Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.6, No.14, 2016

Indigenous Knowledge, Uses and Conservation of Prunus africana (Hook. F.) Kalkman in Nandi Forests

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Abstract
Prunus africana is a multipurpose medicinal tree of worldwide fame in treatment of benign prostate cancer. However, the wild collection is no-longer sustainable due to overharvesting. In order to conserve the species, there is need to determine the status of the local community knowledge on uses and conservation measures to develop protocols for sustainable utilization and avert extinction of the species. Stratified random sampling was used to interview and administer questionnaires to 188 households and herbalists within a buffer zone of 1 km in South Nandi Forest. The study found that 99% of the locals were aware of the *P. africana* tree. Majority (82%) agreed that *P. africana* population was decreasing both in the forests and farmlands. Almost all parts of the *P. africana* were utilized for different purposes. Majority of the locals (66%) acquire *P. africana* products from the forest. Closer proximity to the forest and uncontrolled harvesting provides easier accessibility to *P. africana* for households use. The study concluded that *P. africana* is an important multipurpose medicinal tree to the local community and recommends enhanced planting and protection within and outside the forests to ensure posterity.
Keywords: Multipurpose, medicinal, sustainable, local community, use.

1. Introduction

Prunus africana is classified by the International Union for the Conservation of Nature (IUCN) as vulnerable and is listed in Appendix II of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) (Betti, 2008; IUCN, 2015). In Kenya, the natural populations become threatened due to over-harvesting, poor protection and management of the protected areas (Gachie *et al*., 2012).

Traditionally, *P. africana* has multiple uses (Ingram *et al.,* 2009). It produces timber that is used for making tool handles and poles for construction and fencing and fuel-wood particularly for charcoal (Stewart, 2003; Fashing, 2004). The tree bark is used by herbalists in treatment of prostate problems, as a remedy for stomachache, an infusion to treat appetite, urinary and bladder infections, chest pain, malaria, microbial infections, and kidney disease (Betti, 2008; Bii *et al*., 2010; Jeruto *et al.,* 2011; Otieno & Analo, 2012; Mwitari *et al*., 2013).

Internationally, *P. africana* bark extracts are being used medicinally to treat Benign Prostatic Hyperplasia (BPH) that is common in older men (Cunningham *et al*., 2002; Fashing, 2004; Briganti *et al.,* 2009; Jimu, 2011; Betti & Ambara, 2013; Betti *et al*., 2014). This is eased through the anti-inflammatory effect of *P. africana* extract on prostatic tissue and inhibition of bladder hyperactivity (Cunningham *et al*., 2002).

Wild-collection of *P. africana* materials is no longer sustainable because bark harvesting adversely affects morbidity and mortality rates of harvested populations (Stewart, 2003; Mugaka *et al*., 2013). Notably, the destruction of the species especially in natural forests has been increasing. This has led to concerns on the long-term sustainability of harvesting and the conservation of the species (Navarro *et al.*, 2008; CITES, 2012; Weru, 2012; Owiny & Malinga, 2014). The high demand therefore poses immediate need of conservation strategies of the populations. This study therefore aimed to fill the knowledge gap on the indigenous knowledge, uses and sustainable harvesting by the locals communities in SNF. This study therefore aimed at determining the status of awareness, uses and conservation measures of *P. africana* by the local communities living around South Nandi forest.

2. Materials and Methods

2.1 Study area

South Nandi Forest is located in Nandi County, Western Kenya, between latitudes 0˚05‘N and 0˚21‘N and longitudes 34˚90‘E and 35˚08‘E (Figure 1). The forest land measures approximately 18000 ha, with the area

under forest cover *ca.* 13000 ha at an altitudinal range of 1700 – 2100 m asl. Rainfall is high (1600 to 1900 mm per year) depending on altitude.

