Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.5, No.19, 2015

Coping Mechanisms to Invasion of Prosopis juliflora in Kenya: Case Study of Salabani Location, Baringo County

Masakha, E.J.
National Environment Management Authority,P.O. Box 2660, Eldoret Kenya

Wegulo, F.N.
Egerton University,Box 256 Njoro, Kenya

This is my original work and was self financed

ABSTRACT
Alien invasive species are a threat to functioning and structure of ecosystems in the world. They affect provision of goods and services of ecosystems and have also ecological and socio-economic impacts on local communities. The purpose of this study was therefore to examine how the local community in Salabani Location, are coping with the invasion of *Prosopis juliflora*. Results indicate that the local community utilizes the plant for charcoal production, sale posts, poles, and pods to improve their livelihoods. The tree is the main source of firewood. It is also used as fence against wild animals, poachers and cattle rustlers. 49% burn the trees, 28% uproot, 22% prune and 7% thin. No chemical or biological control is used. Cut stems are scourged using cow dung as source of fuel which burns for a long time hence effective. The Government formed five Farmers Field Schools to train and build capacity of the local people. The locals wear special sandals made from old vehicle tyres called 'kinyira' to protect them against the tough Prosopis thorns. They have formed cooperative societies to help sale their charcoal to avoid exploitation by middlemen. The introduction of bruchid beetle was put on hold as animal feed manufacturers test the viability of using pods instead of wheat bran. However, the Kenya government should release the beetles to help control spread of the tree as locals enhance and diversify utilization of Prosopis.
Keywords: Coping mechanism, *Prosopis juliflora*, weed control

Introduction

Concern about deforestation, desertification and fuel wood shortages in the late 1970s and early 1980s prompted a wave of projects that introduced *P. juliflora* and other hardy tree species across the world. Prosopis which is native to the region between Mexico to Peru in South America, Central America and the Caribbean has survived where other tree species have failed and in many cases become a major nuisance (Pasiecznik *et. al*., 2001). *P. juliflora* continues to invade millions of hectares of rangeland in South Africa, East Africa, Australia and coastal Asia (Pasiecznik *et. al*., 2001). In 2004 it was rated one of the world's top 100 least wanted species (IUCN, 2004). It is considered as the second greatest global threat to biodiversity after habitat destruction (Raghubanshi et al. 2006). Prosopis impacts on native species by competing for nutrients, water and is allelopathic (Baumer 1990, Coppen 1995). They have deep rooting systems upto 20 metres deep hence draw water from deep down the soil structure where other species cannot reach. They seed profusely each mature tree producing between 630,000- 980,000 seeds per annum (Harding and Bate 1991). The trees also start seeding as early as 4 years old and regenerate from cut stems and roots alike. The seeds lay dormant upto 10 years and regenerate immediately soils are disturbed like in plaughing or burning (Pasiecznik *et al*. 2001, Shackleton *et al*. 2006). Affected countries have devoted increasing amounts of time and funds to control invasion but with limited success.

Prosopis juliflora was introduced in Kenya from South America in 1973 in Bamburi, Mombasa District, Tana River District, and Turkana District. Later in 1983, the plant was introduced in Marigat in Baringo District during the Baringo Fuel Wood Afforestation Extension Project sponsored by the World Bank, FAO and Government of Kenya. The objective was to mitigate desertification and fuel wood shortages in the ASALs (Pimentel *et. al*., 2000). The plant was preferred due to its resilience, drought tolerance, fast growth, source of fodder and fuel wood (Meyerhoff, 1991). It was easily imported into Kenya due to the poor phytosanitary regulations and enforcement policies of the 1960s to 1980s. Further planting of the tree was stopped in the early 1990s when the weedy characteristics of the plant were noticed (Choge *et. al.*, 2002). In 2007, the affected communities in Marigat District sot compensation from the Kenya Government for introducing what they termed a 'dryland demon'. The purpose of this study therefore was to review how the local community in Salabani Location are coping with the wide spread of this thorny weed which inflicts injuries to man and his livestock apart from blocking infrastructure, waterways and paths to schools and markets.

