that indicate best practice in Prosopis management, are shared to different actors, and stored in an easily-accessible manner for future use.

iii) Monitor and evaluate progress of national Prosopis management efforts

Monitoring and evaluation of the implementation of the national strategy and action plan needs to be carried out to ensure that progress is being made according to the proposed timeline. Monitoring and evaluation also needs to be carried out to ensure activities to control and remove Prosopis are being effective. The reductions in or continuing spread of Prosopis also needs to be monitored and updated.

Action points:

- Monitor and evaluate progress of implementation of the national Prosopis Management Strategy and activities of the work plan, according to timeline, roles/responsibilities and budget.
- Monitor and evaluate the efficiency, effectiveness and appropriateness of the Prosopis Management Strategy and actions undertaken, in reducing Prosopis spread and removing from and rehabilitating the invaded land.
- Regularly monitor and update information on Prosopis distribution (increases, decreases etc.) including GIS mapping, at a national and regional levels.

2.2.3 Prevention of new introductions or establishment of Prosopis

Prevention of Prosopis establishment is the most cost-effective action possible. If new Prosopis plants are discovered before they are well established, eradication is possible. The goal is to intervene in the early stages of the process by preventing the introduction and early spread of new Prosopis plants by acting quickly i.e. pulling up the Prosopis as early as possible. It is the least environmentally damaging intervention, and can, with adequate resources, be applied to a greater or lesser extent over the long term. This should be complimented with the collection of mature seedpods from areas where Prosopis already exists. Prevention of new Prosopis establishment is a high priority intervention. The development of a Prosopis spread prevention program is considered in this section – see Box 2.1.

Actions to be taken include:

i) Early detection and rapid response (EDRR)

Early detection and rapid response (EDRR) involves an inventory and mapping of the invasion, a rapid-response plan, public notification and making the resources available to act quickly when a new invader is discovered. An important component of an early detection system is monitoring. Monitoring of new invasions must occur on a regular basis. Those who are regularly in the field can carry out the monitoring, including pastoral scouts assigned for such a purpose, development agents, agricultural experts, researchers, teachers, students, members of the military and police. Experiences indicate that even the best prevention efforts cannot stop all invasive species. EDRR is a critical second defense against the establishment of invasive species. EDRR increases the likelihood that localized invasive population is contained, and eradicated before they become widely established. EDRR can slow range expansion, and avoid the need for costly long-term control efforts. Vigilance is key to enable the early detection of new arrivals. It is also important that there is surveillance on updating the status (population levels and/or range and pattern).

There are three components of EDRR:

- i) Early detection – establishing mechanisms for ensuring that new invasions are identified, notified and action taken.
- ii) Rapid assessment – the context and scale of the new invasion should be assessed – maps and other information on the invasion will be collected.
- iii) Rapid response – a systematic effort will be made to eradicate the new invasion as quickly as possible and before it becomes widely established.

Action points:

The following are action points for prevention of establishment:

- Identify high-risk areas for *Prosopis* invasion within the country, and target attention to these immediately in order to take measures to prevent invasion.
- Develop and implement a national *Prosopis* spread prevention program and plan that includes effective measures to prevent *Prosopis* – this should be implemented through the different levels of government with clear roles and responsibilities.
- Map out livestock routes so invasion can be prevented along the routes and from a *Prosopis*-invaded area to a *Prosopis*-free-zone. Strengthen border and pre-border controls where livestock routes are known in order to prevent further *Prosopis* spread.
- Maintain, review and update import protocols to maximize protection against further introduction of *Prosopis* into the country.

- List Prosopis as a noxious plant, and ban any planting of it.
- Establish a nationally coordinated Prosopis alert and early warning system that includes effective surveillance mechanisms.
- Declare Prosopis-free-zones and prevent movement of livestock into these areas from infected areas, and ensure extra vigilance here to prevent Prosopis establishment.
- Governments, regional bodies and industry to develop contingency plans for action against new Prosopis infestations.
- Establish core capacities at the regional and national levels for responding to Prosopis intervention needs.

ii) Controls over livestock movement

Livestock are known to be the major agent of Prosopis spread. Livestock preferentially browse on the palatable Prosopis pods once they have fallen to the ground. Once ingested the seeds may take up to eight days to pass through an animal. Seeds excreted by livestock are more likely to germinate. Livestock movement within and between properties should be carefully managed to avoid spread. Particular care should be taken when purchasing livestock from regions as they may be carrying Prosopis seeds internally. Prosopis-free-zones should control livestock coming into their areas from Prosopis-invaded areas. In addition livestock movement corridors will be under special surveillances so that early removal of new Prosopis seedling is made possible.

Action points:

- A public awareness campaign on Prosopis should include information on how Prosopis is transported including through livestock, and what controls are necessary to stop its spread.
- Prosopis-free-zones should put in place controls to prevent spread transmitted by livestock from Prosopis-invaded areas. Where livestock are known to have come from these areas, then they should be quarantined in a specially designated paddock (enclosure) until the seeds have been excreted (around 8 days). The paddock should be monitored constantly and any seedlings removed and/or manure/seeds removed and destroyed after each set of livestock
- Removal of Prosopis from known major livestock routes is a priority. Regular monitoring of livestock routes should be carried out at different levels to identify Prosopis invasions, and immediate action should be taken to remove any plants that establish.

