

## **ANALYSIS OF SOCIO-ECONOMIC CONTRIBUTION OF PROSOPIS JULIFLORATO THE LIVELIHOOD OF LOCAL COMMUNITIES IN TANA RIVER AND GARISSA COUNTIES IN KENYA**

### *To Cite:*

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**ABSTRACT:** This study sought to assess the socio-economic contribution of Prosopis juliflora products into the livelihood of local communities living in Tana River and Garissa Counties, Kenya. Previous studies had indicated that the potential benefits of the species have not been well captured to mitigate its impacts and promote utilization contrary to the realities on the ground. Reality check shows that most communities where the species are prevalent in northern Kenya continue to utilise it for subsistence and commercial purposes. The study targeted Tana River and Garissa Counties in Kenya where both primary and secondary data were collected. Primary data was collected using two sets of semi-structured questionnaires that were administered to 150 randomly selected households involved in the harvesting, processing and marketing of prosopis products such as charcoal. The respondents were drawn from twenty-two (22) Charcoal Producers Associations in the study area. Quantitative and qualitative primary data was analysed using Predictive Analysis Software. The findings show that poles/posts, fuelwood and pods were the major products harvested from P. juliflora in the study areas. Its economic benefits translate to an annual income of Ksh 1,497,120 and Ksh 240,000 from charcoal and poles per producer respectively. It was further established that charcoal production and marketing was more entrenched in Tana River County compared to Garissa due to the social-cultural differences between the local communities in the two study areas. Prosopis product market awareness among the local communities was ranked high. Therefore, the study recommends that the local Community Participatory Management Teams be strengthened towards management and utilisation of P. juliflora, awareness creation be intensified on the social and economic benefits of P. juliflora, while linking the local communities to the market and undertaking legal reforms to support the utilization of P. juliflora through research and innovations.

**Key Words:** Benefits, Prosopis Products, livelihood, local communities

### **I. Introduction**

Concerns over deforestation, desertification and fuelwood shortages in the 1970s and 1980s promoted a wave of projects that introduced P. juliflora and other hardy tree species to new environment across the world. Prosopis juliflora commonly known as “Mathenge” in Kenya, is mostly found in Arid and Semi-Arid Lands (ASALs) of Kenya which account for about 80% of the country’s land area. These ASALs continue to witness massive natural resource depletion, declining land productivity, a sharp rise in demand for food, fibre, wood and other raw materials due to increasing human population coupled with high poverty levels that negatively impacts on our environment (Bakewell-Stone, 2006). The natural vegetation in the ASALs comprises Acacia species and bushes of *Slavadorapersica* (Anderrsson, 2005).

Prosopis juliflora was introduced to Kenya at varied dates from its native range in South America. It is reported to have been introduced in Kenya in the 1930s for fodder, shade and as an ornamental plant (Mwangi & Swallow, 2005). In the 1970s and owing to drought, there was increased planting of P. juliflora to rehabilitate degraded areas and mitigate recurrent famines and massive losses of human and livestock population. The first records of propagation of Prosopis in Kenya was through species trials of 1973 in Mombasa and Menengai (Nakuru County) to produce fodder or high value cash crops (Maghembe, Kariuki & Haller, 1983).

The species is drought tolerant, establishes rapidly and grows to form a dense impenetrable thicket (Maghembe et al., 1983). Millions of hectares within the ASALs continue to be invaded in Africa, Australia, Asia (Berhanu & Tesfay, 2006; Maundu, Kibet, Morimoto, Imbumi & Adeka, 2009). The fast growing invasion and adaptability of P. juliflora is positively influenced by land use changes, competitive ecological advantages and

climate change making the species to be rated as one of the world's 100 least wanted species (Vander Maesen & Oyen, 1997). The species grows fast and chokes other vegetation, watering points and canals and colonizes most of the areas that are not cropped, including the riparian environments (GoK, Tana River second PID, 2018). It prefers occasionally water-logged areas and regeneration is triggered by such seasonal flooding. Prosopis has both fibrous and tap roots making it a better competitor compared to other species.

Prosopis juliflora is characterised by both negative and positive impacts and if managed well can improve the livelihood of host communities (Lenachuru, 2003). P. juliflora positively improves the environmental degradation and boosts livelihood of the host communities (Hajji, 2018). Prosopis juliflora is a secure source of goods (fuel wood and timber, posts and poles, gums, honey, medicines) and services (conservation and rehabilitation of degraded and saline soils, nitrogen-fixation, and shelter, windbreaks and shelterbelts and shade). Prosopis wood and pods is easily converted into a wide range of products at cottage and industrial levels (Mendes, 1988). The species should be discouraged on irrigated land due to its potential host to pathogenic such as nematodes (Castro, 2002). P. juliflora has the ability to grow on saline and alkaline soils hence valued as soil reclaimer in very poor soil sites. It stabilizes sand dunes on coastal zones and bunds around mangrove creeks (Felker, 2003). It has an overall positive impact on soil where sodium, Sulphur, organic matter and soluble salts are increased threefold within the upper 4.5 m of soil under mesquite (Felker, 2003). The carbohydrates, protein and sugar-rich pods are used as food and fodder especially during dry spell (Geesing, Al-Khawlani & Abba, 2004).

