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## NATURAL RESOURCES UTILIZATION BY THE AWEER IN BONI-LUNGI AND DODORI NATIONAL RESERVES, KENYA

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### ABSTRACT

A study was conducted to record the utilization of Boni-Lungi and Dodori National Reserves by the Aweer community. Results indicate the procuring of a wide gamut of provisional, regulatory, cultural and supportive services from these reserves by the community ranging from wood forest products utilized in construction to their use in expression of religious beliefs to non-wood products. In addition, 16 wildlife species were found to be utilized as primary source of protein, with eggs (guinea fowls and ostrich), fish and honey were utilized as secondary products, while various fungi and algae were consumed as vegetables. Resource extraction occurred with a seasonal dissimilitude. This study underscores the need for appreciation of Aweer ethno-biology input on native forest conservation.

**Keywords:** Aweer community, Boni-Lungi and Dodori National Reserves, Indigenous Knowledge, Natural Resources Utilization

### INTRODUCTION

Over 350 million people globally are known to be living within or adjacent to dense forests (FAO 2006). Fundamental to improving livelihoods of the locals and

promoting sustainable development, the forests offer a wide diapason of products and services: land, soil, water catchment, vegetation and renewable energy sources (Falconer and Koppell 1990). The Boni-Lungi and Dodori forests comprise part of the coastal forests of Kenya. The forests are the remaining remnant of the Northern Zanzibar-Inhambane coastal forest mosaic in Kenya (White 1983; Olson *et al.* 2001), and significant biodiversity hotspots (Mittermeier *et al.* 2005; Conservation International 2009) within the East African coastal strip.

Presently, the forest natural resources are utilised by the Aweer (also called the Boni) community who live along the forest corridor and in close proximity to the reserves. The community is linguistically related to the Somali and the Rendille. According to UNESCO (2010), the Aweer language is classified as a “definitely endangered” language. The major economic activities of the Aweer are hunting and gathering. They source both wood and non-wood forest products from the Boni-Lungi and Dodori forests for food, medicine, building material and fuel-wood (Andanje *et al.* 2010; Young 2012). After the gazettment of Boni-Lungi and Dodori forests as National Reserves in 1916, the community was forced to



practice subsistence agriculture. However, agriculture is not feasible, as much of the land they inhabit is of low agricultural value due to low rainfall and poor soils. Despite the availability of high level of information on natural forest resource utilisation, there is still a deficiency of knowledge on Boni-Lungi and Dodori National Reserves. The objective of this study was to bridge the gap on utilization of the resources in Boni and Dodori reserves with a view to sustainably manage and conserve this threatened coastal forest mosaic.

### Description of the Study Area

The Boni-Lungi and Dodori National Reserves lie in South-Eastern Kenya, between latitudes 1°18' and 2°06' South

and longitudes 40°48' and 41°34' East. Both reserves were gazetted in 1976 and were carved out of the Lungi and Boni forest reserves. The reserves cover 1339 km<sup>2</sup> and 877 km<sup>2</sup> respectively (Figure 1) and are characterized by semi-evergreen lowland dry forest, acacia thorn bush land, lowland cultivated savanna and lowland woodland ecosystems (Kuchar and Mwenda 1982). The climate is hot, humid to sub-humid throughout the year, lying in eco-climatic zone V and VI. Rainfall is bimodal with peaks in April and in October-November, during which roads often become impassable. The soils are mostly sandy with poor structure, but also there are extensive black and dark brown clays (Kuchar and Mwenda 1982).