Methodology

A survey was conducted on 200 households randomly selected from the residents living in Salabani Location using pretested questionnaires. The purpose was to understand how the local people are coping with the rabid

invasion of Prosopis juliflora. Key informant groups were also interviewed.

Data Analysis

Data was coded and analyzed using SPSS computer programme. Relative importance of the uses of Prosopis was analyzed using the Likert score and descriptive statistics used to summarize the findings.

Study Area

Salabani Location lies between longitude $0^0$45'N, $0^0$30'N and latitude 35^0 45'E, $36^0$0'E. It is located about 15 km from Endao bridge junction along Marigat - Kambi Samaki road in the Ilchamus (Njemps) plains between Lake Baringo and Lake Bogoria. The local community relies mainly on pastoralism. Salabani experiences severe soil erosion due to poor vegetation cover and poor soil structure (GoK, 2002). Soils are mainly clay loams with alluvial deposits derived from tertiary / quaternary volcanic and pyroclastic rock sediments that have been weathered and eroded from the Tugen highlands. The soils contain high levels of phosphorous, potassium, calcium and magnesium and low levels of nitrogen and carbon. The soils range from acidic to slightly alkaline (GoK, 2002).

These lowlands receive 600 mm of rainfall annually which is bimodal, low, erratic and unreliable. Long rains start from March to July while short rains between September and November. The mean annual maximum temperature lies between 25°C and 30°C and minimum temperatures from 16–18°C (GoK, 2002). The hottest months range from January to March. The flood plains lie between agro-ecological zone IV and V. The ASAL vegetation is characterized by *P. juliflora* and Acacia woodlots (mainly *A. tortilis*) in association with *Boscia* spp., *Balanites aegyptica* and bushes of *Salvadora persica*. High evapo-transpiration rates and low variable rainfall create water scarcities that limit intensive agricultural land use (GoK, 2002). The population density is relatively low 21 persons per square kilometer, with a total population of 40, 985 people in Marigat division and 2000 households in Salabani Location (GoK 2009).