The negative effects associated with Prosopis foliage is that the green leaves are not palatable with the cattle restricted to eating the buds and immature pods (Geesing, et al., 2004). Direct browsing of the foliage can negatively impact on tree development (Oduor & Githiomi, 2013).

The introduction of P. juliflora in Kenya was received with mixed perceptions over the years especially on costs and benefits. The species is an important source of income through charcoal sales (Admasu, 2008) while positively contributing towards enhanced food production in Ethiopia (Zeray et al., 2017). However, the species negatively impacts on ranchers, pastoralists and agro pastoralists as it invades pastures and farm lands (Esther & Brent, 2008). Esther and Brent (2008) through their study on rural residents of Lake Baringo, Kenya concluded that the potential benefits from Prosopis had not been well captured with only few individuals realizing the net benefits from the widespread presence of the tree.

The Prosopis juliflora invasion in Garissa and Tana River Counties continue to receive increased attention from the county government and other development agencies. Strong local support towards management and control appears to be well justified. However, sustainable utilization may require considerable investment in the development of new commercial enterprises P. juliflora with the potential to improve livelihoods of local communities. Despite the numerous negative impacts associated with P. juliflora especially on livestock and crop farming; blocking of passage, the species, has the potential as a secure source of income for improved livelihoods of the locals in Garissa and Tana River Counties.

In this regard, the objectives of the study were to identify the products generated from Prosopis plant, to determine the social economic contribution of prosopis products to the livelihoods of local communities in Garissa and Tana River Counties and to determine the market chain of prosopis products in Tana River and Garissa Counties in Kenya.

## **II. Methodology**

The study was conducted in Tana- River (Bisigidera, Tana north, Bangale, Gubatu and Sala Riverline) and Garissa (Fafi, Jambale, Nanighi, Kamuthe, Bulla Baluku and Guyo) Counties (Figure 1). Tana-River County is located off-coast line between latitudes 0° 0' 53" and 2° 0' 41" South and longitudes 38° 0' 25' 43" and 40° 0' 10' 29" East. The county borders Tana Delta to the South, Garisa and Fafi to the Northeast, Ijara to the East, Motomo to the West, Mwingi to the Northwest and Garbatula to the North. The County covers a total area of 22,453 Km<sup>2</sup>, where 90% is trust land. The vegetation is characterised by scattered trees, shrubs and perennial Grasses. (Tana River second CIDP II, 2018).

Garissa County is part of the former North Eastern Province and borders Wajir County to the North, Tana River County to the West, Isiolo County to the North West, Somalia to the East and Lamu County to the South. The County covers a total area of 44,057 Km<sup>2</sup> and rises from an elevation of 200m to 400m above sea level. The county falls under ecological zone V & VI that is characterised by low erratic and unreliable rainfall. The rains are bimodal in nature with long rains occurring from mid-March to May and the short rains occurring from mid-October to late November. The temperatures are high all-year-round. The County is home to nomadic pastoralists who practice livestock production and subsistence farming around homestead and irrigated agricultures along River Tana. Most lands are held under communal tenure system (Garissa CIDP II, 2018).