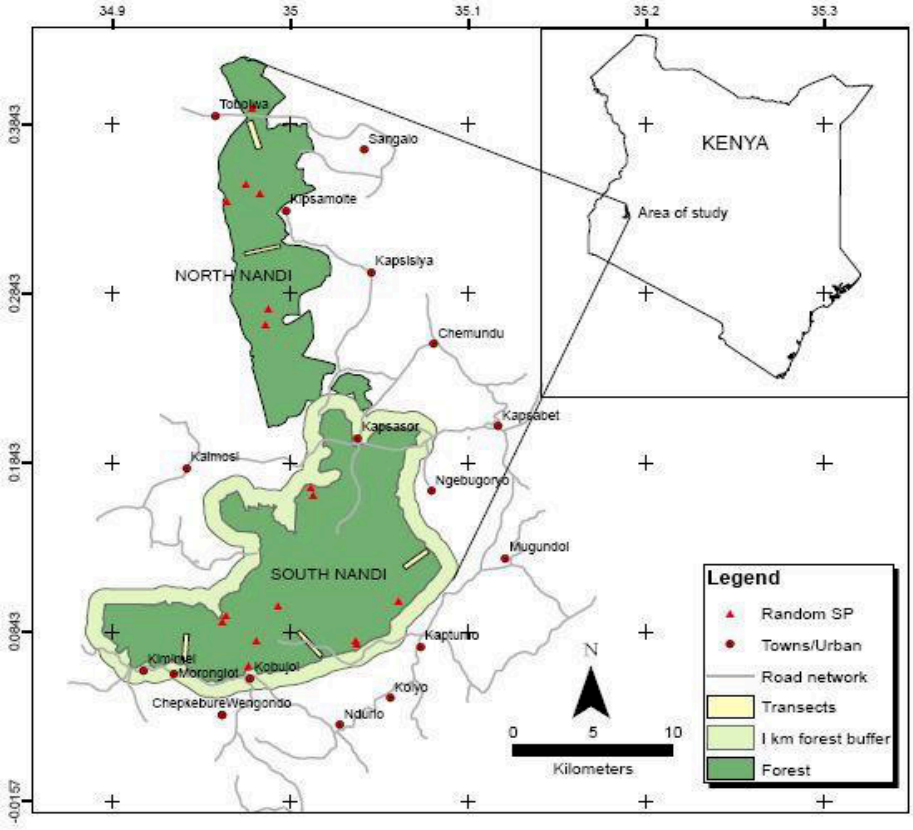

Figure 8: A map showing the study area
Source: Author

2.2 Sampling and data analysis method

Google earth, under the open layer tool, was used as a background in QGIS Brighton V 2.6 to generate a buffer zone of 1 km to the outside of the South Nandi Forest (SNF) edge. Both Stratified random sampling (SRS) and Purposive Sampling were used. The number of sub locations and their area in km^2, homesteads population around the 1 km buffer zone around the forest was obtained using the Kenya population and Housing Census 2009 (GoK, 2010). The household density within the buffer zone was obtained by dividing the population households' density of the entire sub-location by the relative area (km^2). Using a growth rate of 2.9 % and multiplied by the household density, the 2015 household population density of 9,574 households was obtained.
A total of 370 households were obtained as the sample size of the population using Krejcie & Morgan (1970) formula as shown below.

$$S = X^2NP(1-P) \div d^2(N-1) + X^2P(1-P)$$

Where **S** = required sample size

χ2 = the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841)

P = the population proportion (assumed to be 0.50 since this would provide the maximum sample size).

N = the population size

d = degree of accuracy expressed as a proportion (0.05)

A total of 185 (50%) households were then sub-divided to each sub-location based on the total household population ratio. The obtained sample from each sub-location was randomly selected and preferable the eldest in the household interviewed. Semi structured questionnaire intended to collect information on the local awareness, social-economic uses and conservation measures of *P. africana* by the locals was used per household. In addition, three (3) well-known practicing herbalists to the locals were interviewed to obtain further information on the uses of *P. africana* for medicinal purpose. All qualitative data from questionnaires after cleaning were coded and analysed by use of SPSS (version 20). Frequency tables, bar charts and pie charts were used to present the results.

