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SOCIO-ECONOMIC IMPACTS OF INVASIVE ALIEN PLANT SPECIES OF CACTUS (*Opuntia stricta*) IN EWASO NYIRO AREA IN NAROK COUNTY, KENYA

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Citation: Githae, E.W. and Magana, A.M. (2017). Socio-Economic Impacts of Invasive Alien Plant Species of Cactus (*Opuntia Stricta*) In Ewaso Nyiro Area in Narok County, Kenya. In: Isutsa, D.K. and Githae, E.W. *Proceedings of the Third Chuka University International Research Conference held in Chuka University, Chuka, Kenya from 26th to 28th October, 2016. 100-107 pp.*

ABSTRACT

Several plants have been introduced in Kenya for various purposes. Some have become aggressive and rapidly colonize and out-compete the indigenous vegetation. Among them are the *Opuntia* (Cactus pear) species, one of them being *Opuntia stricta* Haworth, which was introduced as an ornamental but has spread widely in natural ecosystems especially in the drylands. However, information about its impacts to livelihoods and the sources of spread has not been well documented. This study investigated the challenges faced as a result of invasion and the factors that contribute to the spread. It was done in Ewaso Nyiro, one of the most invaded areas in Narok County, using questionnaires where a sample size of 50 was purposively selected since the area is not densely populated. Impacts caused by *Opuntia stricta* invasion included denied access to land, injury to both human and livestock and reduced farm-land and pasture-land, land productivity and the well-being of the community. Although majority of the respondents were not aware of how the species got into their farms, some thought that the main source of spread was due to planting the species as an ornamental and a fence. Others thought that it was spread mostly by floods since new invasions occurred immediately after the rainy season. The most common plants affected by *O. stricta* invasion were indigenous vegetables such as terere (*Amaranthus*), stinging nettle (*Urtica dioica*), African nightshade (*Solanum*), spider plant (*Cleome gynandra*) and pumpkins (*Cucurbita pepo*) since they were mostly found on the fence and farm edges and this heavily impacted on the food security. The main methods used to control were chopping, burning, burying and use of herbicides. These methods posed challenges in terms of practicality, expense and environmental impacts and therefore other sustainable methods should be identified that can assist in control as well as improve livelihoods. This should integrate the reported benefits such as source of food, fodder and medicine in order to sustainably manage the species.

Keywords: *Cactus, Invasions, Impacts*

INTRODUCTION

Invasions by alien plant species are considered to be one of the largest threats to ecosystem processes and services that are vital to human well-being (Pejchar and Mooney, 2009). They are able to reproduce and spread at alarming rates across landscapes. They are recognized as the second biggest threat to

biodiversity loss after habitat destruction, and have been implicated in the decline of endangered species across the globe (International Union for the Conservation of Nature [IUCN], 2004). Among the invasive alien plant species that have developed adaptations to survive in dry areas are the cacti (Cactaceae), which have invaded many parts of the world. They are one of the most interesting plants in the arid and semi-arid regions due to their extensive set of peculiar adaptations to water scarcity, which allow them to be perennial and evergreen despite the sometimes extreme dry conditions of their environment (Arechiga and Yanes, 2000). The group is characterized by a fleshy habit, presence of spines and bristles, and large, brightly colored, solitary flowers. Many of the species are grown as ornamentals or oddities. Among them is the genus *Opuntia* (cactus pear) that mainly grow in the wild especially in semi-arid and arid regions. It is native to South America and has invaded many parts of the world (Cronk and Fuller, 1995). Approximately 300 species of *Opuntia* are recognized worldwide. However, description of these species is difficult because of their phenotypes, which vary greatly according to ecological conditions, vegetative reproduction by cladodes and the existence of numerous hybrids as almost all species blossom during the same period of the year with no biological barriers separating them (Ochoa, 2003). Their high level of invasiveness is probably due to the strong ability to grow from vegetative cuttings which can allow rapid dispersal (Henderson, 2001).

