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Socioeconomic Impacts of Prosopis Juliflora on the People of Salabani Location, Marigat District, Baringo County in Kenya

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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 ASAL communities. The purpose of this study was therefore to examine the socio-economic impacts of *Prosopis juliflora* on the livelihoods of the people of Salabani Location in Baringo County. A survey was carried out on 200 randomly selected households out of the total households living in Salabani using pretested questionnaires. The results were coded captured and analyzed using SPSS computer program. Satellite images of 2012 indicate that *Prosopis juliflora* covers 8555ha of land as compared to 2906 ha in 1998 representing an annual increment of 66%. Survey results showed that 95% of the households use *P. juliflora* as the main source of fuelwood and produce 240 bags of charcoal per household per annum. The economic benefits accruing from products associated with *P. juliflora* is KES 169,400 per household per annum. Economic losses from Prosopis which are associated with its thorns are estimated at KES 128,000 per household per annum. The net present value of *Prosopis is* 21,244.74 while the benefit / cost ratio is 3.091 hence the study concludes that utilization of Prosopis is economically viable. The study recommends that the Government of Kenya should encourage utilization of the many products and services of the tree since the residents have underutilized it.
Keywords: Invasive species, Prosopis juliflora, Economic benefits, Economic losses

Introduction

Invasive alien plants can dominate ecosystems and are a growing threat to the delivery of ecosystem services (Levine *et. al.*, 2003). In some cases the same invasive species can simultaneously provide benefits and cause negative impacts, hence finding efficient and equitable solutions can be problematic due to conflicts of interest (Sala *et. al.*, 2006; McNeely *et. al.*, 2011). 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. *P. juliflora* has survived where other tree species have failed and in many cases become a major nuisance. *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). Affected countries have devoted increasing amounts of time and funds to control invasion with limited success.

Prosopis juliflora was introduced in Kenya 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 by the World Bank, FAO and Government of Kenya. The purpose 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 investigate the socioeconomic impacts of this plant on the community living in Salabani Location.

Methodology

The study used pretested questionnaires as a research tool to interview 200 households randomly selected from a sampling frame of 2000 households living in Salabani Location. The independent variable was invasion of Prosopis and the dependent variables were economic costs and benefits.

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).

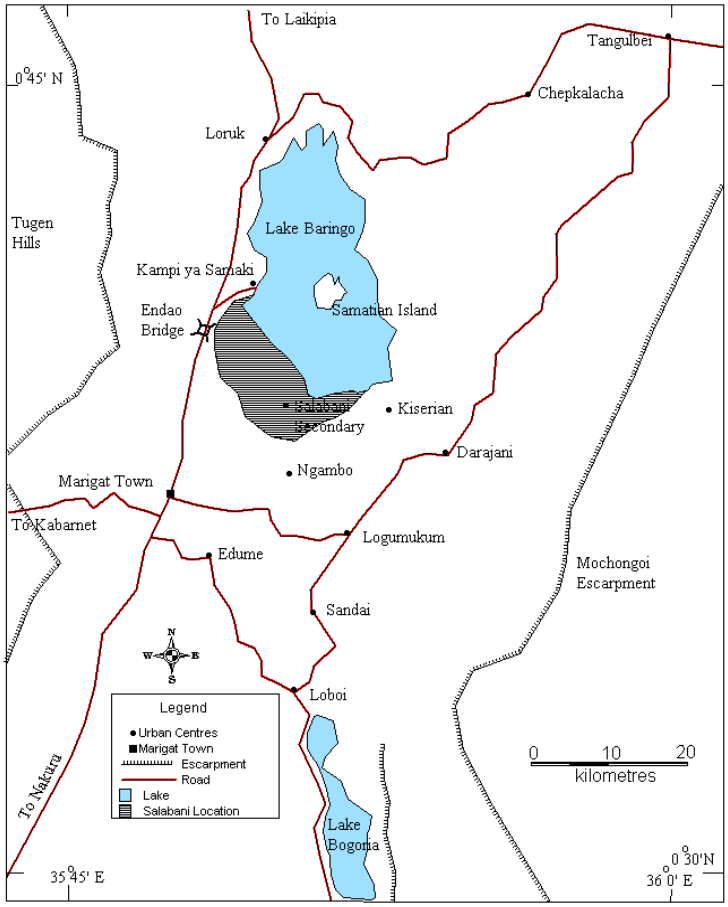


Figure 1: Map of Salabani Location, Kenya
Source: Moi University, Geography Department 2012