3. Results

3.1 Awareness by the local community of the population status of P. africana

The study shows that 99% of the respondents were aware of the *P. africana* tree. Seventy four percent (74%) of the respondents were aware that *P. africana* is listed as a vulnerable species by the IUCN. Amongst them, 86% were aware of the requirement of a permit by the government to fell down *P. africana* as well as any other indigenous tree for various uses. This information was obtained by the locals mainly from Kenya Forest Service (KFS) officers (57%) such as forester, forest rangers and scouts. Majority (82%) agreed that *P. africana* population was decreasing both in the forests and farmlands. The decrease was mainly attributed to charcoal burning (49.5%), logging (47.9%), overgrazing (19.1%), firewood collection (8%), debarking (4.3%), infestation (3.7%), uprooting (2.7%), forest fires (1.6%) and invasive species (1.6%). On the other hand, the increase in *P. africana* population (17%) was attributed to the high regeneration of the seedlings (69%) and planting them on farmlands (24%). The study found that 74% of the respondents were aware of *P. africana* products in the local market which included furniture (96%) and beams (4%). However, 99% were not aware of the use of *P. africana* in the international market as medicine for the treatment of prostate cancer.

3.2 Sources and Uses of P. africana by the local community

The study established that almost all parts of the *P. africana* tree were utilized for different purposes. The major parts of *P. africana* used by the locals was the stem (95%), branches (90%), bark (67%), leaves (57%) and roots (18%) respectively (figure 2). About 95% of the respondents used the stem for timber (47%), charcoal burning (30%), wood (12%) and beams/posts (11%) due to its straight bole and strength. Moreover, about 90% of the respondents use the branches for firewood (68%) because the wood burned for a long time, charcoal burning (13%), fencing (12%) and other purposes (7%) for instance, handles for axes and hoes due to its strength.

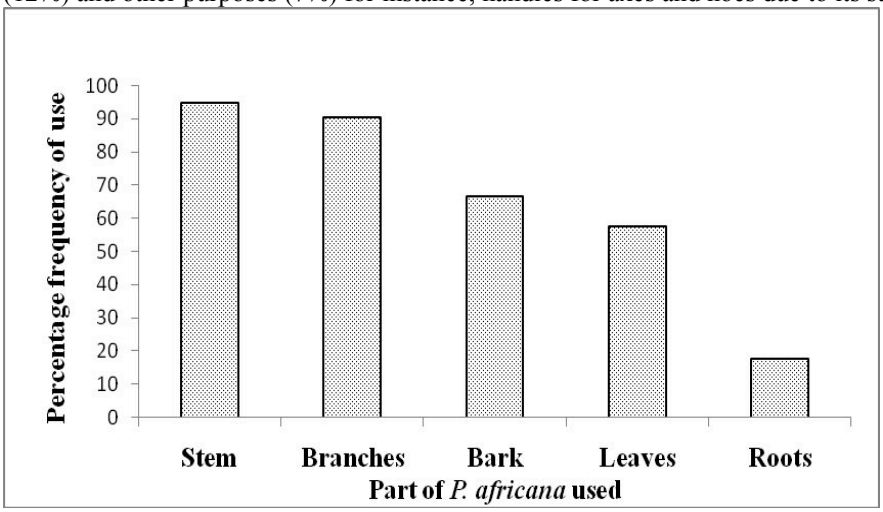

Figure 9: Parts of *P. africana* used by the local community

About 67% of the respondents used the bark for human medicine (52%), livestock medicine (44%) and for other uses (4%). The bark is crushed and boiled to produce a concoction that is used to treat a wide range of illness (56%), prostate cancer (2%), stomachache (2%), typhoid (1%), ulcers (1%), malaria (1%), skin rashes (1%) and coughing (1%) in humans while in animals it was used to treat foot and mouth disease. About 57% of the respondents used the leaves as medicine both for humans and animals (39%), animal feeds especially during droughts (36%), shade (22%) and as manure (3%) for crops. Furthermore, about 33% of the respondents used the roots for medicinal purposes (76%) and firewood (24%).