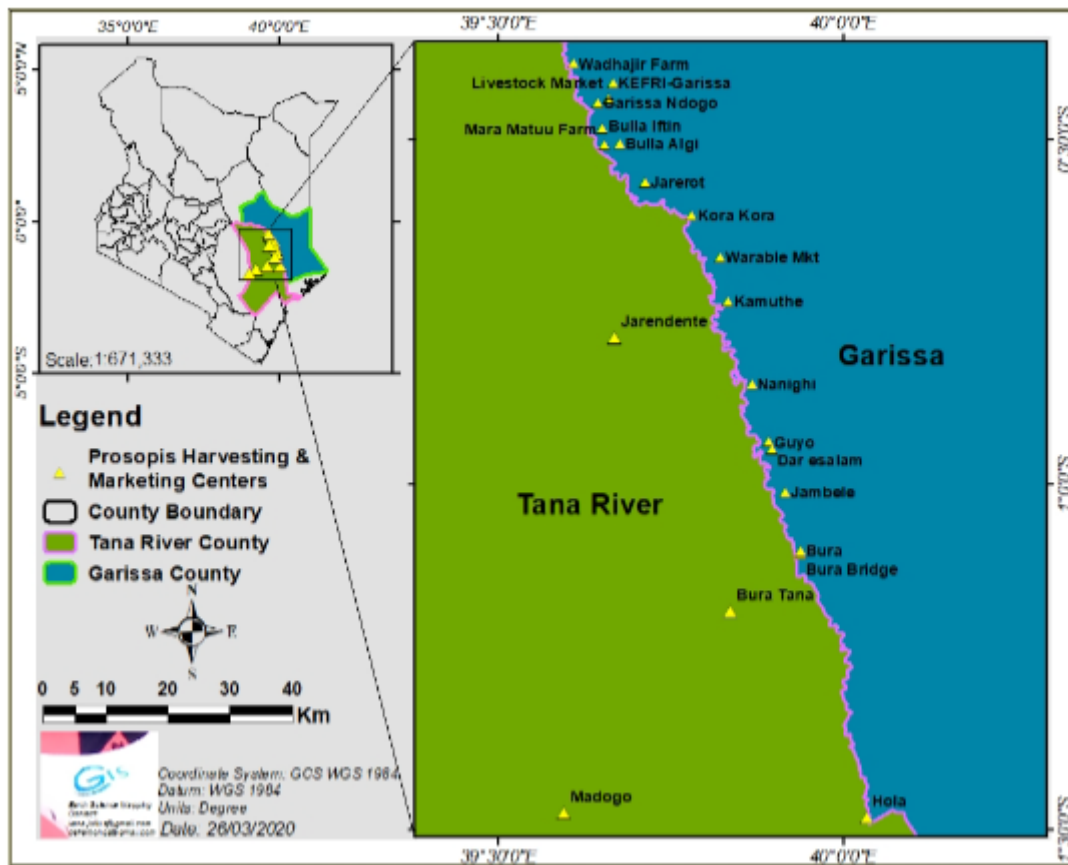


Figure 1: Location Map of study area

### III. Data Collection

Primary and secondary data were collected. Primary data was collected through group discussions, interviews and observations. The interviews were undertaken using two sets of semi-structured questionnaires and a checklist that targeted producers, entrepreneurs and key informants. The questionnaires were administered separately to producers and entrepreneurs of *P. juliflora* products in Garissa and Tana River Counties. The questionnaires sought to establish the types of *Prosopis* products harvested and marketed, technology and innovation in harvesting, processing and marketing. Furthermore, information on household income, farming, agro-forestry practices was gathered. Data on the management and utilization, value addition and marketing of *Prosopis* products was also captured. The checklist was used to solicit information from key informants drawn from Kenya Forest Service, Charcoal Producer Associations (CPAs) and Charcoal Producer Groups (CPGs) officials. Data collection was supplemented through observations and photographing. Secondary data was collected through literature review on related publications, Kenya Forest Services and Ministry of Environment and Forestry reports. A total of 150 households were randomly sampled and interviewed in Tana River and Garissa counties. Eight (8) Charcoal Producer Associations with an average of 24 members and 14 Charcoal producer's association with an average of 30 members drawn from Garissa and Tana River participated in the study.

### IV. Data Analysis

The secondary data gathered from Kenya Forest Service (KFS) and quantitative primary data collected using structured questionnaires was coded and entered into computer using a Microsoft Excel computer package. Once all the data entries had been done and verified, the sheet was exported to Predictive Analysis Software (PASW) for analysis. The data was analysed as percentages and frequencies and presented in form of bar graphs, pie charts and tables. Qualitative data from the interviews was thematically analysed and presented in an narrative.

**V. RESULTS AND DISCUSSIONS**

Social economic characteristics of respondentsThe production and marketing of P. juliflora charcoal in Garissa and Tana River Counties areorganised under an umbrella body, the Charcoal Producer Association (CPA). According tothe Charcoal rules 2009, commercial charcoal producing individuals or groups shouldorganise themselves into CPAs. The producers within a particular area organises themselvesinto charcoal producers group CPGs which merges together to form CPAs. CharcoalProducer Groups are registered with the Ministry of Social Services as Community BasedOrganisations (CBOs). Alternatively, CPAs with recommendation from Kenya ForestryService (KFS) are registered with the AG’s. The CPAs are charged with the responsibility of facilitating sustainable production of charcoal by the membership and ensuring theimplementation of reforestation and conservation plans.