A large number of alien cactus species have been introduced to Kenya and are known to be invasive especially in the arid and semi-arid areas. They include: *Opuntia stricta*, *O. engelmannii* and *O. elatior* (CABI, 2014). *Opuntia stricta* Haworth is native to America and was introduced in Kenya as ornamental in the 1940s but has spread widely in natural ecosystems mainly due anthropogenic activities. The species has rapidly replaced native vegetation especially in grazing areas. Some of the distinguishing features include: much branched stems that are longer than they are broad, groups of two or more sharp spines, showy yellow flowers borne along margins of the stem and fleshy fruit that turn reddish purple in color when mature. In Narok County, *O. stricta* is mostly used as an ornamental and hedge plants in homes. As a hedge plant, it is able to regenerate through vegetative growth when trimmed. This has contributed to its fast spread in new areas. In the recent years there has been a steady increase in the number of areas that are affected by the invasion of *O. stricta* in Narok County, which is a serious environmental problem that threatens grazing and farm lands. However, little has been done on the socio-economic impacts and consequences of these invasions to livelihoods.

This study therefore sought to find out the social and economic impacts resulting from *O. stricta* invasion among residents in Ewaso Nyiro area of Narok County where cactus growth is widespread. Research questions were (i) what are the challenges faced as a result of *O. stricta* invasion? (ii) What are the factors that contribute to the spread of *O. stricta*? (iii) Which ways can be used to control the spread of *O. stricta* and reduce new invasions? The findings enhance knowledge and awareness about *O. stricta* invasion as well as their impacts.

RESEARCH METHODOLOGY

Study Area

The study was carried out in Ewaso Nyiro area of Narok County. The area is located in Maji Moto ward, Narok south constituency in Narok County. According to the 2009 census report, Maji Moto ward had a population of 8200 people and has an area of 270km², some of the economic activities carried out in the area include pastoralism, mixed farming and trade and tourism businesses.

Data Collection and Analysis

The study gathered information by use of structured questionnaires where a sample size of fifty was purposively selected based on percentage cover estimates of farm invasions by *O. stricta*. Daubenmire cover scale was used: 1 to 5 where, 1 = less than 20% cover, 2 = 20-40% cover, 3 = 41-60%, cover, 4 = 61-80% cover, and 5 = 81-100%. The questionnaire assessed the impacts as a result of *O. stricta* invasion, mode of invasion, areas invaded and some of the strategies used to reduce spread. The target population were residents of Ewaso Nyiro area both men and women above the age of 18 years. All collected data was cleaned for the purposes of identifying any incomplete, inaccurate or unreasonable data followed by coding. Data was analyzed using SPSS Statistics 15.0 for Windows.

RESULTS AND DISCUSSION

Fifty respondents, both men and women were interviewed. Figure 1 indicates that 54% of the respondents were male while 46% were female. Most cases where women were interviewed were because the husbands (the land owners) were away from home for livestock grazing or distance trading.

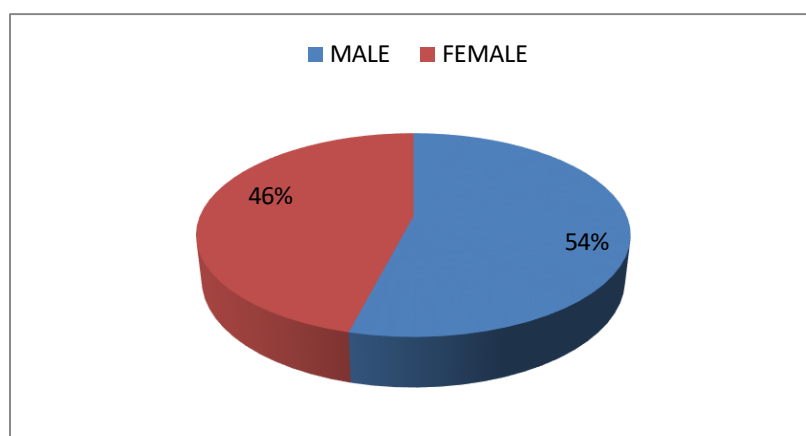


Figure 1: Gender of the respondents

Age structure

Figure 2 shows the different ages of the respondents. The youngest respondent interviewed was 23 years of age while the eldest was 72 years. Age structure between 31-40 years had the highest number of respondents. The area was mostly occupied by middle-aged people who made up majority of the population. In addition, early marriages enabled young people to inherit and own land at an early age.