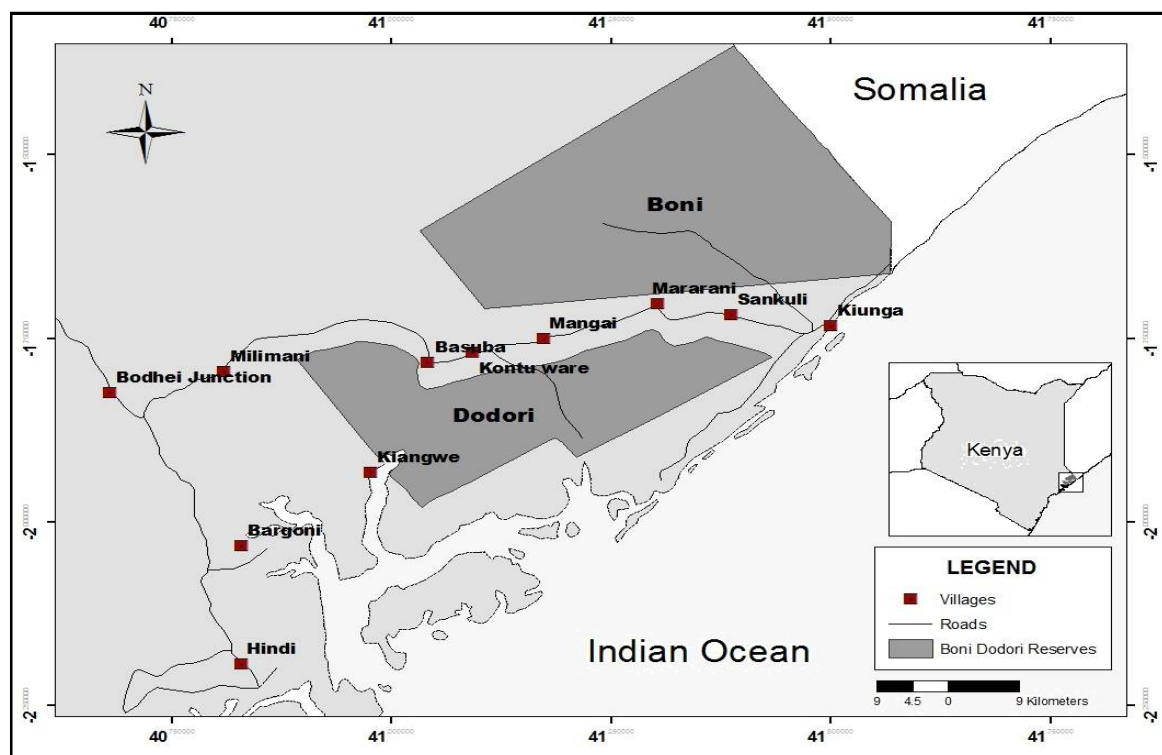


Figure 1: Map of Boni and Dodori National Reserves and adjacent villages

The fragmented and interspersed savanna and bush-land has enormous wealth due to its high aesthetic value, high diversity of endemic plant and animal species and valuable resources for the people (Burgess and Clarke 2000). Dominant woody plants comprise of *Cassia* sp. L., *Lansea schweinfurthii* (Engl.) Engl., *Oldfieldia somalensis* (Chiov.) Milne-Redh., *Salacia*

*madagascariensis* (Lam.) DC, *Uvaria acuminata* Oliv., *Cassipourea euryoides* Alston, *Diospyros* sp. L., *Combretum* sp. Loefl., *Strychnos* sp. L., *Heinsia crinita* (Afzel.) G.Taylor, *Dovyalis* sp. E.Mey.ex Arn., *Grewia plagiophylla* K.Schum. and *Philenoptera bussei* (Harms) Schrire (Kuchar and Mwenda 1982).



The population of the Aweer people in 2012 was about 7,602 as per the 2009 Kenya census (Okombo and Muluka 2011; Young 2012). The Aweer people are concentrated in several villages closely associated with the main Hindi-Bodhei-Kiunga road (Andanje *et al.* 2010).

:

$$Sample\ Size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + (\frac{z^2 \times p(1-p)}{e^2 N})}$$

where:

Population Size = N (7200)

Margin of error = e (15%)

z-score = z (2.58)

Structured pre-tested questionnaires were administered through a stratified simple random sampling technique. The questionnaires comprised of closed and open ended questions. The key information captured included resource utilized, frequency of utilization, resources associated with religion, secondary natural resources utilized, resources avoided due to taboos or religion, and resources associated with other resources. In addition, local and scientific names of resources identified and utilized by the Aweer community were recorded. The

## METHODS OF DATA COLLECTION AND ANALYSIS

The study utilized responses from 72 respondents (n) in 11 villages. The sample size was calculated using the following formula

data from the questionnaires were entered into an excel sheet for storage. Descriptive analysis was done using MS Excel programme.

## RESULTS

Results indicate a robust (94.44%) utilization of tree products, followed by herbs (41.67%), grasses (31.94%) and succulents (20.83%)(Figure 2). The plant resources were mainly used as food, medicine and raw materials for construction.