- Livestock should be prevented from grazing/browsing in or close to Prosopis infested areas. Controls (potentially with penalties/fines) should be put in place to control this. Infested areas that are not going to be cleared in the near future should be fenced-off preventing access of both domestic and wild animals.

Box 2.1 Developing a Prosopis spread prevention program and plan

Prevention of spread is the most successful and cost effective way of managing Prosopis. Domestic stock, wild animals, water flow (rain, floods, irrigation channels), vehicles, and careless Prosopis clearance all spread Prosopis. With careful attention and planning Prosopis spread can be prevented. A program or plan to prevent Prosopis spread needs to focus on the different transmission mechanisms and put in place safeguards.

Livestock are known to be major agents of Prosopis spread. Seeds excreted by livestock are more likely to germinate. Many remote road infestations can be attributed to livestock truck movements due to dung being spread as the truck moves or being excreted in animal resting places. Livestock routes can also be major areas and means of infestation. Prosopis spread can be avoided by: a) Isolating incoming stock to a new area (particularly when know to be coming from a Prosopis-infested area) in a designated quarantine paddock for at least eight days. b) Frequently monitoring quarantine paddocks to detect any newly establishing Prosopis early, which when found should be removed immediately. c) Preventing grazing or browsing in areas where mature pods are available, including the fencing/enclosing of Prosopis-infested areas.

Rivers and irrigation channels can carry the seeds from one area to another, and when they flood these can be deposited on banks and in fields. This is likely to be a major course of the infestations along riverbanks. Filters/dams can be used to stop seeds flowing downstream. Irrigation canals should be regularly cleaned.

Vehicles entering Prosopis-infested areas can pick up seeds with mud e.g. in the treads of their tyres. Transporting Prosopis should be avoided and removed plants should either be disposed or used on-site. Where Prosopis is transported utmost care should be taken to ensure that there is no danger of seeds dropping from the vehicle and/or no seeds are stuck between the tread of vehicle tyres. Once the vehicle has finished its transportation of Prosopis it should be washed down in a place where Prosopis seeds can be easily disposed of. Alternatively seeds should be brushed from the vehicle and be carefully and appropriately disposed of.

Careless Prosopis clearance can also be a cause of spread. In order to avoid this, workers clearing Prosopis should always work from clean/clear areas back towards infested areas. Clearance works should be scheduled prior to seeds setting on trees/shrubs. All those working on Prosopis clearance should be aware of dangers of spread and of Prosopis identification. All machinery used on site, should be cleaned before leaving the area.

Wild animals have also been shown to spread Prosopis. There is a lack of information about how best to control this. However, preventing them entering into heavily-infested areas by enclosing these areas, would be one measure that could be taken. Experiences from other countries in this regard will be sought.

2.2.4 Removal of Prosopis where it is already established

Preferably Prosopis is removed when the plant is small – but this requires early detection and response (see above). There is also a need for sufficient financial resources to carry out activities, and the commitment of local stakeholders. Often action is not taken early enough, and this means that the plant is well-established by the time removal is attempted. As described in Section 2.1, the physiology of the plant makes it very difficult to remove. And once removed, the cleared land needs to be used immediately and constantly to prevent the re-invasion from dormant seeds still found in the soil. Widespread invasions are subject to control efforts that slow the rate of range expansion and lessen the impacts of invasive populations. Complete eradication will be difficult. In some areas the best approach in the short-term may be to simply contain the Prosopis and to prevent further spread (see Box 2.2).

Box 2.2 Containment as a short-term temporary solution

Containment of Prosopis is a potential management option, however the actions required to achieve containment are likely to be expensive and labour intensive. Effective containment will also require the management of Prosopis spreading agents. Areas for containment will need to be clearly defined and mapped. In this type of management, Prosopis areas will be identified and prioritized for systematic treatment. High priority areas (i.e. those with highest agricultural, rangeland and conservation values) and those where the resources required are least, are treated first. Other areas are treated as resources become available. Controlling outlying plants is the priority to reduce further dispersal. Plants at the centre of infestations are controlled progressively as resources allow. Costs decrease over time as densities are reduced and mature plants are removed reducing dispersal and new establishment. Controlling the smaller and least resource demanding infestations first ensures that these infestations do not expand while resources are spent at one or two large resource-demanding areas. Ideally, resources would be available to begin control on all infestations immediately however this is seldom the case so temporary containment may be the only option. All livestock should be kept out of these containment areas.

There are several management options for removing Prosopis including mechanical, chemical, biological and/or integration of two or more of these methods (see Box 2.3). Whichever method is chosen, this should be used in an environmentally safe and socially acceptable manner. Local and other stakeholders should make decisions together about which method will be used, when and where. Though the focus of action is very site-specific, it is important that evidence-based experiences and best practice from other sites are considered.

2.3 Methods for integrated management and removal of Prosopis

Integrated Prosopis control involves using a combination of control techniques to manage and remove Prosopis in order to increase efficiency and effectiveness. Integrated control generally results in more effective longer-term Prosopis management outcomes. A systematic plan for management and removal should be produced, describing methods to be used, where, when, and by whom. More information on the use of these methods will be provided in the practical handbook and manual to be produced by the Pastoral Directorate, Ministry of Livestock and Fisheries and EIAR.

