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Controlling and/or Using Prosopis Juliflora in Spate Irrigation Systems

Practical Note Spate Irrigation

Spate Irrigation Network

1. Introduction

This practical note describes one of the most invasive shrubs in spate irrigation systems prosopis juliflora also known as mesquite. The note focuses on how it disturbs the management of spate irrigation systems and crop cultivation in Eritrea, Ethiopia, Pakistan, Sudan and Yemen. It gives country overviews of when and for what purpose prosopis juliflora was introduced and the programs that have taken place to eradicate or manage the plant (chapter **2**). Further the different mechanical, chemical and biological eradication methods are mentioned (chapter **3**) and how prosopis juliflora can be used as a valuable resource for purposes such as charcoal or timber (chapter **4**). From this, it aims to take stock of the problems and draws some tentative lessons on how to control or use the shrub.

Prosopis julifora invades land and even worse encroaches on river beds and canal beds – blocking them and causing drainage patterns to uncontrollably shift. Yet prosopis juliflora is a blessing as well, albeit mixed. It is a source of biomass in some of the most marginal lands and provides fuel wood, charcoal and fodder.

This practical note takes stock of how to manage this 'mixed blessing' in spate irrigation systems, based on first-hand experience and grey literature. In the last thirty years the hardy well rooted shrub made its way from Latin America to all parts of the world, covering millions of hectares in for instance India, Pakistan, Yemen, Sudan, Somalia or Ethiopia. In many places it was first introduced in sand dune stabilization projects. However prosopis juliflora has the habit to 'overstay its welcome' and expand rapidly and not go away. The area estimated conquered by the invasive species in the last ten years in India. Pakistan, Yemen, Kenya, Sudan and Ethiopia is way above 10 million hectares.

Particularly in areas where there is livestock grazing prosopis juliflora spreads rapidly: the seedpods cling to the animal skins and are distributed widely. Prosopis juliflora germinates easily and once it has settled in an area it is difficult to get rid of it. It takes over the natural vegetation, does not allow undergrowth and hence greatly reduces the grazing value of land. It also tends to creep into waterways – including dry riverbeds – choking them in the process and causing flood rivers to run wild. The prosopis juliflora thorns are poisonous and can even cause blindness. Livestock, particularly cattle, can become ill when they are almost exclusively fed with pods of prosopis juliflora. Symptoms can be facial contortions and constipation, sometimes resulting in death. In the Tihama region in Yemen farmers consistently ranked prosopis juliflora in the top three of major problems.

Prosopis juliflora

Geographical range:

Native range: Native to Colombia, Ecuador, Mexico, Peru, Venezuela.

Known introduced range: An exotic invasive weed in Sudan, Eritrea, Ethiopia, Kenya, Iraq, Pakistan, India, Australia, South Africa, Caribbean, Atlantic Islands, Bolivia, Brazil, Dominican Republic, El Salvador, Nicaragua, United States (USA) and Uruguay.

Prosopis juliflora is a woody stemmed, thorned, evergreen shrub or small tree usually up to about five metres tall. High level of seed dormancy. Seed coat usually requires damage to germinate. Roots develop rapidly after germination and can reach a depth of 40cm in eight weeks (Pasiecznik, 2002). It grows in dense and impenetrable thickets and is a colonising species. Often invading land that has never before supported vegetation cover of any description. Its foliage is unpalatable to most animals, although the seed pods are palatable which facilitates spread in animals' dung.

Power invader because:

- production of many, small and hard seeds capable of surviving passage through the digestive system of animals
- attractive pods for animals
- accumulation of dormant seed reserves
- production of a mixture of seeds, with a few capable of germinating immediately after dispersal, while the majority remain dormant for spreading germination
- great ability of re-sprouting and fast coppice growth from damaged trees

Source: F.M. Blanco (1845) Flora de Filipinas.

prosopis juliflora is not only a scourge. It also has benefits to its credit. It is important for people in providing fuel and timber. The sweet nutritious pods are eaten by all livestock and can be made into different foods and drinks. Honey is made from the flowers and the gum is similar to gum arabic. The bark and roots are rich in tannin and the leaves can be used as mulch or to help in reducing pests and weeds. Also as a nitrogen fixing tree it improves the land and can reclaim saline soils. Furthermore in India charcoal generated from biomass of prosopis juliflora improved the fertility of alkaline soils (Sai Bhaskar N. Reddy 2009). On balance however if unmanaged it is a scourge that is steadily undermining the livelihoods of large populations in some of the most vulnerable dry agricultural and pastoralist areas.