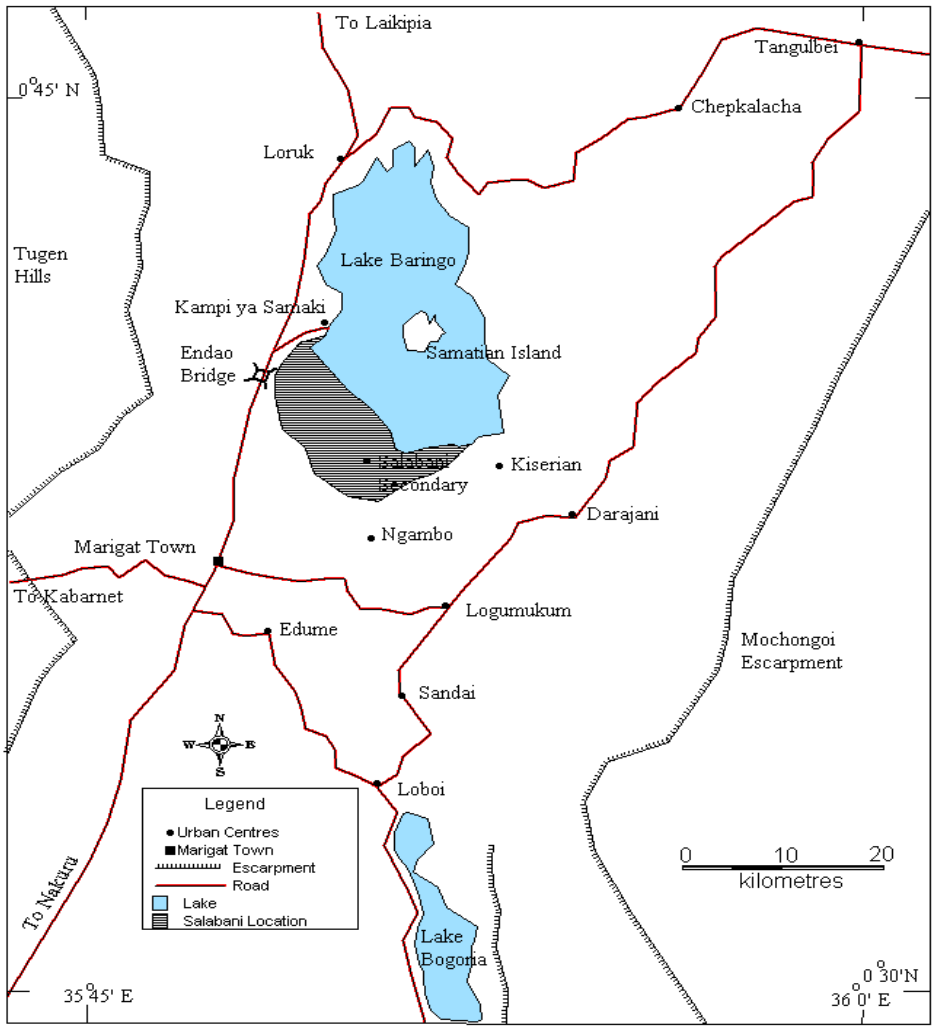

Figure 1: Map of Salabani Location, Kenya
Source: Moi University, Geography Department 2012

Results and Discussion

Table 1: Methods used to control further spread of P. juliflora

Method	Type	Frequency	%
Mechanical(uprooting0)	Management	56	28.0
Burning	Management	98	49.0
Pod collection	Utilization	25	12.5
Charcoal making	Utilization	88	44.0
Chemical	Control	0	0
Thinning	Management	14	7.0
Pruning	Management	44	22.0

Source: Survey Data, 2009

From the survey it was observed that the coping methods used by the local community could be classified into three categories: management, utilization and control (Table1). Most of the local community interviewed burn the stands as a management tool or utilize the trees for charcoal production (plate 1). 49% of the local community burns the trees this ends up scarifying seeds which regenerate profusely. 44% cut the trees and produce charcoal for both commercial and domestic use, 28% mechanically uproot the young seedlings around their homesteads before they take hold, 22% prune the trees and 7% thin the stems to reduce density. No chemical or biological control is practiced in Salabani Location.

The Government of Kenya and FAO through Kenya Forestry Research Institute (KEFRI) started training programmes for the local communities on alternative tree uses and how best to manage the spread of the invasive tree species. Farmers' Field Schools (FFS) were formed in each sub-location by the Government of Kenya through KEFRI to train the local community on how best to utilize *Prosopis juliflora* and manage the wide spread of the invasive species. They also intended to create awareness and build the capacity of the local people to manage the species sustainably. After this initial training the local communities have since adopted some coping mechanisms to control further spread of *P. juliflora*.

From the study it was observed that 49% of the respondents burn the cut stumps of *Prosopis juliflora* using cow dung or waste motor oil as a source of fuel energy to curtail further regeneration from the stumps. Cow dung and goats droppings were more preferred than waste oil since they keep a lot of livestock hence it is readily available than waste motor oil which they have to buy from motor vehicle garages in towns. This method has the double effect since burning cow dung or goats droppings destroys seeds which pass undigested in animal dung and is spread in grazing fields. Cow dung burns for a longer time hence effective economically and ecologically.

44% of the local people interviewed cut Prosopis for charcoal production. Each household in Salabani produces 240 bags of charcoal per annum which generates KES 120,000 per household per annum. Farmers have since formed cooperative societies to help sale their charcoal and to avoid middlemen. This should be enhanced as the case of Gujarati state in India where 3 million tons of charcoal is produced annually creating 55,500 man-days of employment per year (Kanzaria and Varshney 1998). In Peru charcoal production supports livelihoods of 150,000 people and generates over 50 million US dollars per year (Lea 1996)

The local community also harvests 240 litres of honey per household per annum which generates KES 24,000 per household per annum. Honey yields of between 100-400 kg/ha/year have been reported in Brazil (Silva, 1990) and 225 tons of honey/year in Hawaii (Esbenshade, 1980). The total economic benefit accruing from Prosopis associated products is worth KES 169,400 per household per annum (table 2).