Data Collection

Data was collected from 200 households randomly selected from the total households living in Salabani Location using pretested questionnaires which yielded a reliability coefficient of 95%. Satellite images of 2012 and 1998 were used to compare the spread of Prosopis in the study area.

Data Analysis

Data collected was coded and analyzed using SPSS computer program and cost benefit Analysis performed.

Results and Discussions

Satellite images of 2012 indicate that *Prosopis juliflora* had spread to 8555 ha of land in an area between Lake Bogoria and Lake Baringo in Marigat division from a meager 2906 ha reported in 1998. This constitutes 66% annual spread of Prosopis or 403 ha annual increment an indication that the weed is fast spreading in the study area (plates 1 and 5). This is because invasive species do not require special conditions to germinate and out-compete native species (Raghubanshi et. al. 2005). They reproduce sexually and asexually, seed profusely and

have deep rooting systems (Pasiecznik 2001). It was declared a noxious weed in Ethiopia (Catterson, 2003).

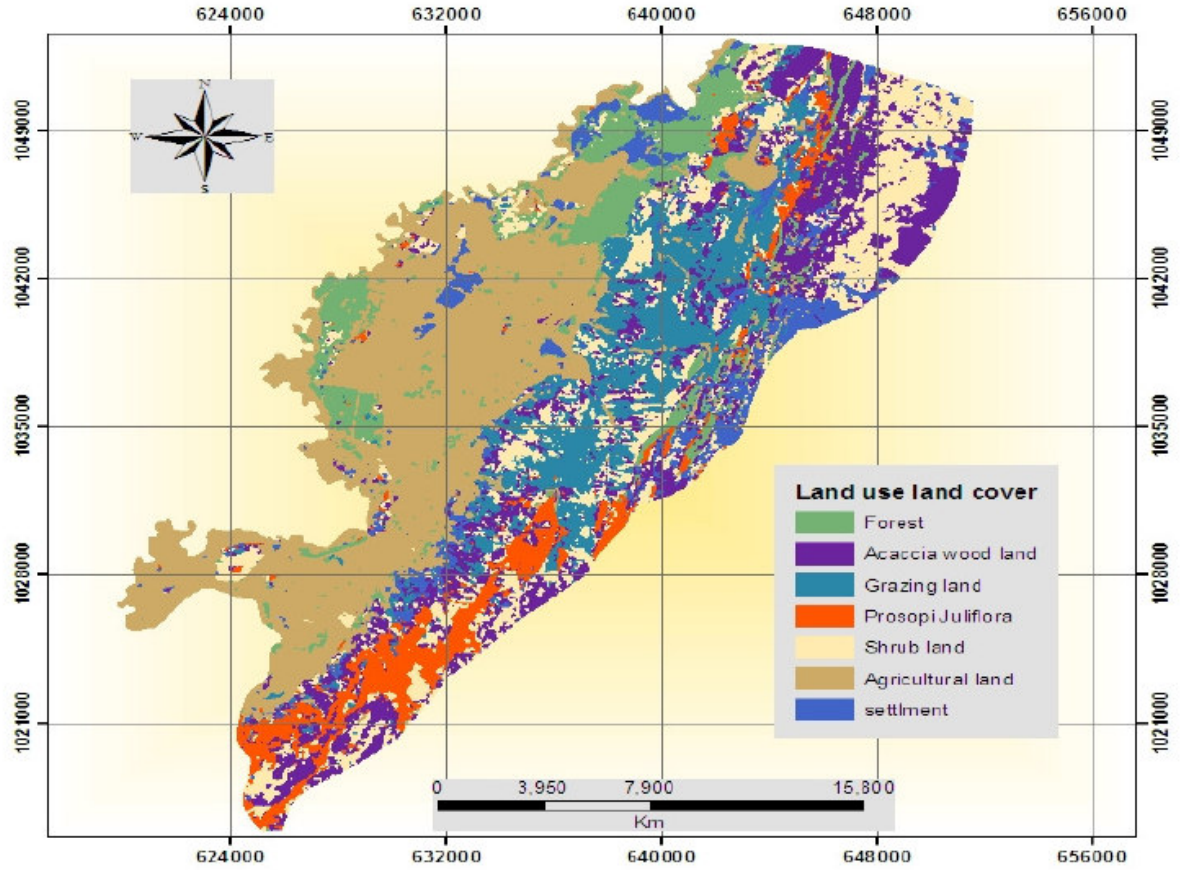


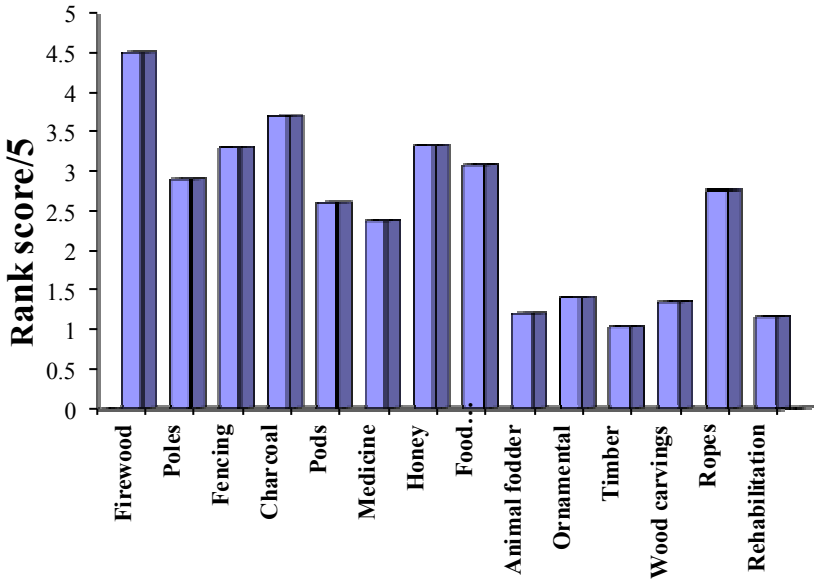
Plate 1: Satellite image showing spread of Prosopis 2012
Source DRSRS 2012

Survey results indicate that 95% of the population use *P. juliflora* as the main source of firewood. On average each household produces 240 bags of charcoal per annum. 85% of the women interviewed noted that they have access to plenty of firewood which was previously a scarce resource. This is in agreement with a similar study done in Ethiopia (Catterson 2003). This has reduced the time and distances they walk in search of firewood. Findings from KEFRI indicate that fuelwood from prosopis has a high calorific value of 4.2 Kcal/gram to 4.8 Kcal/gram (Choge 2002). Most of the people interviewed observed that the plant has helped control desert storms of the early 1980s. The locals harvest 240 litres of honey per household per year. *P. juliflora* is a highly flowering evergreen plant with bright yellow flowers that easily attract bees (Pasiecznik et. al. 2001). On average each household in Salabani location uses 250 backloads of firewood per annum and 240 bags of charcoal per annum. Pods are used as animal fodder (plate3). The total economic benefits accruing from products associated with *P. juliflora* is KES 169,400 per household per annum (Table 1).