Education levels

The researcher also took into account the different levels of education among the respondents. The levels included primary, secondary, tertiary and also informal education. Majority of the respondents were educated to tertiary level (33%) indicating high level of literacy among residents (Fig. 3). About 26% of the respondents had received informal education, a good indication of transfer of indigenous knowledge.

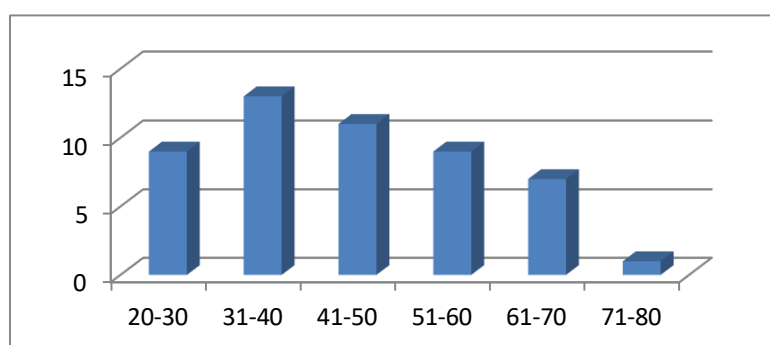


Figure 2: Age structure of the respondents

Means of livelihood

The study determined what the residents did for a living and if the activities could have directly or indirectly contributed to spread of cactus. Figure 4 shows diversification of livelihoods among the residents. They were mainly engaged in farming, pastoralism, agro-pastoralism and trade. Most respondents engaged in farming (mainly maize, wheat and potatoes) and agro-pastoralism. Only 20% of the respondents engaged in pastoralism. Livestock kept were cattle, sheep, goats and donkeys. The results indicate a high rate of diversification to increase income and enhance food security.

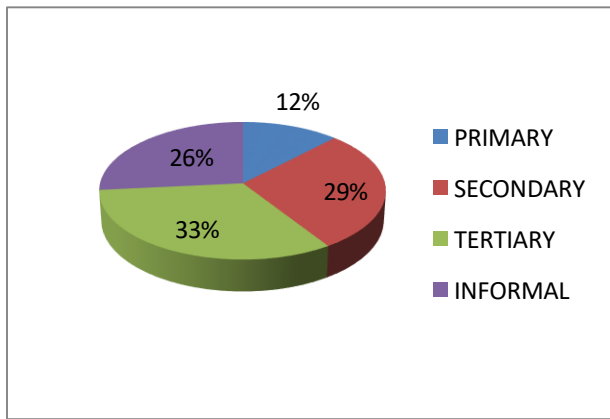


Figure 3: Education levels among the residents

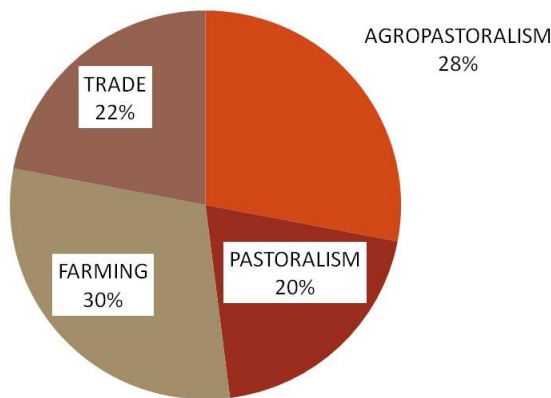


Figure 4: Diversification of livelihoods among the residents

Time duration

This is the time period which the respondents were aware of the *O. stricta*. This was backdated to a period of fifteen years, where respondents were to choose the time frame from 0-5 years, 6-10 years and 11-15 years. Figure 5 shows that most invasions had taken place within the last five years. About 50% of the residents agreed that they became aware of the species in the last five years while only 3% reported that the species was present in the area for a period of more than 10 years. These results indicate that there is likelihood of more ongoing invasions in the area.