The study established that majority of the locals (66%) acquire *P. africana* for use from the forest. Other sources of *P. africana* include the farmlands (52%), homesteads (9%) and along the rivers and roads (2%). Majority of them (92%) collects *P. africana* when necessary while others collect them on monthly (4%), yearly (3%) and weekly (1%) basis.

3.3 Measures taken to conservation of P. africana by the locals

The study established that the locals had taken some steps towards conservation of *P. africana* (Figure 3). Majority of them (70%) participated in planting of *P. africana* in their farms as well as in protection of the few remaining in the forest. Some of the community members volunteered as forest scouts helping the KFS in the management of the forest. However, some were reported not to be doing anything to conserve *P. africana.* Their main source of seedlings for planting included the forest (44%), Non-Governmental Organizations (34%), local tree nurseries (16%) and Kenya Forest Service (3%). In addition, they also collected the seedlings from natural regeneration in their farms and homesteads.

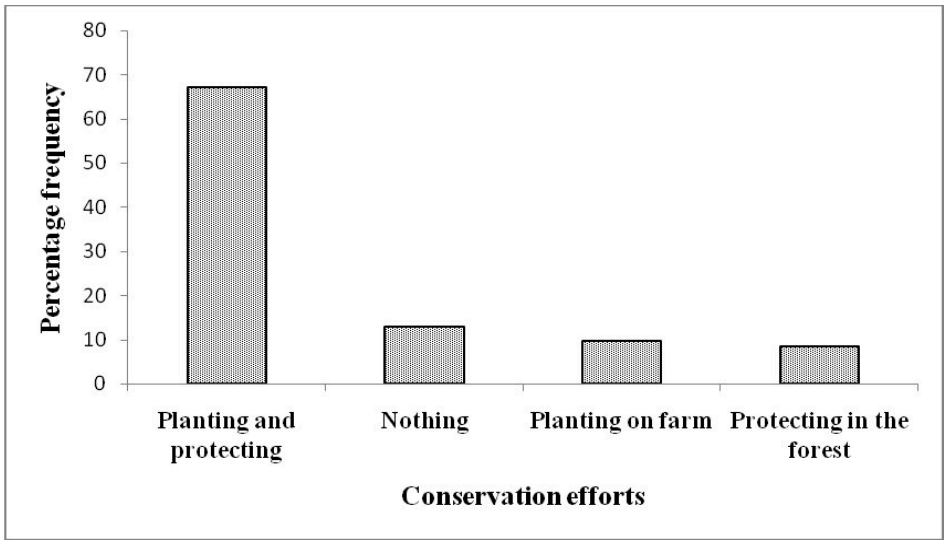

Figure 10: Steps taken to conserve *P. africana* by the local community

4. Discussion

A high awareness on *P. africana* by the local communities living around SNF was observed. This is attributed to the fact that the tree is widespread in the afromontane forest ecosystems (Kalkman, 1965; Stewart, 2003; Betti & Ambara, 2013). However, the populations have been declining globally even getting locally extinct in some regions (IUCN 2015), mainly attributed to its multi-purpose function (Bii *et al.,* 2010; Mwitari *et al.,* 2013; Ingram *et al.,* 2015). *Prunus africana* is preferred by the local communities because it produces good quality charcoal and timber used for fuel, construction and in making furniture and tool handles. In Ethiopia, the local people harvest and use the bark, stem and branches for fuel wood, charcoal production and as timber (Betti & Ambara, 2013). Many studies have noted that *P. africana* is valued for its high quality timber and branches used for various purposes (Stewart, 2003; Fashing, 2004; Betti & Ambara, 2013).

A dense and rapidly growing human population around the forest exerts high pressure on the forest. Legal and illegal logging have been identified and documented as the major causes of the decline in populations of *P. africana* (Sunderland & Tako, 1999; Cunningham *et al,.* 2002; Ingram, 2014). Firewood remains the most widely used source of energy for the local communities around the forest (Stewart, 2003; Girma, 2011; Weru, 2012). In addition, other notable causes of the decrease include debarking (CITES, 2012; Vincenti, 2013), trampling (Girma, 2011), infestation (Orwa, 2009; Weru, 2012) and invasive species (MEA, 2005; Lung, 2010; Jimu, 2011).