Table 2: Economic benefits of *P. juliflora* per household/year in Salabani

Economic use	**Unit**	**Quantity**	**KES. (Per year)**
Firewood	Back loads	250	5,000
Poles	Numbers	120	4,800
Fencing	Numbers	100	3,600
Charcoal	Sacks	240	120,000
Fodder	Kg	600	12,000
Medicine	Kg	0	0
Honey	Litres	240	24,000
Food	Kg	0	0
Timber	Numbers	0	0
Wood carvings	Numbers	0	0
Ropes	Meters	0	0
Total			169,400

Source: Survey Data, 2009

The relative importance of the uses of *P. juliflora* was evaluated using Likert score. Firewood had the

highest rank score (4.52) followed by charcoal (3.7) and fencing (3.3) while the least ranked use of *P. juliflora* were: for timber (1.035), rehabilitation (1.16), fodder (1.21) and ornamental (1.42). Lack of awareness and knowledge to extract the exudates from the plant for its medicinal value and the crooked nature of the plant for use as timber has limited its uses to firewood, charcoal and poles. Pods are also collected for fodder. The least mentioned uses of the plant are ornamental due to thorns and woodcarving since the Ilchamus are not woodcarvers. The plant is very important for live and dead fencing around the villages and farm lands in the study area. It has helped to keep away wild game which used to destroy crops especially wild pigs and hippos from Lake Baringo

From the population sampled 28 % mechanically uproot the seedlings especially around there homesteads to pave way for food crop production or settlement. A local NGO Rehabilitation of Arid Environments (RAE) has been encouraging locals to uproot Prosopis seedlings and plant *Cenchrus cilliaris* grass for their livestock but with little success. 22% of the population sampled prunes the prosopis trees, while 12.5 % collect Prosopis pods for sale to animal feed manufacturers like Unga feed limited and Nairobi millers. Animal feed manufacturers now prefer Prosopis pods to wheat straws and prams as an animal feed additive since it has high carbohydrate and amino acid content (Choge *et al.* 2002). Collecting of pods for sale as animal feed additive also has double effect of controlling available seeds for regeneration hence has the double effect of controlling the spread of invasion of Prosopis in the study area. The local communities interviewed do not use any chemical or biological control methods as used in South Africa and Australia. This is chiefly because chemical control is expensive and beyond the ordinary means of poor pastoralists of Salabani Location whose per capita income is below 1 dollar per day.

Plate 1: Preparing charcoal Kiln
Source: Survey data 2006

Plate 2: Naitongaa Farmers Field School.
Source: Survey data 2006

It was observed that 4% of the local community members had migrated to other areas due to invasion of the weed since land is communally owned anyway. To cope with the thorn menace the locals wear special sandals made from old car tyres to protect their feet against injury (plate 2). Injuries caused by prosopis thorns are septic and cost of treatment is prohibitive a few have amputated limps. Goats lose their teeth due to sugary pods which cause teeth decay hence animals starve to death. The local community sued the Government of Kenya for compensation.

The local community do not utilize the tree for its medicinal value unlike other countries. In India for example, the bark extract is used as an antiseptic on wounds, while the gum is used to treat eye infection (Patel, 1986). Because of bactericidal and fungicidal effects, the plant extracts are widely used to treat eye infection, stomach disorders, skin ailments and superficial wounds. In Guatemala, *P. juliflora* is used to treat sexually transmitted diseases such as *Neisseria gonorrhoea* and crushed leaves of the plant are known to be used as suicidal agent in India and incidence of poisoning is common in rural areas. *P. Juliflora is* also used as remedy for colds, diarrhoea, dysentery, flu, headache, inflammation, measles, and sore throat (Pasiecznik *et.al.* 2001). *P. juliflora* wax can be used in industrial and pharmaceutical industry as raw material for production of candles, furniture polish, creams and balms (Durr, 2001).

Experiences from America, Asia and Australia indicate that eradication of *P. juliflora* entirely is difficult. However biological control is gradually gaining prominence in America Australia and South Africa for its cost effectiveness, ecological and environmental compatibility and no disturbance to the soil (Zimmerman 1991; Hildegard, 2002). *Algarobiuos prosopis* and *A. bottimeri* (Bruchid beetles) have been used in USA, South Africa and Australia with great success as they attack seeds in pods and reduce their viability. In South Africa 70% success has been reported in open grazing fields (Zimmerman 1991; Hildegard, 2002).