1. Chemical control can be used in combination with mechanical control. Only those chemical products authorized and registered with the local government office must be used in the control program. Government will allow the importation and the use of the chemicals for the purpose of Prosopis control under the existing legal framework. The registered product must be used at a recommended concentration, rate or frequency that is specified on the label. The chemicals should only be used on the plant itself, spillage must be avoided, and storage appropriate. Old engine oil and creosote can also be used to prevent re-growth. The thick bark on older trees can prevent the absorption of the chemicals. Therefore, older trees should first be cut and chemicals applied to their exposed stumps.

2. Physical removal of Prosopis is made difficult by the deep and vigorous root system and large thorns on branches. In mature trees, root systems may exceed a depth of 50 metres. The removal of plant material and disturbance of soil which results from physical removal of Prosopis can create ideal conditions for seed germination so it is vital that the land is rehabilitated and used immediately after Prosopis clearance. Mechanical methods include:

- **Hand cutting and root removal.** This has to date, been the most common mechanism used for Prosopis removal. In Afar, local communities have designed a long stick with a hook at the end that can be used to assist pulling branches forward for cutting. Saws and (including chain-saws) are used for cutting trunks. Once all foliage and branches/trunk have been cut then 20-30 cm of root (i.e. below the bud zone) needs to be removed to reduce the likelihood of re-shooting. Alternatively the trunk can be cut off close to the ground and chemicals applied to prevent re-growth (though the success of this is low). All foliage/root should then be burnt (unless arrangements have been made to use it – see below).

- **Blade ploughing** cuts off plants stems/trunks below ground level. This control method is suitable for low to medium density infestations. It is best undertaken before seeds have set or when root reserves are low. Success depends on cutting the root system below the bud zone (20–30 cm) to reduce the likelihood of re-shooting. Attachments can be front- or rear-mounted on vehicles including bulldozers (D6 and above) or 4 X 4 tractors (80 hp or more). Care should be taken to avoid native plant species when blade ploughing, as these plants will provide competition for Prosopis seedlings when they start emerging after soil disturbance (ploughing).

- **Bulldozer pushing/grubbing** is effective for both low, scattered densities and for medium and high densities of Prosopis. This method is similar to blade ploughing in that it aims to use a blade to push over individual trees at or below ground level. Bulldozers can also dig up the roots. As above, care should be taken to avoid damage to native plants and trees.

- **Chain pulling** can be used in the control of high-density Prosopis tree infestations. Chain pulling, which involves dragging a heavy-duty chain between two dozers through an infestation, is effective only if used in combination with fire, and followed up with chemical treatment and complete root removal.

Fire can be used to burn removed biomass and soils containing large amounts of seeds in highly-infested areas. However, care needs to be taken that fire is controlled and does not spread to other species. There is also evidence to suggest that fire can increase the germination of Prosopis seed in the seedbed.

3. Biological control

Biological control involves the introduction of insects or pathogens to control exotic plant species. To date, four introduced biological control agents, including two seed-feeding beetles, have been used in some other countries for the control of Prosopis. This method could be recommended in areas where Prosopis infestation is believed to be highly aggressive and to ensure eradication. The introduction and use of the biological agents will follow the existing legal framework of the country. Currently testing of biological agents is being carried out under controlled conditions. As such the use of biological control has not yet been approved.

Where Prosopis is producing mature seedpods, these should be collected before livestock can feed in the area. It may be possible to use these pods (see Box 2.4).

In cases where local community action is required, this action should be integrated into community action plans as part of their rangeland management strategy. They should understand that results may not be immediately apparent, and repeated effort may be required to produce obvious reductions in Prosopis distribution and density. In this regards, all projects and different stakeholders should be coordinated so that Prosopis removal and control is completed in a systematic and coordinated manner. Inter-regional communication and regionally coordinated action is required.

Action point: Establish a mechanism for coordinating projects and different stakeholders involved in Prosopis management to facilitate better information sharing, to ensure systematic and complementary program of activities, and to make the best of opportunities for partnership working and other resource synergies.

Successful Prosopis management may require significant investment over an extended period of time. In particular, the control of large, established infestations require careful planning, prioritization and budgeting. Results may not be immediately apparent, as repeated effort may be required to produce obvious reductions in distribution and density. Control and management of Prosopis can be considered for two main scenarios – areas with low infestation and areas with

moderate/high infestation. These two scenarios demand different approaches and actions. In all cases preventing re-invasion is a key activity, most ably achieved through immediate and intensive rehabilitation of the land and continued use.

1. Approaches and actions for areas of low infestation.

In areas where there is low infestation of *Prosopis* and/or it has only recently established itself, action can be taken to arrest the advances. Eradication is a realistic objective in this kind of situation. Small isolated infestations should be prioritized for action by agricultural extension agencies. Where removal of the *Prosopis* in these areas is not possible immediately, then action should be taken to prevent further spread of the *Prosopis* e.g. by livestock.