The umbrella body in Garissa consist of eight (8) Charcoal Producers Associations with anaverage of 24 members per group while there are fourteen (14) Charcoal producer’sassociation in Tana River with an average of 30 members per group. The functions of theumbrella body are to coordinates charcoal activities in the respective counties. There weresome efforts to ensure that the charcoal produced by various CPAs is branded. Themotivation for the formation of associations/groups was attributed to management andcontrol of invasive species particularly P. juliflora, and availability of resources that werebeing exploited by non-residents. Furthermore, the Fafi CPA engages youth to collect Ksh8,000 per lorry per day, Ksh 20 per bag for the CPAs, Ksh 20 per bag per CPGs and Ksh 10per bag as packaging fees.

The survey established that the family size per households in Garissa and Tana River were 6and 7 people respectively. Land is still under communal ownership arrangements in bothCounties. These families reside on approximately 8.0 and 2.0 acres of land in Garissa andTana River respectively. The main livelihood economic activities practised by the localcommunities in both the counties are mixed farming, pastoralism and small-scale businesses.

Most of the respondents who practise mixed farming were involved in keeping livestockmainly goats and sheep) and subsistence farming (mainly grow maize). Some of thecommunity members owned farmlands along the Tana river banks where they grow differentkinds of food crops such as maize, bananas and mango trees. These food crops were mainlygrown for domestic use with the exception of mangoes which are sold on both local andnational markets. Pastoralism is practised mainly by the Somali community living in GarissaCounty, who keep camels, cattle and goats that provide a secure source of income. Somerespondents were involved in transport businesses using motorbikes as source of income.

The main source of income among the households was farming (40%), charcoal production(30%) and livestock keeping (30%). Those involved in farming produced cereals, vegetablesand fruits. The annual income per households from key economic activities in the twocounties was: charcoal production (Ksh 1,497,120), livestock (Ksh 1,224,000), faming (Ksh888,996) and Prosopis poles (Ksh 240,000). This depicts that Prosopis charcoal productioncontributed the highest income earner hence a good opportunity for improving localcommunity livelihoods in the study sites. Prosopisjuliflora produce high quality charcoal,the wood does not split, produce sparks, or emit much smoke and its commonly referred to aswooden anthracite. Moreover, the durability, strength, less shrinkage and cracking and hardness make the wood of P. juliflora more useful for many purposes (Victor, Pillay, & Al-Minji, 2007).

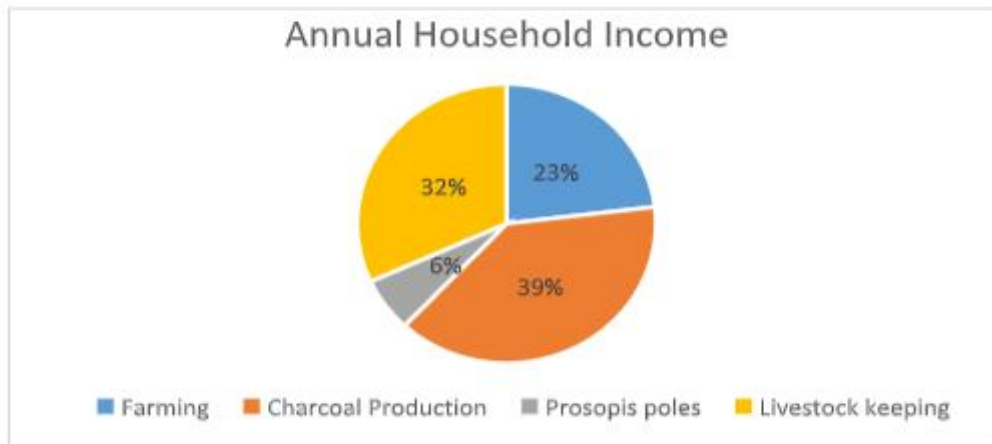


Fig 2; Annual households’ incomes

Prosopis Products as a source of livelihood Majority of respondents (80%) were involved in utilization of P. juliflora besides its disadvantages with 20% of the respondents indicating prosopis is useless and a nuisance. Prosopis was mainly utilised for firewood, poles/posts and charcoal. Charcoal was mainly produced using the traditional charcoal kilns (Figure 2). The harvested products were obtained through pruning and clear felling of trees to minimise on the effect of colonisation.

The common hand tools used in harvesting and processing of P. juliflora products includeanga (39%), axe (32%), spade (19%) and fork jembe (10%). The local community members were involved in charcoal production (42%), poles /posts production (29%), bee forage (17%) and pods production (12%) from P. juliflora (Figure 2). Trade in P. juliflora products provided a secure and major source of income with of four to six family members per household being employed in harvesting, processing, transportation and marketing. However, harvesting of P. juliflora products is labour intensive.