Table 1: 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

Figure 1: Rank score of the relative importance of various uses of *P. juliflora* in Salabani location
Source: Survey Data 2009



Source: Survey Data, 2009

Plate 2: Charcoal Kiln
Source: Survey data 2006

Plate 3: Goats browsing on Prosopis pods
Source: Survey data 2006

Economic costs of *P. juliflora*

Economic costs of *P. juliflora* are associated with injuries caused by the thorns of the weed to man and livestock. The thorns of the weed pierce hooves of animals limiting their movement in search of pasture and water. The thorns pierce and lower quality of the hides and skins. This increases the cost of treatment. In particular goats lose their teeth probably due to high sugar content of the plants' pods hence they starve to death (plate 4)**.** *P. juliflora* pods have high sugar content which enhances activity of rumen bacterial cellulase that causes teeth decay in goats leading to high mortality cases (Pasiecznik et. al. 2001).

Plate 4; Goats teeth decay
Source: Survey data 2009

Plate 5: House invaded by Prosopis
Source: Survey data 2009

The total cost associated with the plant is estimated at KES 128,000 per household (Table 4). 39% of the respondents reported that *P. juliflora* led to a reduction of grazing land, 45% reported that the thorny thickets prevent animal movement, 10% reported that it blocks infrastructure (plate 5), while 8% reported that it hosts crop pests and 5% have migrated (Table 2).

Table 2: Frequency distribution of Economic Loses of *P. juliflora*

Economic use	Frequency Reported Cases	Percent
Decreased woodlands	21	10.5
Injury to animals	65	32.5
Reduced biodiversity	44	22
Reduced crop production	77	38.5
Decreased grazing land	78	39
Restricted movement	90	45
Blocked infrastructure	20	10
Crop pests	16	8
Thorns puncture tyres	194	97
Host predators	150	75
Migration	10	5

Source: Survey data. 2009

Table 3: Economic Losses incurred per household per year due to *P. juliflora*

Impact	Number per year	Estimated costs KES
Cattle death	2	40,000
Goat deaths	8	24,000
Livestock treatments	15	15,000
Cost of clearing *P. juliflora*	600 Man hours	30,000
Repair of bicycle tyre punctures	150	3,000
Cost of treatment (human health)	4	16,000
Total Economic loss		128,000

Source: Survey Data, 2009

The weed has also blocked access routes to watering points on Lake Baringo and River Endao, Salabani primary, Salabani secondary school and to Marigat town hence residents have to move for longer distances in search of water or access schools and markets. However no monetary value was attached to this inconvenience. 10% of those interviewed reported cases of their relatives having relocated to other areas due to the invasion.

The net present value of *P. Juliflora* is 21, 244.74, the benefit/cost ratio is 3.091. Since the NPV is greater than zero, the Benefit / Cost ratio is greater than one, internal rate of return is greater than the discount rate the study concludes that it is economically viable to grow *P. juliflora* in Salabani. However some environmental costs and benefits are intangible hence could not be assigned monetary value which could affect the exact monetary economic benefits and costs.

Conclusions

Economic benefits associated with utilization of products from this tree outweigh economic losses. Pastoralists rely on their livestock than any other source of income hence they perceive the tree negatively. In view of the many potential uses of *P. juliflora* all efforts should be made to exploit these products and services. The

community has underutilized the tree

Despite charcoal business being a multimillion enterprise.

Recommendations

The government of Kenya should enhance commercial charcoal production from Prosopis by issuing movement permits which is a trade barrier. It should fast track establishment of a power plant to generate steam energy from Prosopis, introduce non-invasive and thorn less *Prosopis chilensis* alongside commercial utilization of *P. juliflora.* The government should create awareness among communities on other potential uses of the plant like animal feeds, wax and medicinal value. The local community should enhance utilization of *P. juliflora* through charcoal production, sale of firewood and poles. The community should stop burning *P. juliflora* as it encourages re-sprouting from damaged stems, scarifies the dormant seeds, removes all valuable native plants from the ground and contributes to global warming.

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