On the other hand, *P. africana* population increase was attributed to its high natural regeneration. However, in reality this is not the case as most of the seedlings do not survive to maturity especially due to overgrazing (Fashing, 2004; Abebe, 2008; Vincenti 2013). Communities living near the forest kept large herds of livestock and rely on the forest for grazing throughout the year. Illegal grazing in the forest has been found to be one of the major threat to *P. africana* and other species (Ingram, 2009; Schaab, 2010; Khan, 2015; Mligo 2015). Lack of awareness by the locals on any international products of *P. africana* can be attributed to low information and sensitization levels on the importance of *P. africana*.

Other studies has shown that *P. africana* bark is used by herbalists to cure more than one ailment depending on the part used, mode of preparation and administration. For instance, in treatment of prostate problems, as a remedy for stomachache and an infusion to treat appetite, urinary and bladder infections, chest pain, malaria, and kidney disease (Navarro *et al.*, 2008; Bii et al., 2010 and Mwitari *et al.,* 2013). This indicates its multipurpose functions to cure different diseases (Addo-fordjour *et al.,* 2008). *Prunus africana* is an evergreen tree and the locals use the leaves to feed their animals especially during the dry season. It has a big canopy cover thus preferred in the homesteads for shade (personal observation). The fallen leaves provide good manure for use in the farms.

Closer proximity to the forest and uncontrolled harvesting provides easier accessibility to *P. africana* for households use. The increase in human population has also put pressure on the available resources on the surrounding farmland hence the need to supplement their demands from the forest. It is widely reported that rural households rely on wild natural resources to help meet current-consumption needs and to provide a safety net in times of hardship (Belcher *et al.,* 2015).The study showed that majority of the users of *P. africana* products had no specific time of collection of the resource from the respective sources. This can be attributed to the fact that products were only collected for use when a need arises and not throughout. For instance, the high demand for

firewood due to the increased population and dwindling farm land leads to a high frequency to the forest for the resource. This indeed endangers the survival of the target species. *Prunus africana* is a multipurpose tree for the local use and consequently the rate at which they are harvested can be higher than that of other woody species (Jimu, 2011).

The study established that the major source of *P. africana* seedlings is the forest. This is due to the high germination of the seeds that fall from the mother plant and germinate under the shade hence can be collected for free. *Prunus africana* seeds are highly dispersed by birds (Farwig *et al,*. 2006) and therefore can be found germinating naturally at any suitable grounds. Increased planting of *P. africana* in the farmlands due to their economic value was seen as a major contributing factor to their increase. The cultivation of medicinal plants on farm have been found to be a means to combine biodiversity conservation especially the endangered species and alleviate poverty (Wiersum *et al,*. 2006; Ingram, 2014). Planting *P. africana* on farms as well as helping in protecting them in the forest by reporting any illegal harvesting or any form of destruction of the forest is a good starting point towards the conservation of the species. However, the best way to ensure the survival and sustainable utilization of this multi-purpose tree species in the future is therefore planting them on farms (Franzel *et al.,* 2009; Ingram *et al.,* 2009; Ingram *et al,*. 2015).

5. Conclusion and Recommendations

The study concluded that *P. africana* is an important multipurpose medicinal tree to the local community. It is valued for its cultural, social and economic function. The most harvested part of *P. africana* was the stem due to its high quality timber as well as the bark used in the treatment of several human and animal ailments. However, the major threats to the survival of the species included overgrazing, logging and charcoal burning in the forest which serves as the major source. The study recommends enhanced planting and protection of *P. africana* within and outside the forests to ensure its future survival. In addition, there is also a need to create awareness on the importance of *P. africana* to the locals as well as establishment and support of the existing tree nurseries.

6. Acknowledgement

We acknowledge the local community and herbalists for their active participation, time and cooperation during the interviews. Also, the kind assistance by Nature Kenya (Kapsabet Office), Kobujoi Community forest Association (CFA) and the field assistants particularly on the provision of logistics and guidance in the field.

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