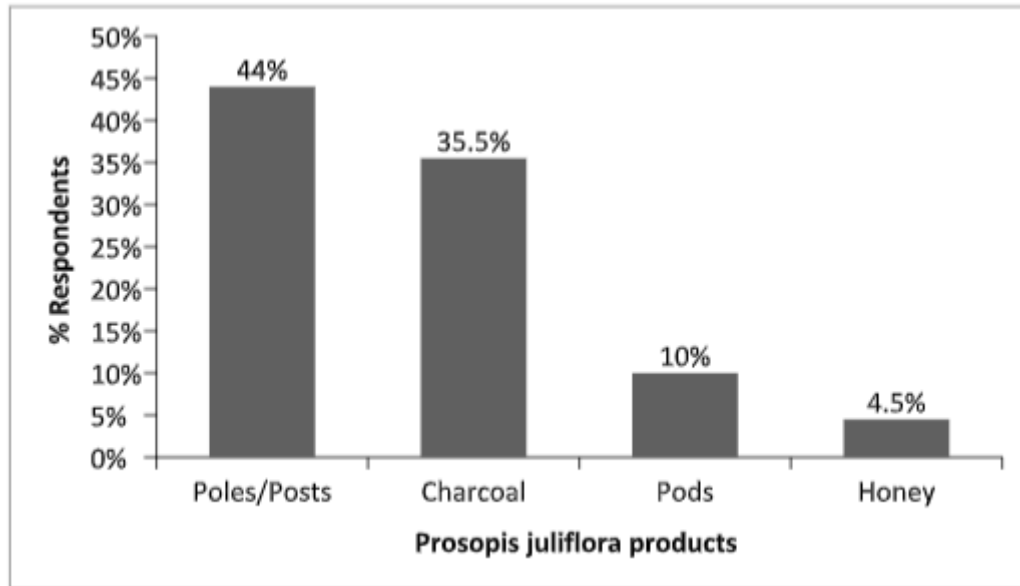


Figure 3. The main Prosopis products identified in the study areas

It was established that P. juliflora charcoal positively contributed to the livelihoods of the community through income while firewood was the main source of energy used for cooking food. Most of the local people use P. juliflora poles/posts for house construction though the wood is normally attacked by borers after a very short time. The other ecosystems services were reduction of dust storms, wind break and improvement of soil fertility. In this regards, P. juliflora is a multi-purpose resource that positively provide both tangible and intangible benefits.

The commercial and subsistence use of Prosopis products in Tana River and Garissa Counties cannot be disputed. Income and employment opportunities provide a sustainable coping mechanism to the recurrent drought and famine. The annual income earning per household from Prosopis Charcoal in Tana River and Garissa Counties was Ksh 3,028, 692 and Ksh1,931,477 respectively. The annual income earning from poles are Ksh 139,992 and Ksh99,300 respectively. The Prosopis fodder and firewood was sold in small quantities.





Fig 4: Various Prosopis products identified within study site (or you may name them)

Charcoal production in Garissa and Tana River County Charcoal production from *P. juliflora* mostly was reported in Garissa and Tana River Counties. The production was mainly for commercial purposes (75%) and domestic uses (25%). It was reported that all the charcoal producers paid a fee of Ksh 50 for every bag of charcoal to the landowners. The producers targeted only matured *P. juliflora* which was believed to produce high quality charcoal in the colonised areas within the counties.

However, charcoal production requires 2-4 people since it was labour intensive as compared to other products. Production of charcoal in both counties was mainly produced using traditional earth kiln method (100%). A single charcoal kiln could yield 8-20 bags of charcoal depending on the size of the kiln. In a week, a producer would make 5 to 10 charcoal kilns depending on availability of *P. juliflora* logs. Thus, a producer could produce an average of 00-600 bags of charcoal per month. At the production site, charcoal was packaged into gunny bags with twine ropes weaved on top to secure the charcoal. Since there are no standards for the weight of a bag of charcoal, observations made within different sites visited revealed variations in bag sizes and weight filled with charcoal. Ready charcoal was always packaged in either 50kg or 90kgs of gunny bags ready for transporting or sale.

Between 2012 and 2017 the Prosopis charcoal production in Garissa County varied from 20,000 to 140,000 bags annually while production in Tana River County ranged between 150,000 and 200,000 bags. The variations in production between the years and between the two counties can be attributed to various factors like the local culture, change in attitude, government ban on logging and trade in charcoal, insecurity and weather changes such as floods (Figure 4). Whereas the Somali communities in Garissa are predominantly pastoral, the community in Tana River practice agro-pastoralism. The peak was attributed to various factors such as migration of youth from Kitui, Tana River, Kakamega and Bungoma counties who are able to produce more charcoal than the other years. On the other

hand, the increase in invasion of *P. juliflora* positively contributed to the availability of raw material leading to mass production of charcoal in the county resulting into higher sales.