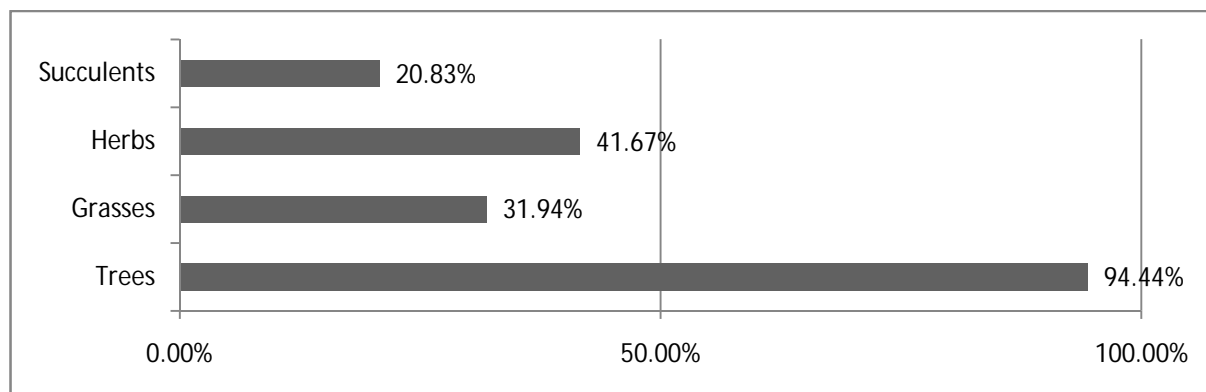


Figure 2: Plant forms utilised as food by the Aweer

Herbs and grasses were used as traditional vegetables while succulents provided

fruits. The study recorded over 16 different food plants in the Aweer language. These



were *Dioscorea dumetorum* Pax. [*digi* – Aweer] tubers, *Adansonia digitata* L. [*mbuyu* – Kiswahili] seeds, *Mangifera indica* L. [*maembe* – Kiswahili] fruits, *Bridelia cathartica* Bertol. [*mkarakara*–Aweer], *Hyphaenesp.* Gaertn. [*mkoma* – Kiswahili], *Grewia bicolor* Juss. [*mtone/mkone*–Kiswahili], *Garcinia livingstonei* T. Anderson [*mangales* – Aweer], *Tamarindus indica* L. [*kwaju* – Kiswahili], *mariga* [Aweer],

*ndewere* [Aweer], *igelo* [Aweer], *tiel* [Aweer], *kama/kamua* [Aweer], *kurek* [Aweer], *huro* [Aweer], and *borei* [Aweer]. Out of the plant resources utilised, the community used all the 5 major plant parts as sources of food. Fruits were the most (91.67%) utilised plant part, followed by leaves (58.33%), stems (48.61%), roots (43.06%) and barks (25%) (Figure 3).

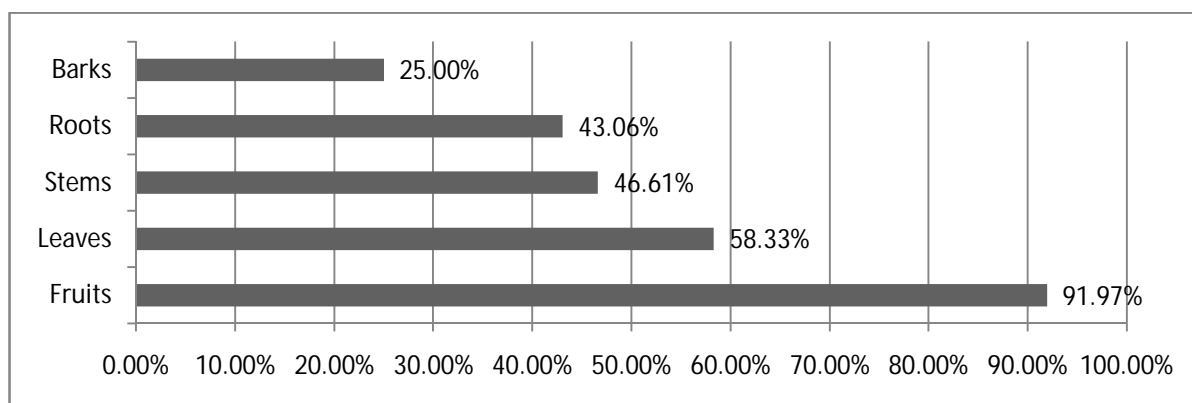


Figure 3: Tree parts used as food by the Aweer community

In addition, plants were used for medicinal purposes with the tree products being the most (91.67%) utilized by the community. Other plant utilized to remedy diseases

were from herbs (48.61%), grasses (38.89%), and succulents (19.44%) (Figure 4).