Action points include:

- Develop and implement a nationally agreed *Prosopis* response plan for management, eradication or containment. Roles and responsibilities of different institutions and actors will be defined for each intervention including such as the private sector.
- Organize collective and individual physical removal or control activities at an appropriate time and frequency (several times in the season). This should include an immediate local public awareness campaign to ensure that everyone in the local area is aware of the dangers of *Prosopis* and what action needs to be taken. At community levels, action on *Prosopis* should be incorporated into community action plans. For information on different options for removal or control, see Box 2.3 above. Training in these different approaches and tools will be required for those involved, and a short practical manual in the local language will be produced to aid this.
- The Pastoral Directorate, Ministry of Livestock and Fisheries and EIAR will produce a *Prosopis* Management Handbook, based on good practice. This will be translated into local language(s) providing technical guidance on *Prosopis* management for use by local government and local communities, and training provided. These will be disseminated to all relevant government departments and offices.
- Prevent further spread of the *Prosopis* by fencing the areas and/or preventing livestock entering the area and feeding on the seedpods. Seedpods should be collected from the ground immediately they fall, and where possible collected from the plants before they fall. If livestock have

accessed the area and are known to have fed on the pods, then these animals should be quarantined in an enclosed area until they have deposited the seeds in their manure, which can then be burnt. Prosopis should not be transported from the local area without government permission/permit, but rather destroyed (e.g. burnt) on site.

- A local community monitoring system should be set up to watch for new Prosopis plants. Those responsible can either take immediate action by pulling up newly established plants or inform the community leaders and/or government (Woreda Prosopis Management Committee if established – see below) so collective action can be taken. Monitoring should be an ongoing process, and particularly during flowering prior to development of seedpods. Cleared areas will need to be monitored for at least 10 years to ensure that all seeds left in the soil have been destroyed, and any new seedlings emerging are immediately destroyed.
- Deploy an integrated management program followed by coordinated control on a continuous basis in order to keep cleared areas free of Prosopis. Control also involves ensuring the use of proper disposal methods for invasive plant material removed and where appropriate the removal of the top layers of soils to remove seed bank. The most effective mechanism for preventing re-invasion is rehabilitating and using the land immediately and intensively, with any new Prosopis seedlings appearing being removed and destroyed immediately. Rehabilitation of the land is discussed further below

2. Approaches and actions for areas with moderate and high infestation

In areas of moderate and high infestation a more coordinated and collective response needs to be taken. Because of the scale of the problem it is likely that individual action will make little difference and it would be better for individuals to work together. The main focus in these areas will be to use integrated measures targeted at substantially reducing dense infestations. Control of Prosopis requires initial deployment of an integrated management program followed by maintenance control. Maintenance control involves use of techniques in a coordinated manner on a continuous basis in order to maintain invasive populations at the lowest acceptable level. Control also involves ensuring the use of proper disposal methods and areas, especially with respect to invasive plant material. Control methods should be socially, culturally and ethically acceptable as well as efficient, effective and environmentally-friendly.

Where large-scale removal of biomass is taking place, there may be interest from local businesses to use the biomass for such as a fuel source e.g. in cement making. However, it would be expected that the land is not only cleared, but also rehabilitated afterwards. Agreements to this effect could be made between national or regional government and the business.

Action points include:

- As above, develop and implement a nationally agreed Prosopis response plan for management, eradication or containment. Roles and responsibilities of different institutions and actors will be defined for each intervention including such as the private sector.
- Organize collective removal and/or control activities at an appropriate time and frequency (several times in the season). This should include an immediate local public awareness campaign to ensure that everyone in the local area is aware of the dangers of Prosopis and what action needs to be taken. For information on different options for removal or control, see Box 2.3 above. Training in these different approaches and tools will be required for those involved. At community levels, action on Prosopis should be incorporated into community action plans.
- Prevent further spread of the Prosopis by containing it in fenced areas and/or preventing livestock entering the areas and feeding on the seedpods (see above), whilst preparations are made to clear the Prosopis. Prosopis pods should be picked up and destroyed or used, where they have dropped. Cut Prosopis will not be transported from the local area without permission/permit, and rather should be destroyed (e.g. burnt) on site.
- A local community monitoring system should be set up to watch for new Prosopis plants. Those responsible can either take immediate action by pulling them up or inform the community leaders and/or government (Woreda Prosopis Management Council) so collective action can be taken. Monitoring should be an ongoing process, and particularly during flowering prior to development of seedpods. Cleared areas will need to be monitored for at least 10 years to ensure that all seeds left in the soil have been destroyed.

- Deploy an integrated management program followed by coordinated control on a continuous basis in order to keep cleared areas free of Prosopis. Control also involves ensuring the use of proper disposal methods for invasive plant material removed and where appropriate the removal of the top layers of soils to remove seed bank. The most effective mechanism for preventing re-invasion is rehabilitating and using the land immediately and intensively, with any new Prosopis seedlings appearing being removed and destroyed immediately. Rehabilitation of the land is discussed further below.

4. Restoration and rehabilitation of cleared lands

Cumulative impacts of direct and indirect effects of Prosopis invasion can adversely affect ecological processes and availability of soil nutrients and water. Therefore, rehabilitation of an area invaded by Prosopis involves restoring an ecosystem to its pre-invasion state or to a preferred new state - wherever possible. Any action should be cost-effective and proportionate to the level of change, threats and opportunities, as well as taking into account any possible consequences for native species. It should be noted that rehabilitating the land will be costly and require ongoing labour and resource demands – so the use of the land should take account of these investments. Where land users have secure rights of access, use and/or 'ownership' then they are more likely to commit to providing the high investment required for rehabilitating the land.

Once restoration has taken place, the area needs to be kept clear of Prosopis re-invasion – this will require constant surveillance. As noted above it is likely that a significant Prosopis seed-bank will have accumulated in the soil, which can germinate sequentially over many seasons or years following first-round eradication. Sustained and long-term control mechanisms are required to prevent this.