2. Countries overview

2.1 Eritrea

Prosopis juliflora in Eritrea is widely known locally as Temer, Musa or Sesban. Prosopis juliflora entered into western and northern Eritrea from the Sudan, probably during the early 80s, and was introduced by livestock (Bokrezion 2008). Prosopis juliflora can be found in both the Western and the Eastern Lowlands irrigated areas. Because of the relative high water availability in irrigated areas, prosopis juliflora is in these areas flourishing. It obstructs the diversion channels and invades irrigated crop land.

Because farmers have to remove seedlings and shrubs from the fields and clear the diversion channels, cultivation becomes more labour-intensive and costly. Prosopis juliflora is especially a problem in Gash Barka where irrigation takes place to a large extent. Although prosopis juliflora is used as a source for fire wood and fodder, prosopis juliflora has also a great impact on native grassland and range land species. The level of infestation in Eritrea still remains relatively low, but it can potentially become a serious risk over the long-term on farmers' food security (Bokrezion 2008).

2.2 Ethiopia

Prosopis juliflora was widely distributed in Ethiopia as a biological soil and water conservation agent during the late 70s. Now it is considered a major threat because of its invasive nature. Prosopis juliflora has an aggressive invasive character invading pastureland, irrigated cultivated lands and irrigation canals causing an irreversible displacement of natural pasture grasses as well as native tree species (Kassahun et al. 2004).

In terms of coverage, the area's most adversely affected nationally include the Afar and Somali Regions in the east and southeast of the country and the area around Dire Dawa City. There are also moderately affected areas in Amhara, Oromia, Southern Nations Nationalities and Peoples (SNNP) and Tigray Regions – that is, in the mainly dry lands of Central, East and North Ethiopia (Steele 2009).

Infestations typically originate from the many small villages, extending along the main routes and are now steadily advancing into the surrounding landscape. The invasion of prosopis

Box 1: Experience in Afar, Ethiopia

There is a potential to control the spread of prosopis juliflora to farmlands and key pasturelands by promoting utilization which proved economic incentive to local people to be involved in the mangement if planned and regulated carefully. Farm-Africa had been supporting local communities through provision of hand tools and organizing mass campaigns to clear prosopis juliflora from pasturelands and cultivable areas. However the approach couldn't get wider acceptance as there was no immediate benefit to the people. The idea of control through utilization such as charcoal production and pod crushing was raised with the principle of providing incentive for local people to be engaged on the control initiatives (Tegegn 2008). Cooperatives set up by Farm Africa were able to clear prosopis juliflora from over 396 hectares of land, in one year, and availed pasture as well as cultivable land to local communities depending on the potential of the land (Admasu 2008). Because prosopis juliflora expands in Afar its area faster than the area that is brought under productive use, research from Farm Africa shows that not much can be done to eradicate prosopis juliflora, if external support in terms of community mobilization, technology transfer, private sector participation and supply of resources is not taking place.

juliflora corresponds with movement of animals being driven to markets and nomadic settlements. It has also spread to cultivation areas and flood plains along the river Awash, which is of high economic importance to the region (Senayit et al., 2004). Many communities and farmers have belatedly attempted to eradicate the plant. However, prosopis juliflora particularly when it is cut above ground, it simply regenerates and it has almost become impossible to get rid of it.

Especially in the Afar region, where the invasion of prosopis juliflora is most severe, much effort has been done to manage and control the shrub. In Afar region the production of charcoal from prosopis juliflora was very much encouraged. The problem however was that the prosopis juliflora charcoal was inferior to the one from acacia for instance. Instead of prosopis juliflora charcoal the acacia was widely processed – accelerating the degradation of the common land. A total ban on charcoal trading was hence reinvaded in several parts of this region.