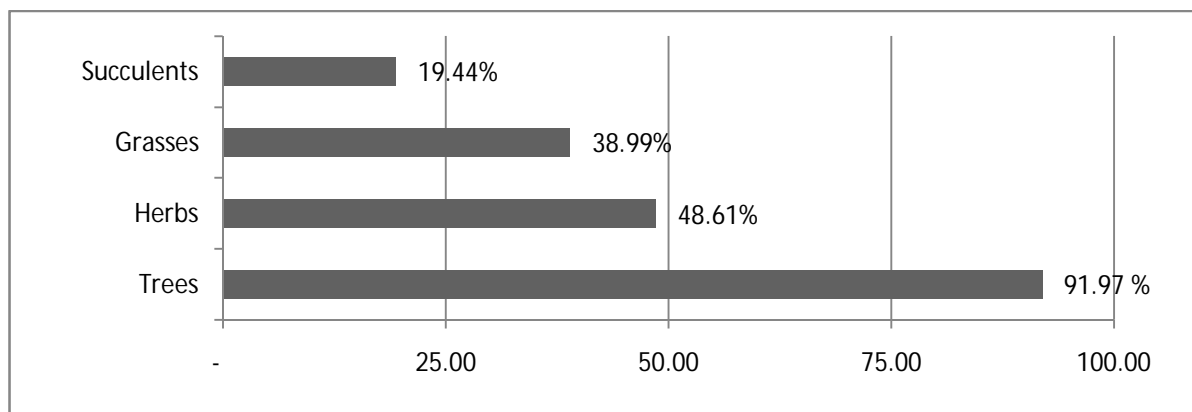


Figure 4: Plant forms sought for medicinal purposes

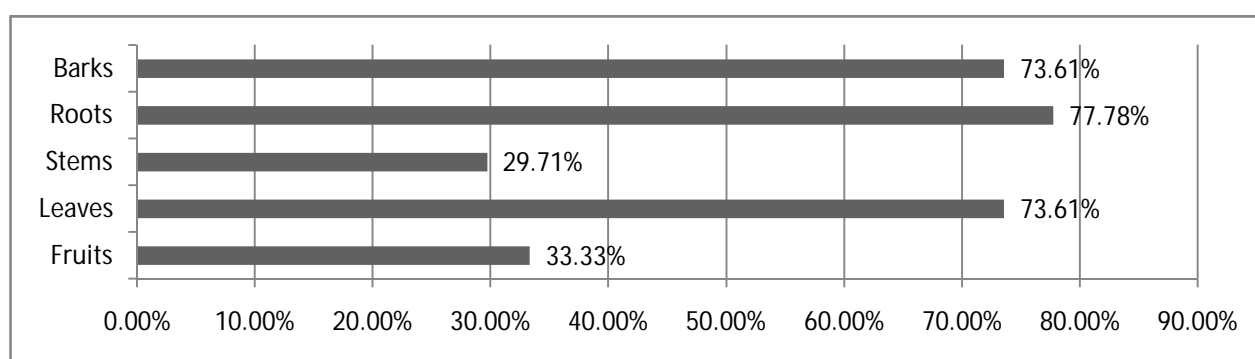
Plant roots were the most (77.78%) utilised, followed by leaves (73.61%), barks (73.61%), fruits (33.33%) and stems (29.71%) (Figure 5). The medicinal tree plants offered remedy and relief for 24 mentioned diseases and ailments (Table 1).

For construction of houses, the Aweer primarily utilised trees for construction (97.22%), followed by grasses (88.89%) (Figure 6). Herbs were the least utilised plants for construction (47.22%).