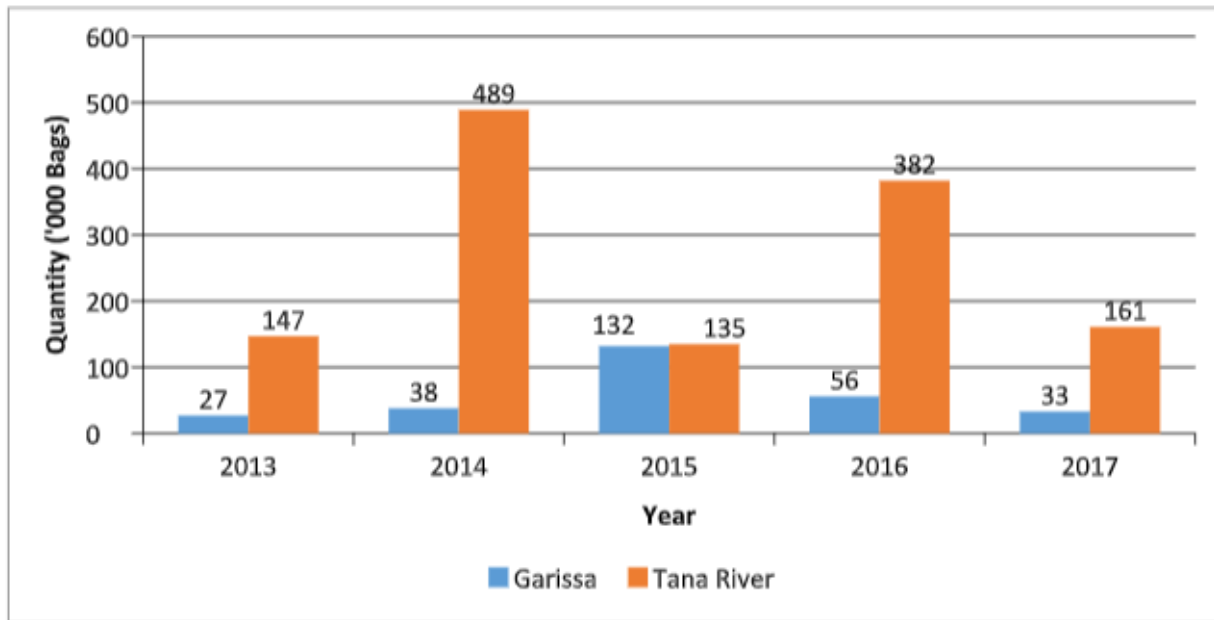


Figure 5. Charcoal production in Garissa and Tana River Counties from 2013 to 2017

(Source: Kenya Forestry Service Office, Garissa and Tana River)

**Marketing of Prosopis Charcoal in Tana River and Garissa Counties**

*Prosopis juliflora* charcoal played a big role in revenue generation in the two counties. It contributed a total amount of from Ksh. 3,000,000 to 65,000,000 in Garissa County and Ksh.60,000,000 to 300,000,000 in Tana River County annually (Figure 5). However, fluctuations were experienced in both counties as a result of floods and government moratorium on logging.