Furthermore the NGO Farm Africa has tried on controlling prosopis juliflora in the Afar region in a number of ways. First to uproot the plants and then very rapidly convert the area in an agricultural area or into a well-managed grazing area – so as not to allow a comeback. Secondly to encourage the regulated production of charcoal through a number of co-operatives. Thirdly to systematically collect the pods and crush them into animal feed – making sure they do not germinate but are turned into an economic asset. (Tegegn 2008). Results from a pilot initiative showed that there was a potential to control the spread of prosopis juliflora by promoting utilization. However the pilot initiative was not supported with realistic land use plans. Due to this, cleared pasture lands were re-invaded from the seeds in the soil or new seed load from animals or flood (Tegegn 2008).

2.3 Pakistan

Prosopis juliflora is locally known in Pakistan as Babul, Valiati Kikar, Kabuli Kikar. In the second half of 19th century, it was brought to Pakistan from Mexico and introduced into the semi-arid areas of the country. Sindh province was among the initial sites where it was first introduced. The main purpose was to control soil erosion and desertification. Its propagation was encouraged in places like Balochistan where no other vegetation could easily grown. Much later it became a weed and aggressive plant in many irrigated and valuable land tracts. It is now encroaching aggressively on rangelands and suppressing natural vegetation and dominating fallow lands. Spate irrigation areas in DG Khan are facing prosopis juliflora problems in its command areas. Once it established, it was very difficult to eradicate as its roots penetrated deeply. Some experiments show that roots have penetrated to a depth of more than 50 meters. Due to prosopis juliflora, farmers have difficulties to manage the water at channel and field level during floods. Prosopis juliflora growing in water channels and passages slows down or even block the spate flow. Further the thorny bushes of prosopis juliflora causes serious problems for barefooted farmers to work properly and it obstructs livestock from accessing drinking water.

The invasion by prosopis juliflora also suppresses the indigenous vegetation such as tamarisk and some species of acacia that are used to divert water from channels to the fields and to block the inlets after irrigation. Farmers complain that this causes a shortage of useful and easily handled plants that are used to divert water from channels to fields and also for blocking the inlets after irrigation. Farmers can only control the invasion of prosopis juliflora with strenuous effort using methods such as uprooting, cutting and burning with no guarantee of its complete control. In many cases these methods are costly, time consuming and beyond the capacity of poor people.

Although prosopis juliflora has more negative aspects than positive, people found its benefits as well. Selling prosopis juliflora as fuelwood or as charcoal is now a popular business for the Afghan Panwandas in DG Khan, DI Khan and Barkhan and Loralai districts. They cut the prosopis juliflora at large scale and sell its woods locally in their temporarily dwellings or as charcoal to hotels for 1000 Rs per bag (50kg). Prosopis juliflora is used in the brick kilns industry. Poor families sell cutted wood of prosopis juliflora for 80 Rs per 40 kg to local brick makers. Prosopis juliflora attracts honey bees and honey farms can been seen around dense plantations. Further farmers use the branches of prosopis juliflora for fencing fields against encroachment by livestock and wild animals. In some cases it is also used for boundary hedges around houses in rural areas especially in desert areas of Sindh, Balochistan and Punjab.

Moreover some research have been done in Pakistan how to cultivate prosopis juliflora in saline areas for providing fodder, fuel wood and timber. For instance man made forests of prosopis juliflora have successfully been established in the coastal areas of Balochistan by irrigating it with highly saline underground water (Khan et al.

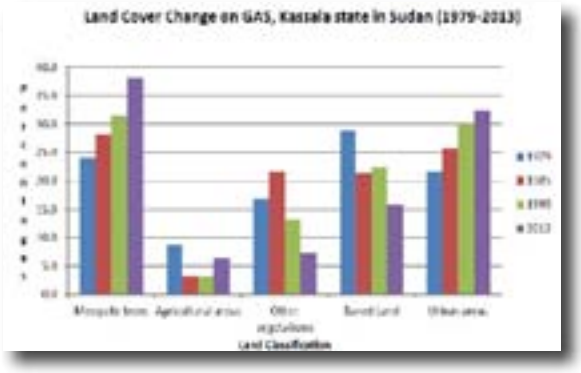

Figure 1: Land cover change in Gash spate irrigated areas (1979-2013).