**Table 1: Complication and remedies attributed to medicinal plants.**

No.	Complication	Remedies attained	Plant parts used
1	Respiratory	Asthma, cough, chest pain and common cold	<i>Maerua triphylla</i>
2	Snake bites	Anti-venom	<i>Uvaria acuminata</i> roots; <i>Boscia angustifolia</i> inner bark, <i>Maerua triphylla</i> roots
3	Helminthes infestation	Anti-helminth (de-wormer)	<i>Capparis cartilaginea</i> stems and barks
4	Buccal	Bleeding gums	
5	Digestive	Diarrhea, stomach ache, heart burns, dysentery and typhoid	<i>Uvaria acuminata</i> roots; <i>Boscia angustifolia</i> fruits as a laxative
6	Wounds	Circumcision wounds, boils, general wounds	<i>Maerua triphylla</i> leaves
7	Osteo – inflammations	Joint pains and rheumatism	<i>Maerua triphylla</i> roots and fruits
8	Dermatological	Skin infections / and ring-worms	
9	Reproductive	STI – Gonorrhoea and breast diseases	<i>Uvaria acuminata</i> roots for breast diseases and <i>Maerua triphylla</i> roots for urinary disorders
10	Vector-borne	Malaria	
11	Aches and pains	Head-aches and tooth-aches	<i>Capparis cartilaginea</i> and <i>Maerua triphylla</i> roots
12	Optical ailments	Eye infections	<i>Capparis cartilaginea</i> leaves
13	Hematological remedy	Blood purification	
14	Nutritional deficiency	Vitamin deficiency	Various fruits
15	Flavors	Tea flavor and food flavor	<i>Cymbopogon citratus</i> (DC. ex Nees) Stapf.
16	Psychic	Dizziness and hallucinations	<i>Uvaria acuminata</i> and <i>Maerua triphylla</i> roots
17	Aphrodisiac	Sexual dysfunction	<i>Maerua triphylla</i> roots



**Figure 5: Tree parts utilized as medicinal remedies by the Aweer community**

Trees were used as building posts during wall construction and rafts (Figures 7, 8, 9 and 10); grasses as thatch while shrubs as hedge demarcation. Both houses and kraals were constructed using sapling, shrubs and thatch. Sedges were also utilised by the Aweer women to make

mats. Only three tree species *Casuarina* sp. L., *nibuzi* [Aweer] and *waranga* [Aweer] were mentioned as used for construction. *Acacia nilotica* (L.) Delile, *A. Senegal* Willd, and *A. tortilis* Hayne were used to delineate boundaries (make-shift hedges).

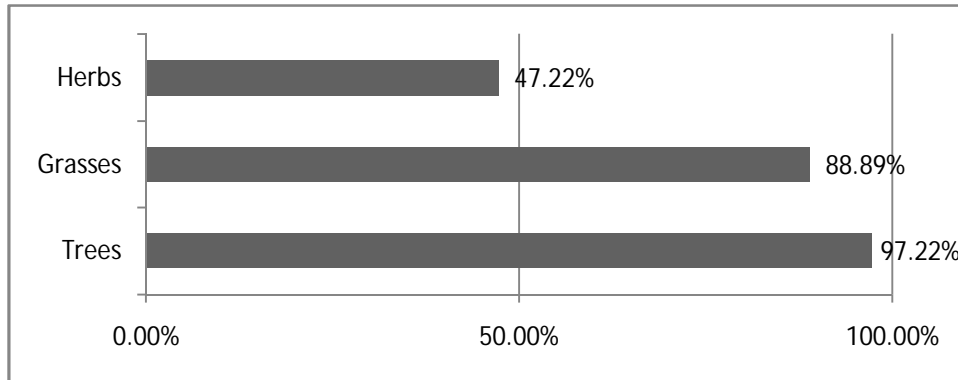


Figure 6: Plant forms utilized in construction by the Aweer community



Figure 7: House construction using poles



Figure 8: Kraal constructed using poles, grass and shrubs



Figure 9: Fence demarcation using saplings and grass as roofing material



Figure 10: Mat making and roofing using sedges

### Frequency of plant utilization

Plants are harvested at different times of the year, depending on the intended product and use. Tree products are the most form of plant natural resources as they offered food, medicine and construction material (Figure 11). The products were derived in form of fruits, bark, leaves, sap and roots.

The utilization of plants and their products for food by the Aweer community varied seasonally and depended on use and product, in tandem with the bimodal rains and maturity of plants. Daily and weekly utilized plants consisted of mainly perennial native vegetables. Seasonally utilized natural products included fruits and tubers.