Conclusions

Prosopis has been underutilized in Salabani hence the local community should be encouraged to enhance

sustainable utilization of the many products and services from the tree. Charcoal production is a multimillion enterprise and should be exploited fully like in Gujarat India and Peru. People don't have incentive to manage Prosopis because land is communally owned hence the tragedy of the commons.

Recommendations

The Government of Kenya should release the bruchid beetles imported from South Africa under quarantine to help reduce seed viability which will control the spread of Prosopis. Government of Kenya should liberalize licensing of charcoal production and transportation from Prosopis to enable commercial production. The local people should be encouraged to fully exploit the potential products from Prosopis like medicinal value, wax, dyes, furniture, timber, poles and posts. The communal land of Salabani should be adjudicated and title deeds issued as land ownership is thought to be an incentive for one to invest in managing invasions.

Acknowledgement

The authors wish to sincerely thank Egerton University for the opportunity to carry out this research and key informant groups in Salabani Location and in particular KEFRI, RAE and Members of Naitongaa Farmers Field School for providing informative data.

References

Baumer, M. (1990): The potential role of agroforestry in combating desertification and environmental degradation with special reference to Africa. Wageningen, the Netherlands: CTA.

Choge S.K., et.al. (2002): The Status and Impact of Prosopis spp. in Kenya: KEFRI, Nairobi, Kenya. 59 pp

Coppen, J. J. W. (1995): Gums, resins and latexes of plant origin. Rome: Food and Agriculture Organization of the United Nations.

Durr, P. A. (2001): The biology, ecology and agroforestry potential of the rain tree: Samanea saman (Jacq.) Merr: Agroforestry Systems. 51:223–237.

Esbenshade, H.W. (1980): A Tree Crop in Hawaii: International Tree Crop Journal.21:134-147

GoK (2002): District Development Plan Baringo, Government printers, Nairobi.

GoK (2009): National Housing and Population census report, Government printers, Nairobi

Harding, G.B. and Bate, G.C (1991): The occurrence of invasive Prosopis species in the north-western Cape, South Africa. South African Journal of Science; 87:188–192.

Hildegard, K (2002):The Potential for Biological Control of the South African weed. Plant Protection Research Institute. Pretoria, South Africa

IUCN (2004): An Approach to Assessing Biological Diversity; Gland Switzerland, 2004.

Kanzaria, M. K. and Varshney, A.K (1998): P. juliflora – Its Uses in Tewari, J.C. Prosopis Species in the Arid and Semi-Arid Zone of India. Prosopis Society of India: The Henry Doubleday Research Association. Coventry, U.K.

Lea, J (1996): A Review of Literature on Charcoal in Haiti in Felker, P and Moss, J. (Ed) (1996): P.: Semi-arid Fuel wood and Forage Tree: Building Consensus for the Disenfranchised Center for Semi-Arid Forest Resources, Kingsville Texas, USA.

Meyerhoff, E. (1991): Taking Stock: Changing livelihoods in an Agro-pastoral Community. Acts Press, Africa Centre for Technology Studies, Nairobi. PP. 58

Pasiecznik N.M., et.al. (2001): The P. juliflora – P. pallida Complex: A Monograph. HYDRA Coventry UK

Patel, K. J. (Ed) (1986): The Role of Prosopis In Water Land Development: Jivrajbhai Patel Agro- cores Centre, Surendrabag, and Gujarat, India. 476 - 480.

Pimentel, D. et al. (2000): Environmental and economic costs of non-indigenous species in the United States. Bioscience 50(1): 53-65

Raghubanshi, A.S. et al. (2005): Invasive alien species and Biodiversity in India: Current Science. 88(4**):** 1-12.

Shackleton, C.M. et al. (2006): Assessing the effects of invasive alien species on rural livelihoods: Case example and a framework from South Africa. Human Ecology an Interdisciplinary Journal; 12: 36-44.

Silva, S. (1990):P. Juliflora in Brazil in Habit, M.A. and Saavedra J.C. (ed.) (1990). The Current State of Knowledge of P. juliflora: FAO, Rome, Italy.

Zimmerman, H. G. (1991): Biological control of mesquite, Prosopis spp. (Fabaceae), in South Africa Agriculture Ecosystems and Environment. 37: 175-186.