1986). Ahmad (1994) carried out experiments to screen local and exotic prosopis juliflora species at germination and seedling stages under salinity conditions. Further prosopis juliflora is used along the coast of Balochistan for sand dune control and prevention of sea incursion.

2.4 Sudan

Prosopis juliflora is known in Sudan since early nineteenth century (around 1917) when it was introduced in Khartoum for research purposes. The success of the tree in its abilities to tolerate drought and fix sand dunes was the reason to introduce the tree in more drought-prone areas. In the 90s, prosopis juliflora was introduced as part of dune stabilization programmes in the spate irrigation systems of the Gash and Tokar. However soon after its introduction prosopis juliflora became a major pest. Tens of thousands of hectares were invaded in these areas.

Figure 1 shows the land cover change of the Gash delta from 1979 to 2013. It shows that the area covered with prosopis juliflora increased from 89,428 hectare in 1979 (24 % of a total area of 371,870 hectare) to 141,942 hectare in 2013 (38 %). The agricultural area however descreased in the same time from 32,125 (8.6%) to 23,538 hectares (6.3%). This area was mainly taken over by prosopis juliflora.

Furthermore prosopis juliflora had a negative affect on the cannel discharge capacity in the Gash delta. A decrease in the cannel discharge capacity lead to less crop production than expected by the farmers. Table 1 shows the effect of prosopis juliflora infestation on the canal discharge capacity and (indirectly) on crop production.

The aggressive spread of the prosopis juliflora in the Gash and Tokar spate systems was mainly the result of poor field and land management. This was related to the absence of permanent land ownership in these systems (Van Steenbergen 2010).

In the last 15 years, different programs and projects were initiated to eradicate prosopis juliflora in the Gash and Tokar area. In 1996, the Kassala state government launched an awareness campaign to eradicate prosopis juliflora. They mobilized local communities and school students to participate. During the rainy season, people had to collect seeds and pods and destroy them. Under the Gash Livelihoods Project (IFAD 2004), land was titled to farmers on the condition that it would be taken back if they could not control the emergence of the shrub.

Intake canal	Canal discharge capacity of canal design (m^3/s)	Canal discharge capacity after infestation of mesquite trees (m^3/s)	Crop production* year	Crop production (bags)**	
				Harvest (bags)	Expected production (bags)
Fola	10	7.5	2006	16	22
Salamaleko	30	22.5	2007	20	27
Makati	20	15	2008	24	32
Digeni	58	23.5	2009	30	41
Tendalal	20	15	2010	13	13
Matatelp	20	15	2011	10	14
Hadalia	20	15	2012	14	15
Kassala	Not measured, very small canal size		2013	Not harvested	

* Crop-Sorghum
** 1 bag =100 kg

Table 1: The effect of Prosopis Juliflora infestation on canal discharge capacity in the Gash scheme.

Box 2: The New Halfa scheme, Sudan.

In 2008, in the New Halfa scheme (Northern Sudan), a company was hired by the government to control the invasion of prosopis juliflora. The total irrigated area of 330,000 feddans (138,600 hectares) was for more than two-third affected with prosopis juliflora. By using heavy machines, it took the company 2 years (from 2008 to 2010) to clear the area for 98%. After the program, the land was titled to registred farmers under the condition that they were not allowed to take animals onto the agricultural fields even after the growing seasons. Regulations and by-laws enforced that the area was not re-invaded by prosopis juliflora.

In 2005, the Kassala state government made contracts with private companies to eradicate prosopis juliflora from 150,000 feddans (6,300 hectares) in the Gash area. The cost of clearing prosopis juliflora by using mechanical removal was 350 Sudanese pound (50 dollars) per feddan (0.42 hectare). The costs for manual removal of prosopis juliflora was 150 Sudanese pound (21 dollars) per feddan.