Action points include:

- The first step in restoration/rehabilitation work is an assessment of the current situation (the soils, water, vegetation etc). Then decisions need to be made as to what the land should be used for after clearing – whether to restore it to its previous use, or to rehabilitate the land for another use. These decisions should be made with the full involvement of land users. Where possible, communities/land users should be given secure rights of access/tenure to the land to warrant the investment required by them in the rehabilitation.

- A plan of action should be defined by all relevant stakeholders, and with the input of experts on restoration/rehabilitation of lands, ecology, hydrology, land use planning etc. Those sites that have highest ecological, social and/or economic values should be targeted first. The roles and responsibilities of different stakeholders should be made clear in the action plan. The rehabilitation plan should reflect and feed into local level (government or community) land use and development planning processes.
- In rehabilitation activities as much as possible native species should be used.
- Develop a monitoring plan that ensures constant surveillance of the land in order to prevent re-invasion. Any new plants that try to establish themselves should be removed immediately.
- Grazing should be minimized for a period of time after any control efforts to encourage the growth of perennial grasses. The competition from many pasture species can reduce *Prosopis* germination and seedling growth.
- Establish demonstration projects, focusing on invaded or highly threatened areas within each regional state from which different stakeholders can learn and ensure annual reporting by the competent regional agency.
- Any areas that have been re-infested should be prioritised for further action i.e. removal of new plants. Cleared areas will need to be inspected regularly for 10 years or so to ensure that all the seeds from the seedbank have been destroyed.
- Document through multimedia, written materials, successful restoration projects/programs involving recovery from the impacts of *Prosopis* invasion. Promote information sharing activities among stakeholders about restoration projects.
- Carry out research on restoration/rehabilitation in order to identify what combination of plant species (including those that best compete with *Prosopis*), inputs, tools, methods etc. work best in different contexts.

5. Utilization of *Prosopis*

Though this Strategy is concerned mainly with management and ultimately, eradication, of *Prosopis*, there are opportunities to use the *Prosopis* biomass as it is removed during rehabilitation activities. In addition, as highlighted above, due to the scale of the problem some *Prosopis* stands (i.e. of those of lesser priority

situation on lower-value lands) will have to remain for some time until after the priority areas have been tackled (eradicated and rehabilitated) first. If it is possible to contain (e.g. enclose) these areas in order to prevent spread of Prosopis from them, then there is the opportunity to use the biomass e.g. through coppicing. This can raise benefits for communities, governments and local businesses. However, it should be made clear that at some point the resource will be completely removed so those using the Prosopis should not become dependent on it. In addition strict rules and regulations of use will be required to prevent further spread of the plant, together with clear benefit-sharing agreements.

Box 2.4 Potential uses of Prosopis biomass as part of removal or containment activities

Prosopis biomass generated during removal can be used for a number of purposes. Most Prosopis in Ethiopia grows as bushy thin-trunked shrubs, so their use is limited. However most usefully Prosopis biomass (and on a large scale) can be used as a fuel source for industry e.g. cement making. As described in Section 1.2, a number of NGOs have supported charcoal-making from Prosopis – this is also an opportunity but needs to be carefully controlled and monitored to ensure that it does not encourage the additional use of indigenous trees for charcoal. Experiments have also been carried out (by NGOs) in the use of Prosopis pods for animal feed, which requires grinding the pods to a powder and mixing with other animal feed. Problems have arisen in sourcing appropriate mills for the grinding process and which can deal with the tough and moisture-absorbing pod fibers. Good success has been achieved in a commercial capacity however, with Ethio-feeds in Adama producing animal feed that contains some ground Prosopis seeds on a commercial basis.

3.0 MONITORING, INSTITUTIONAL ARRANGEMENTS AND KNOWLEDGE MANAGEMENT

3.1 Monitoring

Monitoring of Prosopis spread, cleared and rehabilitated lands, and any re-invasions is an integral part of Prosopis management and should be mainstreamed in all activities (as above). The objectives of monitoring Prosopis controls are to determine the change in number, size, maturity and density of infestations and to assess the presence and extent of any re-growth from treated areas or new seedlings/establishments. This can be achieved by periodic monitoring of a representative sample of areas before and after control. Realistic timeframes and goals should guide this monitoring.

Monitoring the spread of Prosopis will need to be constant in order to identify new areas for interventions, and in order to assess the success of interventions already underway. Where sites have been treated or cleared and rehabilitated these will need to be monitored for at least ten years, as seeds left in the soil may still germinate during this time. This monitoring should commence not later than three months after clearance or treatment. Monitoring of bare sites can also be carried out to watch for new invasions. Where distribution and spread of Prosopis is monitored, consistent measurements should be used such as plant size classes in meters (tree over 5 m, tree 2-5 m, shrub 0.5-2 m, shrub less than 0.5 m, seedling). Annual reports and periodic reviews will demonstrate what is being achieved, requirements for additional resources, and/or identify any shortcomings of the programme.

Maps will be produced of Prosopis spread at the national level. The maps can also show the different treatments underway in different areas. All monitoring sites should be shown on these maps. The maps should be regularly updated to show any changes. This information should be shared with regional governments and others in order to feed into land use planning and development processes. The maps should be digitised in GIS, so that they can be regularly updated and overlaid with other GIS maps of the areas concerned.