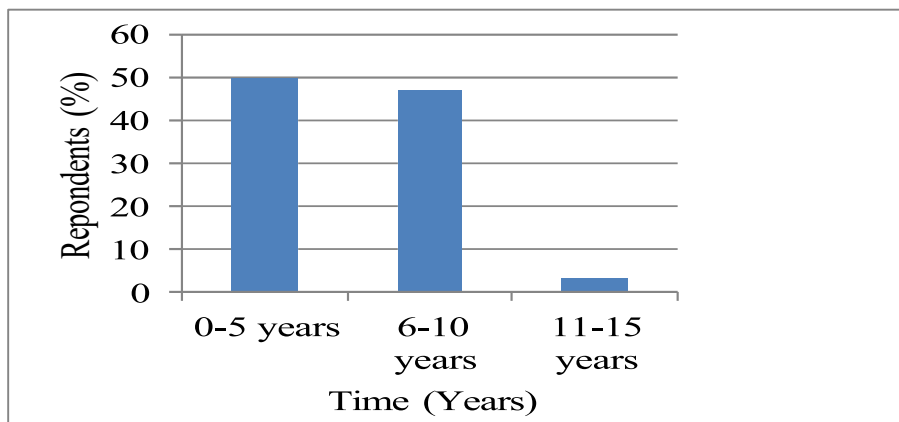


Figure 5: Time period which the respondents were aware of the *Opuntia stricta*

Mode of spread

From figure 6, almost 50% of the respondents were not aware how the species got to be in their farms. They only recalled seeing it growing in different parts of their farms. Even those who agreed they found it growing in their farms (16%), and those who said they found it growing in grazing areas (6%) could not clearly explain how it came to be there. This would therefore mean that the residents were not aware of the means through which *O. stricta* spread. About 28% of the respondents agreed having planted the species as an ornamental plant in their compounds. It later spread fast than it could be controlled to other different areas through cuttings, which were disposed in different new areas around the farm. Some thought that the spread was mainly by flood water since some new invasions occurred immediately after the rainy season.

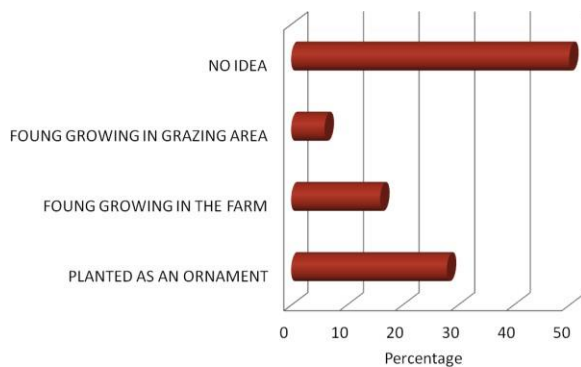


Figure 6: Mode of spread of *Opuntia stricta*

Impacts of *Opuntia stricta*

The respondents were asked if there were any impacts they had experienced as a result of *O. stricta* invasion. Half of the respondents agreed that the species had negative impacts on them and their livelihood. 41% thought that the species had both positive and negative impacts while only 3% said that it had no effect on their livelihoods.

The positive impacts were classified in terms of food, fodder, fencing, medicinal value and any other benefit that the respondents may have identified. The most beneficial use was the use as a fence (84%). Since it is thorny, it is very effective in keeping wild animals away from the compound. Only 5% of the residents said that the species had medicinal value. It is used to sooth burns by rubbing the juice along the burnt part which is said to reduce pain and prevent swelling. None of the respondents had ever used *O. stricta* as either food or fodder.