Furthermore chemical and biological methods were used in which trees of prosopis juliflora were cut one feet above the ground and then sprayed with diesel oil, 2-4 D chemicals, round up or clinic graivosade.

Although the farmers and companies did their task in a proper way, after one year the prosopis juliflora was re-infested. Lack of follow up programs, inadequate management and weak enforcement of regulations played a major role in re-infestation of prosopis juliflora in the Gash area. However an example that with proper management and regulations prosopis juliflora can be controlled is shown in Box 2 about the New Halfa scheme (Northern Sudan).

In the Tokar delta, a Food for Work program was run to control prosopis juliflora. Families of low income were mobilized to the delta, by offered food and two hectares of prosopis juliflora infested land. prosopis juliflora pods were swapped for sorghum to encourage collection.

Although prosopis juliflora has very big disadvantages, the shrub has also its benefits and farmers in Gash and Tokar use prosopis juliflora as a source of fodder and river bank stabilization. The poor and landless are able to generate income from charcoal making and fuel wood from prosopis juliflora and forest depletion has been reversed with the spread of the shrub. Given the areas that are covered with prosopis juliflora , one can say that it has become the second most important crop in the Gash area after sorghum (IFAD 2011). However there are sharp debates in Sudan whether to get rid of prosopis juliflora or to adapt into the ecological system of the areas concerned.

2.5 Yemen

In 1974, proposis juliflora was introduced into Yemen by the Tihama Development Authority to combat soil erosion. (Geesing et al. 2004). Due to the very recent detection of the invasion, only limited statistical information is available that underestimate to define the importance of the problem.

In wadi Hajar, the whole wadi system and its associated sandy fringes have been stabilized by the planting of the introduced shrub prosopis juliflora. However prosopis juliflora is such a major problem that villagers said the shrub was responsible for exacerbating the 2008 floods by blocking watercourses and diverting floodwater into villages. The same is reported from the Hadramawt.

Areas in the Hodeidah Governorate, Hadramout Lahej, Abyan and Shabwa are at risk in terms of food security problems if additional agricultural land is invaded by the species. In the Abyan and Shabwa Governorates the invasion is very recent and severe and, although prosopis juliflora was successfully introduced to combat soil erosion, its recent uncontrolled spread is cause for major concern by farmers, who are confronted with harsh climatic and soil conditions and have very limited irrigated land for agricultural production (FAO, miscellaneous).

A particular problem for spate irrigation areas is the establishment of prosopis juliflora in the irrigation systems where they disturb the water flow. One most important drawback being mentioned by beneficiaries of spate irrigation systems was the encroachment of river beds and canals with prosopis juliflora, blocking the water flow when it occurs (MetaMeta 2012).

In the 90s, a growing number of voices were raised against prosopis juliflora invasion of farmland. Complaints came in particular from large landowners growing irrigated cash crops (cotton, onions, watermelons, wheat and various vegetables), even though the offending species had often been planted by the farmers

themselves (Geesing et al. 2004). Prosopis juliflora has invaded areas of orchards and sorghum fields, where farmers currently hand pull new shoots of the plants (Ali et al. 2006).
For instance in Al-Mujaylis, in Tihama coast plain, date palm orchards were invaded by prosopis juliflora. Most of the palm trees died, because prosopus juliflora essentially sucked up all the moisture away.

Prosopis juliflora can be invasive but exploiting the resources for fuel wood, fodder and food can counterbalance the damage. At the request of the Yemen government, in 2002/2003 FAO implemented a project to manage and control prosopis juliflora better. Farmers were trained in the use of prosopis juliflora pods for animal feeding and the stems of the plant for firewood. Recently the collection of prosopis juliflora pods became a profitable enterprise for local people, who collect them in the plains and transport them to feed animals in higher altitudes (Geesing et al. 2004).