In order to assess the success of the overall Strategy and work plan, monitoring of progress (including performance indicators) will be required at different levels by the Prosopis Management Councils (see below). Different representative sites should be monitored including those receiving different treatments. This information should be fed back into interventions and processes so that they can be improved.

National and regional research institutes will play a role in monitoring the distribution of Prosopis and the impacts of interventions.

Action points:

- Develop a monitoring program to monitor further spread, reductions, and other changes in Prosopis distribution and the impact of different interventions.
- Produce maps of distribution of Prosopis, interventions and changes as they occur, which should be updated on a regular basis.
- Develop a monitoring program to monitor the progress of the Strategy for Prosopis Management.

3.2 Mainstreaming of Prosopis in land use planning and development activities

Prosopis is one of many rangeland issues that require incorporation into land use and development planning processes at different levels. At national level the proposed development of a National Land Use Plan provides an opportunity to integrate Prosopis and other invasive species into land use management decisions across the country. Participatory rangeland management (PRM) is a process that improves rangeland management decision-making and planning at the local level including Prosopis management as part of this: appropriate consultation and buy-in from local stakeholders can significantly improve the intended impact of strategic action. When communities have greater feelings of ownership over decision-making processes and receive benefits, they are more likely to invest time and resources in Prosopis activities. Though programmes such as PSNP (Productive Safety Net Project) can be a source of labour for Prosopis activities, such payment-for-labour schemes should be avoided as they encourage dependency.

In addition, government-led development projects including the Ministry of Livestock and Fisheries resilience-focused projects, environment and forest-focused projects of the Ministry of Environment, Forests and Climate Change (MEFCC), PSNP, the Ministry of Federal and Pastoral Development Affairs (MOFPDA) PCDP (Pastoral Community Development Project), Ministry of Agriculture and Natural Resources SLMP (Sustainable Land Management Program) and watershed management provide opportunities to mainstream the management and control of

Prosopis and other invasive species, as part of integrated land use and development planning.

Action point:

All land use planning and development projects in pastoral areas in particular pay attention to Prosopis, and where Prosopis IS present this Strategy should be followed in order to control, utilise and ultimately remove it.

3.3 Prosopis and land security

Strong long-term incentives to sustain Prosopis removal and management do not exist – insecure tenure in pastoral areas means that communities are cautious to invest time, energy and resources in Prosopis removal and management. Without secure tenure, income-generation schemes such as carbon sequestration and other payments for environmental services are difficult, if not impossible, to implement.

Action point:

Secure land tenure for local rangeland users, including communal lands, is made a priority in order that communities have greater incentives to protect and manage their lands and controlling of Prosopis in the long-term.

3.4 Management structures required, and roles and responsibilities

Better coordination is fundamental if Prosopis is going to be tackled on the scale required. Mandates, roles and responsibilities of different institutions including sectoral ministries, regional offices, development actors, private sector and local land users should be agreed upon and clearly defined.

3.4.1 National and regional

A National Prosopis Management Council (NPMC) will be set up in order to coordinate the process of Prosopis management. The Council will constitute ministers and executives of agencies including key stakeholder institutions such as MOANR, MOEF&CC, MOFPDA and EIAR, relevant CSOs and NGOs. The Council will also have a Secretariat. The Secretariat will be the Ministry of Livestock and Fisheries. The MOLF will dedicate responsibility for implementation of the Prosopis Strategy to the Special Support and Pastoral Areas development coordination Directorate, which will both serve as Secretariat to the Council and coordinate activities.

The NPMC will have wide representation of stakeholders and key decision makers. It is anticipated that these stakeholders will have capacity to mobilize resources and support; facilitate adoption and implementation of policies; champion and lobbying action with a low operational budget; facilitate inter-agency coordination and collaboration, policy, strategy and action-plan alignment and streamlining of the approach. The NPMC will be replicated at regional and woreda levels. Terms of References for these bodies are provided in Annex 1.

The enhanced stakeholder involvement in the proposed overall coordination mechanism is ensured through the use of additional supporting structures such as a Technical Advisory Panel, with members drawn from diverse stakeholder institutions; the Special Support and Pastoral Areas development coordination Directorate, Rangeland Management Platform; and various working groups operationalized as deemed necessary.

The national Prosopis Management Plan will be endorsed by the NPMC, and will be reviewed on an annual basis. This will include a budget for its implementation. The NPMC will oversee the progress of the Plan based on regular monitoring. Regional and woreda PMCs will play similar roles at their respective levels of authority and oversight.

Effective and cooperative Prosopis management can only be achieved if all stakeholders understand the risks posed by Prosopis and the control methods needed to strategically manage these risks. The Special Support and Pastoral Areas development coordination Directorate, and regional pastoral bureaus or commissions will be responsible for coordinating different stakeholders and development activities across the country, and in allocating available resources. The Special Support and Pastoral Areas development coordination Directorate will be responsible for producing a comprehensive range of extension materials, including a Prosopis Management Handbook (as above), which aims to help the community and other land users identify, prioritize and control Prosopis in a manner and which is consistent with best management practice and an enabling legal framework. The NPMC and Technical Advisory Group will provide oversight.

National and regional research institutes will be responsible for research, piloting different approaches and for disseminating results. They will also provide input to monitoring and impact assessment tools. NGOs and development agencies can assist in public awareness programs, building the capacity of local communities to undertake interventions and activities, and provide resources for Prosopis management as part of rangeland management and development support. Civic

organization and professional bodies can assist in raising awareness of different stakeholders on the dangers of Prosopis, and facilitating stakeholder discussions and planning processes. Communities will be at the frontline of activities on the ground. The private sector can also play a role in activities to manage Prosopis, through agreements with regional and local governments.