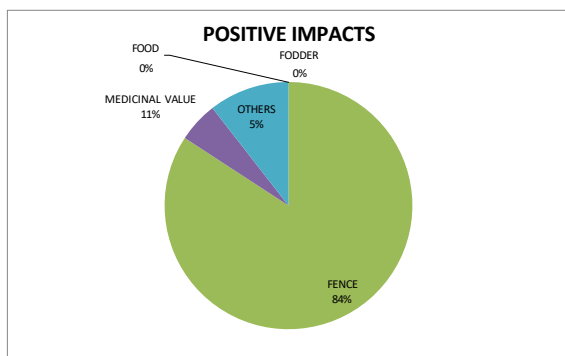


Figure 7: Positive impacts of *Opuntia stricta*

Several negative impacts were identified (Figure 8). About 28% of the residents said that *O. stricta* invasion had denied them access to their lands. This is because where the species had invaded; its thorny stems couldn't allow any farming or grazing activity. 22% of the respondents said that the species had rapidly invaded their crop land. This had gradually reduced the amount of land available for farming. Injury to livestock (21%) was another challenge. The large thorns pierce the eyes of the livestock

causing blindness, which happens when the livestock try to access the grass under the cactus. In some cases, death may occur when livestock develop a condition called pear mouth (collection of pus in the mouth followed by inflammation and swelling). This makes the livestock not to feed which can lead to death. Other negative impacts identified included reduced yields from farms since the species reduced productivity of land. Some respondents said that there was reduced land that was available for grazing which caused overgrazing in the available land. The invasion also greatly contributed to heavy economic losses of both crops and livestock.

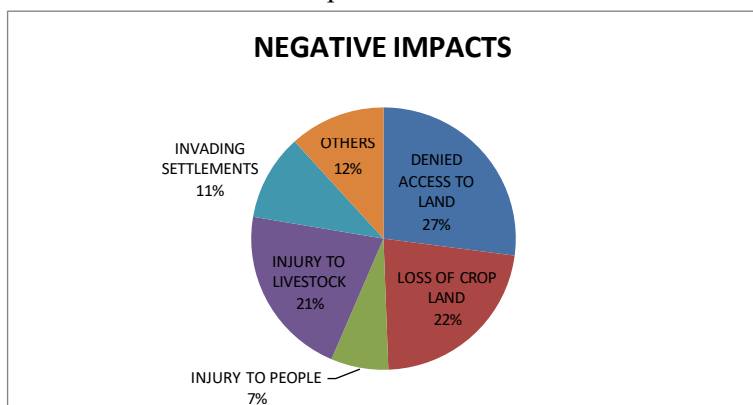


Figure 8: Negative impacts of *Opuntia stricta*

State and rate of invasion

With regard to the state of invasion, about 60% of the respondents said that the rate of invasion had increased in their farms. About 38% of the respondents were not sure while none said there was decreased invasion. While many respondents agreed that *O. stricta* invasion increased with time, about half of the respondents said that the species had spread to less than an acre since they first knew it. About 40% of the respondents were not sure at what rate it was increasing since it was scattered all over their farm and thus an estimate could not be made. Only 3% reported that it had completely invaded their farm.

Areas invaded

There were several areas that were identified as most prone to invasion. These are farmlands, grazing lands, degraded lands, forest and wetlands (Fig. 9). According to the study, areas most invaded were grazing lands and farmlands (32%). This reduced income for farmers and pastoralist since the land productivity had reduced. For the pastoralists, less income was as a result of low milk and meat productivity from livestock. If this trend continues there is likelihood of declining standards of living as a result of declining income. Degraded areas mainly as a result of overgrazing are also prone to invasion at 26%. Continued invasion to these lands leads to more degradation hence reducing land available for carrying out economic activities. If this goes on unchecked there is a possibility of higher economic losses resulting in rising poverty levels.