3. Control or management

Many efforts have been done to eradicate and control prosopis juliflora from its areas of invasion. Geesing et al. (2004) categorized the eradication methods into three broad types:

- Mechanical; plants are removed by machine or people mechanically by hand pulling, cutting, hand digging or mechanical uprooting. This is severely done in Gash, Sudan and Afar, Ethiopia but it didn't give the expected result, due to lack of maintenance. In Australia several mechanical methods have been used. This is **stick racking** (best results are achieved when soil moisture is sufficient to allow machinery to work with minimum strain, but soil is dry enough so the root system desiccates), **chain pulling** (may kill up to 90% of trees in a mesquite infestation. However, the effectiveness of control may be reduced when either very dense infestations or a high proportion of young trees and seedlings are present) **bulldozer pushing** and **blade ploughing**.
- Chemical; Larger trees and shrubs are killed by cutting the stem at ground level and spraying or painting the freshly cut stumps with suitable herbicide. Herbicides like Round up, 2-4, D, Glenside Kerosene and diesel oil are used. Table 2 shows examples of herbicides that are registered and used for the control of mesquite in Queensland, Australia.
- Biological; predators or pathogens are used to control the prosopis juliflora reproduction. Sudanese researchers found some predator insects that attack the leaves that lead to deterioration of the tree canopy. In Australia four species of insects have been introduced as biological control agents against mesquite: The **Algarobius bottimeri** and **Algarobius prosopis** (The larvae of these beetles destroy mesquite seeds in mature pods both in the trees and on the ground), the **Prosopidopsylla flava** (a sap-sucking psyllid that causes dieback) and **Evippe spp.** (a leaf-tying moth that causes defoliation). Nevertheless, this is a very slow operation to eradicate the tree. (DAFF Queensland 2013).

Another method that has been used in several countries is burning the stump after it has been cut. In Yemen for example the application of kerosene over the stump followed by burning has shown to be a way of eradicating the plant. However this only works when the plant is dry (not in stage of flowering) and the root system is not too deep to survive. Otherwise regrowth will occur.
In general, experiences from America, Asia and Australia have shown that eradication of prosopis juliflora, by the different methods, especially the mechanical and chemical ones are highly expensive and mostly ineffective (HDRA, 2005). The magnitude of resilience and distribution of the plant makes prosopis juliflora virtually impossible to eradicate once established.

Situation	Herbicide	Rate	Optimum stage and time	Comments
Basal bark	triclopyr + picloram Access®	1 L/60 L diesel	Plant must be actively growing	For plants up to five cm diameter. Wet stem thoroughly from ground to 30 cm height.
Cut stump	triclopyr + picloram Access®	1 L/60 L diesel	Plant must be actively growing	Stem should be cut close to ground level and treated immediately.
High volume (overall spray)	triclopyr + picloram e.g. Grazon DS Extra®	Refer to herbicide label	Plant must be actively growing	For seedlings and plants up to 1.5 m tall. Do not spray plants bearing pods.

Table 2: Herbicides registered for the control of mesquite, Queensland, Australia (Source: DAFF Queensland 2013)

Figure 2: Prosopis eradication; cutting.

Figure 3 : Prosopis eradication; burning.

Eradication is also difficult, because a significant number of local people are depending on prosopis juliflora for different purposes. Furthermore because of its invasive nature, it asks a lot of maintenance keeping the land clean from Prosopis sprouts. Without any clear policies, organisation and regulations maintenance it will not happen. In Ethiopia for instance, although the stumps were cleared and seedlings uprooted to rehabilitate the land, due to lack of land use right, people were not allowed to manage and use the land and prosopis juliflora re-invaded (Tegegn 2008).

Because most of the conventional control methods are expensive, it could be argued that the utilization of prosopis juliflora is the best option to control the invasion for many invaded areas (Tessema 2012). Many farmers and artisans, as well as researchers, argue that the tree is a valuable resource (HDRA 2005). Exploring beneficial uses of the tree will help to turn it into a more useful tree and perhaps even, to some extent, curb its expansive growth. Thus more ecosystem services can be derived from prosopis juliflora, though its disservice to biodiversity remains a reason for caution. An overview of the positive and negative aspects of prosopis juliflora is shown in table 3.