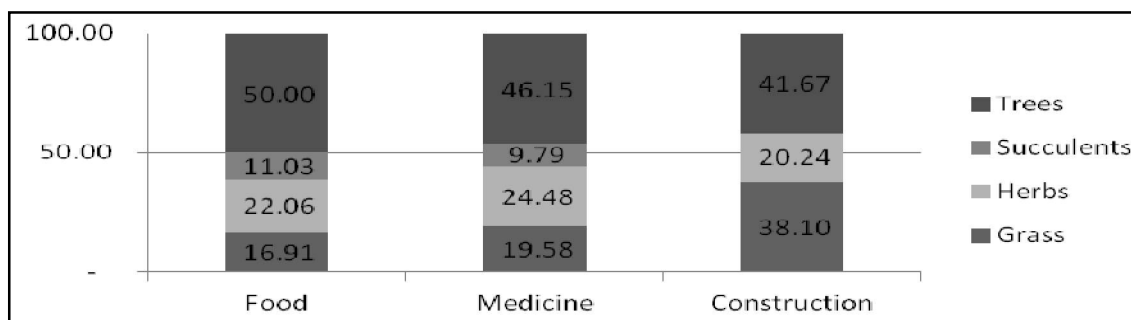


Figure 11: Level (%) of plants form and products utilised by the Aweer

Results showed that the community harvested medicinal plants mostly seasonally (86.36%), as compared to monthly (9.09%) and weekly basis (4.55%). The harvested plant parts were dried and stored before use. In emergency cases such as snakebites, the plant parts were harvested and used when fresh.

Plants used for construction are utilised (collected) either seasonally or monthly. Seasonal collection frequency accounted for 98.61% as opposed to monthly collection of 1.39%.

#### Wildlife utilised

Results showed that the Aweer hunted 16 animal species (Table 2).

Table 2: Wildlife Species Targeted by the Aweer Community

Category	Animal type	Weight (kg)
Small (rodents)	Porcupine ( <i>Hystrix</i> sp.)	*0 – 3
	Dik-dik ( <i>Madoqua</i> sp.)	*3.8 – 7.2
Medium (meso-herbivores)	Suni ( <i>Neotragus moschatus</i> )	*4 – 6
	Duiker ( <i>Cephalophus</i> sp.)	*9 – 20
	Impala ( <i>Aepyceros melampus</i> )	*15 – 25
	Bushbuck ( <i>Tragelaphus scriptus</i> )	*24 – 80
Large (meta-herbivores)	Bushpig ( <i>Potamochoerus larvatus</i> )	*40 – 45
	Warthog ( <i>Phacochoerus</i> sp.)	*45 – 150
	Lesser Kudu ( <i>Tragelaphus imberbis</i> )	*56 – 108
	Topi ( <i>Damaliscus korrigum</i> )	*68 – 160
	Waterbuck ( <i>Kobus ellipsiprymnus</i> )	*160 – 300
	Buffalo ( <i>Syncerus caffer</i> )	*250 – 380
	Zebra ( <i>Equus quagga</i> )	*350 – 450
	Giraffe ( <i>Giraffa</i> sp.)	*450 – 1930
	Hippo ( <i>Hippopotamus amphibious</i> )	*510 – 2500
Carnivore	Lion ( <i>Panthera leo</i> )	

\* Weight measurements from Kingdon, J. 2001

Meta- and meso-herbivores were the most utilised, unlike small game (rodents) at rates of 58%, 39% and 3% respectively (Figure 12).

Buffalo *Syncerus caffer* Hodgson, and dik-dik *Madoqua* sp. Ogilby, were the most preferred species at 24.72% each. Bushpigs *Potamochoerus larvatus* F.

Cuvier, 1822; lions *Panthera leo* Linnaeus, 1758; warthogs *Phacochoerus* sp. Cuvier, 1826; and zebras *Equus quagga* Boddart, 1785 were the least targeted species at 0.56% each. Wildlife species targeted were utilised for both subsistence (77.78%) and commercial purposes by the community (22.22%) (Figure 13).