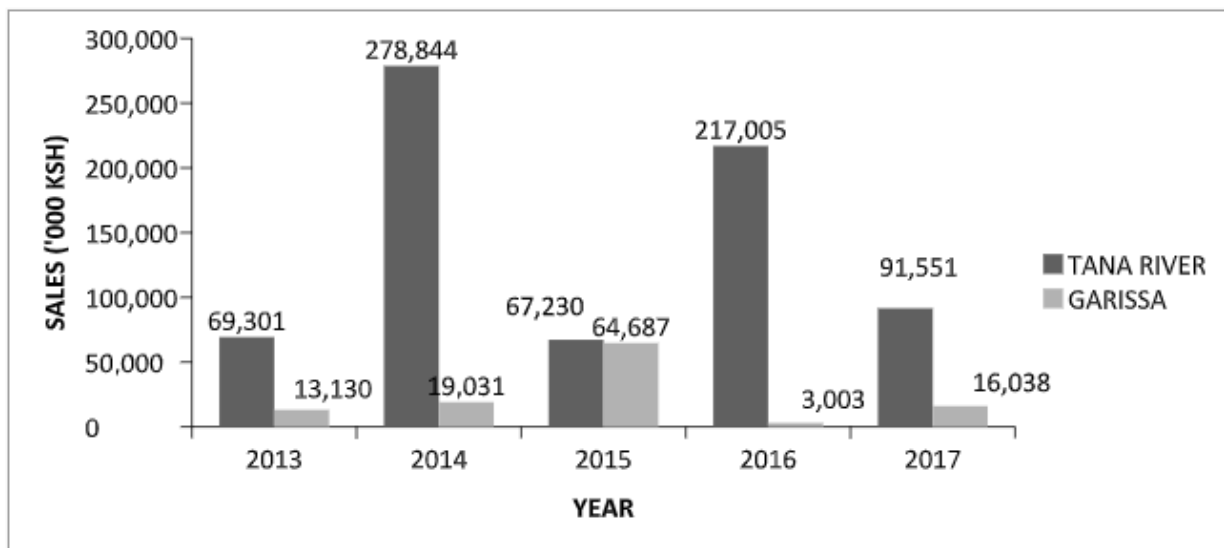


Figure 6. Revenue from Prosopis charcoal (2013-17)

Other *Prosopis* products Firewood from *P. juliflora* was collected locally from the heavily invaded sites in both counties mostly for domestic use (85%) and sale (15%). Only dried *P. juliflora* stands were collected and packed into head loads for easy carrying on the back/head or on a cart. Firewood collection was done by women and children (100%) in both counties. Firewood required no processing as it was cut into sizeable pieces ready for sale or use.

Prosopis juliflora pods provided fodder for livestock (e.g. cattle and goats) during dry seasons. Like firewood collection, pods were collected by women and children since their income was very low compared to charcoal. Collection was quite involving and time-consuming, thus few individuals were engaged in the activity. Pods were collected and packaged into 90 kg bags for sale. It was established that pods collection was more prominent in Garissa County (90%) than in Tana River County (10%) because of their livelihood dependency on it. Prosopis juliflora was one of the best bee forage species for honey production. An average quantity of 1,500 Kg to 2,000 Kg were produced and sold in the local market per month in Garissa County. It was reported that the production of honey in Garissa County had declined due to massive charcoal production and pole/posts harvesting activities that have reduced the forage.

**Marketing of the Prosopis Products** The Prosopis products value chain starts at production and ends at consumption and includes all the economic activities undertaken between these stages. Many different stakeholders participate in the value chain; right from wood production, carbonization, packaging and transportation, retailing and distribution, and consumption. The Prosopis products value chain involved producers, middle men, transporters and consumers as the main players. Production of Prosopis charcoal was being done using the traditional method that was characterised by a low recovery rate of 15%-20%.

According to Kambewa, et al., 2007, a study on charcoal consumption, trade and production in Malawi revealed that there were several channels for charcoal from the producer to consumer. First channel was from producer to consumer, whereby a small-scale producer takes the charcoal directly to the consumer. The second route was from producer to buyer to consumer, where a buyer purchases the charcoal from the producer and takes it directly to consumers' homes. The third route was from producer to primary buyer to secondary buyer to consumer which was a more complex option in which there is both wholesale and retail markets. Therefore, all the stated channels were being applied in both counties though the first two channels were applicable locally in the counties and the third channel was applicable when charcoal was transported from the counties to Nairobi.

However, every product had its own unique channel different from others. Poles and posts were harvested for sale (55%) and local uses (45%). Poles were mainly used in construction of houses in the villages and cattle bomas and fencing. Poles and posts of different sizes were processed by cutting and removing thorns as one of safety measures. They were arranged and packed in bundles for transportation by donkey carts, or vehicles to the market or construction sites. Very few respondents were engaged in the promotion of their charcoal (38%) locally. The rest of the respondents did not promote (62%) their charcoal. Prosopis juliflora is associated with goods and services it provides to the local community.

Pricing of Prosopis charcoal was determined by Charcoal Producer Groups before the charcoal ban took effect in the two counties. An individual or group or business entity requires a movement permit from the Ecosystem Conservator of forests to transport more than 3 bags of charcoal. The charcoal movement is restricted to between 6.00 am and 6.00pm. Charcoal is always transported either directly to the local market or roadside. Generally, the transportation of charcoal from the production sites is undertaken by the buyer. However, findings from this study revealed otherwise. Before the ban on charcoal production, a large number of producers through their CPGs ferried charcoal from production sites to designated charcoal collection points. Alternatively, transporters were equally ferried charcoal from production sites. Since the implementation of the ban, utilization of P. juliflora has been very difficult hence making pricing very difficult for the producers to sell their charcoal at a very low price. Following the moratorium on charcoal production and trade in the country, very few respondents' producers were still engaged in charcoal production on a small scale. A 90kg bag of charcoal was retailing at KES 400 per bag at the farm gate. This was because of the involvement of middlemen/brokers who lower prices of the charcoal. Other products such as poles were sold at KES 60 per pole. The charcoal market awareness (Figure 6) was rated high (50%), very high (32%) and medium (18%) due to the help of CPGs.