4. Making use of prosopis juliflora

Converting prosopis juliflora into a valuable resource presents an opportunity to the communities living in marginal areas. (Pasiecznik 2007). However to manage, control and utilize prosopis juliflora full participation of local communities is necessary. Also appropriate control measures and follow up management activities need to be done.

Furthermore strategic development and encouragement of the private sector to establish a market for prosopis juliflora products is important. Marketing policies and interventions from government could help in this. Finally research have to be done about constraints in the harvest, processing and marketing of prosopis juliflora products and success stories have to be documented.

Positive Aspects	Negative Aspects
Can play a role in sustaining the livelihood of poor rural households	Lack of traditional knowledge on how to manage and control the plants
Source of fuel and dry season animal feed	Obstructs paths and roads
Wood does not spit, spark of smoke excessively	Hard and costly to remove
Often in the commonly owned areas where they are freely available to the whole community	Expands quickly even in the harshest conditions
High quality and hard timber	Thorns can injure animals and people
Good animal feed especially for dairy cows	Depletes the water moisture and limits availability to local plants
Wood can be processed into furniture or construction material	Few plants are able to grow under its crown shade
Can act as vegetative fencing to delimit and protect properties	Can favour the breeding of malaria spreading mosquitoes
Produces good charcoal	Causes pastoralist communal lands to shrink

Table 3: Positive and negative aspects of Prosopis Juliflora (Source: MetaMeta 2009).

Box 3: Making charcoal

Approximately three to six kg of wood of prosopis juliflora is required to produce one kg of charcoal depending on the method used. Charcoal is manufactured in traditional or improved earth kilns, or less commonly in metal kilns. Before processing, wood is first sorted into similar diameters and lengths. Earth kilns can be made up on flat ground, but charcoal manufacturers use large pits, on sloping ground. Wood is stacked and moistened before firing. The stack is covered with soil and burns very slowly for several days depending on the size and condition of the stack and site. The moisture content of the wood is reduced from approximately 45% to close to zero. After two to eight days, the stack is opened and the coals are removed, allowed to cool, graded and bagged up for use or for sale. (Pasiecznik 2001).

4.1 Fuel and charcoal production

Prosopis juliflora wood is hard, burns slowly and has excellent heating properties. Also, the charcoal it can produce has good properties and can be easily traded on urban markets. In Ethiopia farmers were trained in labour efficient charcoal production techniques using metal kilns instead of traditional kilns. (Admasu 2008).

4.2 Timber

Prosopis juliflora wood is extremely hard and durable. It also has an appealing coloration that makes it ideal to make furniture with. The wood matures quickly and stems become dark inside when the plant is trained as a tree. The mature timber is resistant to pest attack and weathering and thus can be used for furniture making and other useful purposes especially housing. It is also used as parquet flooring wood. However particularly in stressful conditions of dry areas, prosopis juliflora trees remain craggy, crooked and small, which makes using them to make furniture or charcoal less attractive.

Figure 4: Wood collection, Pakistan

4.3 Wood chips

Wooden residues from prosopis juliflora can be chipped off and used as mulch in gardens and little vegetable gardens (Pasiecznik, 2001). The mulch is effective in reducing evapotranspiration. Consequently, it also reduces the plant water consumption. The chips have also been successfully proceeded into wooden pulp, which is the primary raw material for paper production (Pasiecznik, 2001).

4.4 Fodder

Free ranging animals can eat prosopis juliflora pods directly from the tree. Alternatively, the pods can be collected and ground to produce course flour which can be included in the animals' diet. The percentage of the flour in the mix should be kept below 50% in order to avoid digestion disorders among the livestock (Pasiecznik, 2001).

4.5 Land reclamation

By spreading charcoal and using it as bio-char, acidic degraded land can be rehabilitated and yields can be increased. Charcoal improves the physical, biological and chemical properties of the soil by releasing and storing nutrients, increasing the bulk density, improving the overall porosity and creating favourable conditions for micro-biological activity. It can be applied in conjunction with farmyard manure and/or soil microbes (Sai Bhaskar 2009).

4.6 Bio-fuel

Prosopis juliflora is an underestimated source of sugars that can be converted into ethanol. Trials in the USA have shown that up to 80% of the pods carbohydrates can be converted in the process (Pasiecznik, 2001). This process, however, is still in an experimental stage.