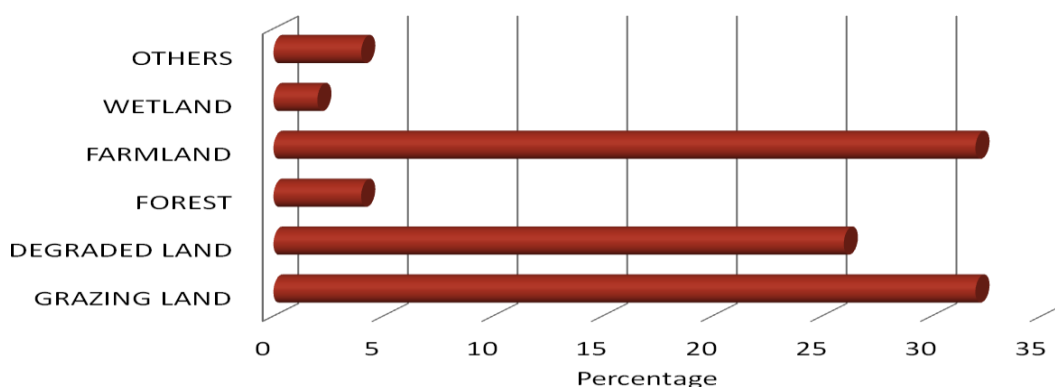


Figure 9: Areas invaded by *Opuntia stricta*

Plants affected

The most common native plants affected by *O. Stricta* invasion included indigenous vegetables such as terere (*Amaranthus*), stinging nettle (*Urtica dioica*), African nightshade (*Solanum*), spider plant (*Cleome gynandra*) and pumpkins (*Cucurbita pepo*). From the study, these crops were mostly found on farm edges and some hanging on the fence for support (climbers) where the invasion suppressed their growth and productivity.

Methods used to control spread

The study sought to find out some of the methods that the respondents used to control spread of *O. stricta* to other areas. Methods used include; chopping, burning, burying and use of herbicides. Most of the respondents interviewed (52%) used chopping as their preferred means of control (Fig. 10). However, chopping was not very effective therefore it was combined with other methods such as burning (10%) and burying the cuttings (20%). Other method used was herbicides. However, respondents said that herbicides used were very ineffective to control the spread. Some said that they used an approximate amount of Kshs 8000 annually in order to control the species through hiring of laborers to chop, buying herbicides, fertilizers and other agricultural boosters to try and improve fertility of lands invaded. The herbicides used were very concentrated with chemicals which are harmful to the environment. Respondents agreed that about three days after spraying the herbicide, vegetation around *O. stricta* died but the cactus itself was not affected. Several attempts had been made to control the spread of *O. stricta* in the area. Use of herbicides was not successful on its own as the plant regenerated after some time from seeds. More effective methods are therefore needed to ensure complete removal of the species.

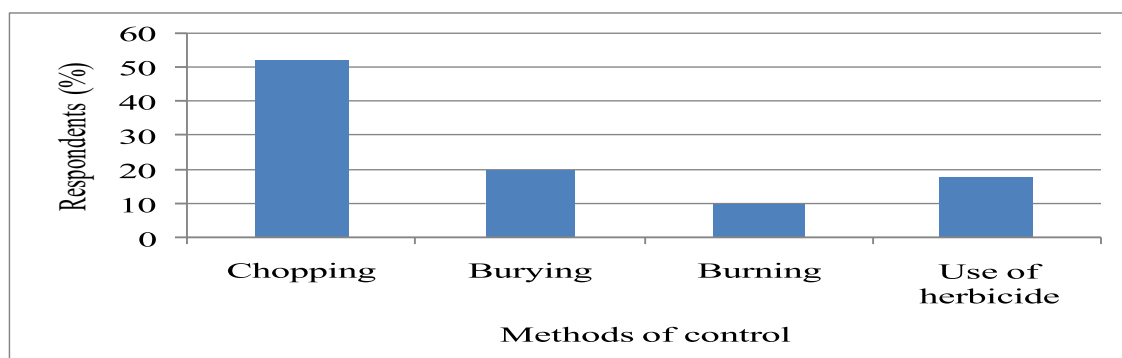


Figure 10: Areas invaded by *Opuntia stricta*

CONCLUSION AND RECOMMENDATIONS

From the findings, it is apparent that *O. stricta* invasion is a growing problem among residents of Ewaso Nyiro, which if not controlled will be of severe consequences in future. The species has encroached areas of possible grazing and farming with an indication of further spread. It is therefore a threat to the well-being of humans, livestock and their environment. Despite its main use as a fence, the following should form a baseline for policy interventions:

- Environmental awareness to ensure that the residents know how the cactus is spread and prevented
- Introduction of bio-control measures to this area.
- Development of herbicides that are environment-friendly and effective.

ACKNOWLEDGMENTS

This study was funded by Chuka University under the Internal Research Fund. Special thanks go to Ms. Mercy Kinyua for her assistance in data collection.

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