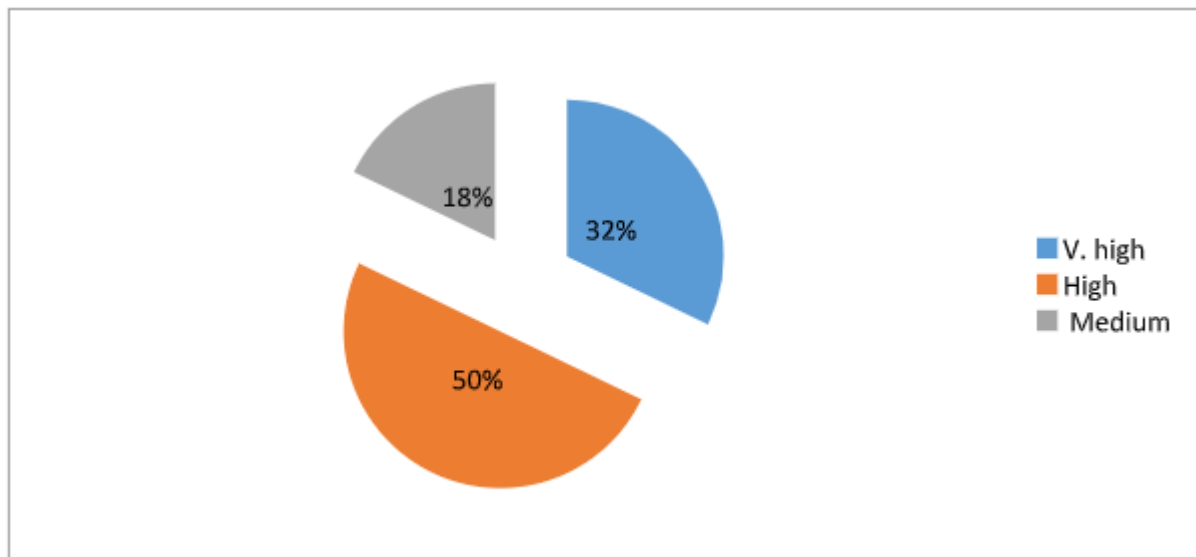


Figure 7. Level of Market Awareness on prosopis uses

Challenges in the Production of Prosopis Charcoal Despite *P. juliflora* providing a secure source of livelihood, various challenges were experienced along the Prosopis products value chain. The reported challenges include: lack of protective gear that leads to injuries and accidents; lack of technology and innovation in the harvesting and processing of Prosopis products; high cost of transport; lack of training skills in the management and utilization of Prosopis *juliflora*; harsh/extreme weather conditions including floods and scorching sun (working under high temperatures caused by the hot sun); the government ban on charcoal production and marketing by the County government had resulted into harassment, arrests and decline in the supply (directly linked to the national moratorium); insecurity resulting into low production; poor roads infrastructure.

## VI. CONCLUSION

The findings indicate that there is a substantial potential to improve household livelihood through commercialization of prosopis *juliflora* products. The main source of livelihood among the communities in the study areas were mixed farming, pastoralism and small-scale businesses. The key *P. juliflora* products in the study area were; poles/posts, fuelwood and pods. The *P. juliflora* charcoal contributed through income earnings whereas firewood was the main source of energy used for cooking. Most of the local people use *P. juliflora* poles/posts for house construction.

The Prosopis charcoal production was the key economic benefit derived from in the study area where a 90kg bag was sold at KES 400 or Ksh 1,497,120 per year. Alternatively, prosopis poles were sold at KES 60 per pole or Ksh 240,000 from poles per annum. Prosopis product market awareness among the local communities was highly ranked (82%).

## VII. RECOMMENDATIONS

Given the huge potential provided by Prosopis species and its products, the study recommends that the local communities be encouraged to form Community Participatory Management Team geared towards management of *P. juliflora*, intensification of educational programmes to create awareness and understanding of the benefits associated with the management of *P. juliflora*, link the communities to the markets, undertake legal reforms to support the management and utilization of *P. juliflora* and strengthen research and innovations in the management of the species. Further research to investigate the role of informal institutions such as CPAs and CPGs in the production and marketing systems geared towards the formulation of compatible interventions. Enhanced cash-flows can be achieved through improved production, local value addition and post-harvest handling, and resource access and market among others. Adopt an integrated approach in exploring the commercial opportunities of the Prosopis products for improved livelihood of the local communities.

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