Box 4 : Costs and Benefits

- A pod collector in Peru can pick up to 150 kg/day and earn 5 USD/day during the production season. In February, the pods sell in the market at USD 27/ton (1997) (Pasiecznik, 2001).
- In India prosopis juliflora wood is sold at INR. 80 per kg (USD 2) and charcoal is sold at Rs. 14 per kg (USD 0.33) (Sai Bhaskar, 2009).
- Clearing of one acre of infested land can cost up to USD 250/ha) (MetaMeta, 2009).
- The use of prosopis juliflora biochar plus manure is known to have brought about a 30-40% increase in cotton yield (Sai Bhaskar, 2009).
- For a small scale charcoal producer it is possible to earn USD 1900/year (CSDI, 2009b).

4.7 Biomass to generate power

The biomas of prosopis juliflora can be used to generate power. In Kenya, the private electricity producer Tower Power is planning to develop two biomass power planta in Baringo and Kwale districts. The new plant will be fed by the prosopis juliflora tree. The project is set to transform the tree from a noxious weed to a cash crop when about 2,000 households begin supplying the company with the tree stems. Baringo has a Prosopis forest cover of about 30,000 hectares, the highest density of the invasive plant in Kenya. Tower Power estimates that the forest can serve its power plant for 10 years (Business daily 2014).

4.8 Honey and gum

Prosopis juliflora blossoms abundantly. It is known to produce high amount of pollen that can be transformed into high-quality honey. The only constraint in dry-lands is the lack of water sources for the bees. The gum that exudates from prosopis juliflora is comparable to gum Arabica and can be used in the food-cosmetic industry. Its use is constrained by the absence of toxicological tests necessary for it to enter the industrial market.

5. Conclusions: how to address the proposes juliflora challenge?

Based on the diverse experience documented so far, the most viable strategy appears to be either to remove prosopis juliflora altogether and keep the land 'clean' by intensive usage - and especially ensure it does not encroach river beds and in areas where this is not possible, to make use of proposes juliflora products. Efforts to completely and permanently eradicate prosopis Juliflora often fail to reach the objective. Pragmatic utilization of the shrub's outputs, such as wood, bark, flower and pods is a complementary approach. This can help to generate income (and improve livelihood) of the affected communities. The main element in a controlled use strategy:

- Focus on removal of prosopis juliflora from water ways, highly productive land or land important for local food security. Keep close vigilance and intense use of these lands
- Land using communities should be encouraged to uproot prosopis juliflora seedlings when they are still easy to remove.
- Land use planning – not allow cattle movement between areas with prosopis juliflora
- Combating and utilizing prosopis juliflora in communal lands should be supported. Ways must be found to empower communities to make joint efforts with governments and authorities and private sector (for instance in biomass conversion)
- Explore innovative uses such as the use of prosopis juliflora bio-char or energy bio-mass
- A new body of regulations is required to facilitate the commercialization of prosopis juliflora products. Policies must promote the production of charcoal and poles for fencing and construction, which until now is discouraged.

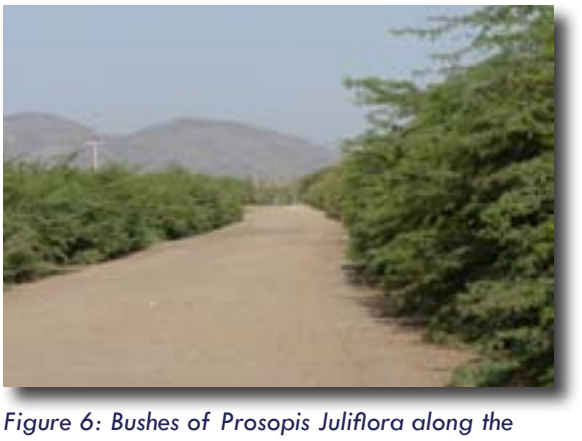

Figure 6: Bushes of Prosopis Juliflora along the road in Afar, Ethiopia.

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Practical Note #25

Colofon

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