3.4.2 Woreda level

Woreda level engagement of responsible offices is essential in order to achieve Prosopis clearance and management of the cleared land. This should be carried out as part of the woreda development planning, with support from the PSNP and other government and NGO activities. By doing so the woreda should be able to leverage funds to support the implementation of activities.

Action points:

- Establish and operationalize a Woreda Prosopis Management Council to coordinate and provide oversight of Prosopis management at national level.
- Establish and operationalize regional and woreda Prosopis Management Council to coordinate and provide oversight of Prosopis management at local levels.
- Establish and operationalize a Technical Advisory Panel to provide technical support to the implementation of the Strategy.

3.4.3 Trans-boundary dimensions

Prosopis has trans-boundary dimensions. The movement of livestock has a role to play in this spread, though this movement cannot be prevented as it is a key livelihood strategy in order to access markets and necessary to avoid famine and environmental disaster in these dry land areas. A control mechanism can be put in place to restrict the spread of Prosopis seeds by livestock. This could include the establishment of quarantine areas where livestock can be held for 10 days or so to ensure that seeds have passed through before movement and a system of permits stating where the livestock have come from and where they are permitted to go. A system to facilitate, but better control cross-border movement across the region can be coordinated by IGAD (Inter-Governmental Authority for Development). The national government will work with IGAD to identify how best movement across international borders can be facilitated, supported and controlled in order to

optimise livestock production and marketing, whilst also preventing the further spread of Prosopis.

Action points:

- Develop mechanisms to control Prosopis spread across regional and national boundaries.

3.5 Legal activities and penalties

A legal framework is required to enforce controls on Prosopis access and use. Legislation will be developed in this regard, including permits for use and movement of animals outside regular (normal) grazing areas. Woreda and kebele level regulatory systems need to be strengthened to implement the regulatory activities to prevent operations that may contribute to Prosopis spread and be provided authority to give out fines for offenders. Arrangements will be made to facilitate agreements with such as local businesses to use Prosopis biomass as part of removal activities.

Action points:

- Develop a legal framework for enforcing controls on Prosopis, including providing woreda and kebele with sufficient authority and guidance to enforce legislation at the local level.

3.6 Knowledge management

Information on the distribution, abundance, rates of spread, and impacts of invasion are critical to their control. Up-to-date information is required on the spread of Prosopis, its status and interventions undertaken to control it. Dedicated institutions need to be created and motivated in order to coordinate action, harmonise approaches, share information and monitor spread, removal and rehabilitation. National and local regional organisations can play a key role in this.

Coordination of data collection is required, and strengthening of data-holding and sharing mechanisms. National and regional governments will lead this coordination, with the oversight of the PMCs. Regular updated Prosopis data is fundamental for planning, prioritizing and coordination management activities. Information will also need to be shared with the Rapid Response team.

Action points:

- Knowledge management systems that can be updated on a regular basis need to be developed to share information on Prosopis, and its distribution and management.

3.7 Resources required

Eradication of established populations of Prosopis requires significant resources and years of committed action to accomplish. Resources are required to support these recommendations including for filling information gaps through research, bringing relevant actors together, financing interventions, and so on. To date limited resources have been committed or made available by national or regional governments. A certain degree of funding can be acquired by utilising the Prosopis biomass as it is removed – the private sector can play a role in this, but mechanisms should be in place to ensure that at least part of this income is returned into control and rehabilitation measures (see above).

Government resources need to be allocated to the eradication and/or control of Prosopis at national and regional levels. The Special Support and Pastoral Areas development coordination Directorate, and regional governments with support from the PMCs, will develop proposals for funding from donors. Government departments should include activities to control Prosopis and other invasives within their yearly budget planning. Regulations should be put in place to ensure that a percentage of money raised from the sale of removed Prosopis biomass is used for further control and rehabilitation measures. Resources can also be contributed by NGOs working on rangeland management and other related activities with local communities. It is also anticipated that communities themselves will also be willing to invest time and resources in Prosopis management.

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Annex 1

TOR of the National Prosopis Management Council (NPMC)

The Ministry of Livestock and Fisheries will be the chair of the National Prosopis Management Council, including EIAR, Institute of Biodiversity, Ministry of Environment, Forests and Climate Change, Ministry of Agriculture and Natural Resources,, Ministry of Science and Technology, Ministry of Defense, Ministry of Federal and Pastoral Development Affairs, and representatives from development partners, research organisations and civil society will be members of the Council.

The Council will:

- Provide guidance and oversight to the implementation of the National Prosopis Management Strategy;
- Coordinate and provide leadership for the implementation of the National Prosopis Management plan.
- Ensure that all concerned parties plan and execute the National Prosopis Management Strategy and action plan.
- Review and develop laws, guidelines, Prosopis management practices, and specific management measures as recommended by the scientific Technical Advisory Group.
- Mobilize resources and ensure that adequate budget is earmarked by government and partners for the management of Prosopis;
- Promote and champion the prevention, control and management of Prosopis in Ethiopia and in the region;
- Create incentive and disincentive mechanisms for effective and efficient prevention, control and management of Prosopis;
- Foster international cooperation in national Prosopis management;
- Create as necessary, subsidiary bodies dealing with particular issues of Prosopis management;
- Periodically review the Prosopis Management Strategy and action plan to respond to emerging issues.

TOR of Regional Prosopis Management Councils (RPMCs)

At regional level the Vice President of the region will be the chair of the Regional Prosopis Management Councils, with relevant bureau or commission of pastoral and agriculture will be the secretary, and regional research centers, regional land environmental agencies, regional police and security and justice bureaus and others will be members.

The Council will:

- Provide guidance and oversight to the implementation of the Prosopis Management Strategy within the regions;
- Coordinate and provide leadership for the implementation of the Prosopis Management action plan within the regions;
- Ensure that all concerned parties plan and execute Prosopis management related tasks for which they are particularly responsible and devise a mechanism for monitoring and evaluation of the activities of concerned stakeholders;
- Review and approve regional laws, guidelines, Prosopis management, and for specific management measure as recommended by the regional scientific advisory group
- Mobilize resource and ensures that adequate budget is earmarked by government and partners for the management of Prosopis management and control within the region;
- Promote and champion the prevention, control and management of Prosopis within region;
- Create incentive and disincentive mechanisms for effective and efficient prevention, control and management of Prosopis within the region;
- Foster interregional cooperation in Prosopis prevention and management;
- Create as necessary, subsidiary bodies dealing with especially issues of IAS within the region;
- Periodically review regional Prosopis management action plan to respond to emerging issues within the region;

TOR of Woreda Prosopis Management Council (WPMC)

At woreda level the woreda Administrator will be the chair of the Woreda Prosopis Management Council, the relevant office of pastoral and agriculture will be the secretary, and members will include research centers, offices of land and/or environment, woreda police and/or security and justice offices and others as appropriate.

The Council will:

- Coordinate and provide leadership for the implementation of Prosopis management program and projects in the woreda;
- Ensure that all concerned woreda parties plan and execute Prosopis management-related task for which they are particularly responsible;
- Ensure that laws, guidelines, Prosopis management practices, and species list for specific management measure are respected in the woreda;
- Ensure that adequate budget is earmarked by government and partners for the management of Prosopis in the woreda;
- Promote and champion the prevention and management of Prosopis within the woreda;
- Implement incentive and disincentive mechanisms for effective and efficient prevention and management of Prosopis;
- Create as necessary, special taskforce dealing with particular issues of Prosopis management;
- Periodically review the Prosopis management action plan implementation within the woreda.

TOR for Kebele/Community level Prosopis Management Council (K&CPMC)

At kebele level the kebele Administrator or community leader will be the chairperson of the Kebele/Community level Prosopis Management Council, the kebele development agent will be secretary, and members could include the director of the school and teachers, community and religious leaders, leaders of rangeland management committees or institutions, and others as appropriate.

The Council will:

- Coordinate and provide leadership for the implementation of Prosopis management program and projects in the kebele ;
- Ensure that all concerned kebele parties plan and execute Prosopis management-related task(s) for which they are particularly responsible;
- Ensure that laws, guidelines, Prosopis management practices, and species list for specific management measure are respected in the villages and surroundings;
- Ensure that adequate budget is earmarked by government and partners for the management of Prosopis in the kebele;
- Promote and champion the prevention and management of Prosopis within the kebele;
- Implement incentive and disincentive mechanisms for effective and efficient prevention and management of Prosopis;

- Create as necessary, special taskforce dealing with especially issues of Prosopis management at community level.

TOR of the National Scientific and Technical Advisory Group (NSTAG)

NSTAG is a body to be created by the Federal Council. It is composed of technical experts represented from the council member agencies, research, academia and civil society. The major function of the NSTAG includes:

1. Provide technical and scientific support to the Federal Council;
2. Review and recommend draft policy, laws, guidelines and management practices that may be adopted for the enhanced prevention and management of Prosopis in Ethiopia;
3. Assess and recommend decision on importation and/or introduction of any species into any ecosystem;
4. Review and recommend management practices that may be adopted for the prevention and management of specific or list of Prosopis in Ethiopia;
5. Recommends indigenous and/or exotic species that may be used for rehabilitation purposes;
6. Assess the effectiveness of the Prosopis management strategy and action plan and recommends amendments and updates;
7. Annually review the participating sectoral agencies' Prosopis related action plans implementation progress and recommend follow-up actions to the Federal Council;
8. Propose resource mobilization strategy for funding of Prosopis management;
9. Review and validate IAS related research result;
10. Study and propose mechanism for coordination of Prosopis related activities within the country and on regional cooperation;
11. Advise the Federal Council on any emerging Prosopis invasion related risks.

TOR of the Federal Prosopis Management Council Secretariat (FPMC)

The Federal Prosopis Management Secretariat will be established in the MOLF as a dedicated unit on Prosopis management. The unit shall, among others, perform the following:

1. Coordinate the national Prosopis Management Strategy implementation
2. Follow-up and implement the decisions made by the council;
3. Consult with the Prosopis Management Scientific and Technical Advisory Group and draft/review Prosopis management action plan, guidelines and present for Federal Council approval;

4. Plan and execute Prosopis management related tasks of the MOLF;
5. Mobilize resources for the management of Prosopis control and management;
6. Support regional governments and other partners for effective implementation of Prosopis management strategy and action plans;
7. Coordinate national Prosopis management prevention and management through the Council.