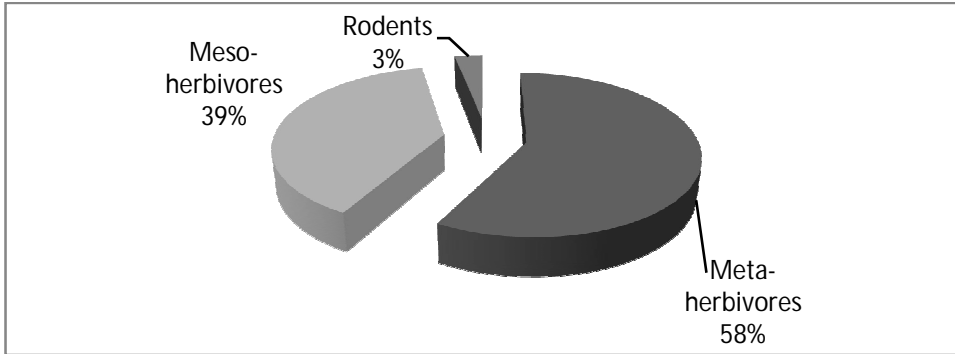


Figure 12: Sizes of wildlife hunted by the Aweer Community

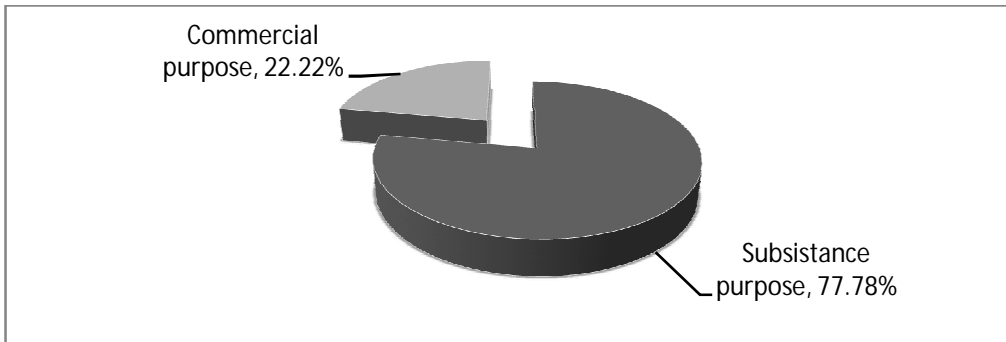


Figure 13: Utilisation levels of targeted wildlife species by the Aweer Community

Wild game was hunted mostly seasonally (99%), with occasional opportunistic weekly and monthly hunting (1%) as illustrated in figure 14. One lion was

hunted for its skin, a negligible yet worrying statistic, should the trend continue.

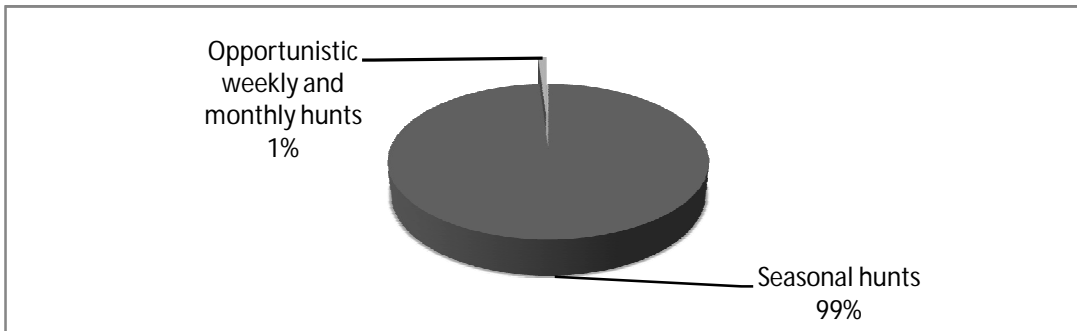


Figure 14: Frequency of hunting by the Aweer Community

The Aweer community utilizes other secondary forest natural resources. These include non-wood products comprised of honey, birds (vulturine guinea fowl – *Acrylliumvulturinum* G.R. Gray, 1840; helmeted guinea fowl – *Numidameleagris*Linnaeus, 1764 and francolin –*Francolinussp.*Stephens, 1819), bird eggs (guinea fowls and ostrich – *Struthio camelus*Linnas, 1758), fish, and amphibians (Figure 15).

The honey harvested is primarily sold (95.52%) at a price ranging between Kenya Shillings (KSh.) 200 – 400 per litre (US\$ 2.5 – 5). The remaining 4.48% is either consumed locally as food or medicinal purpose. Water is collected from natural springs and rivers during rainy seasons, with piped water only accessible in areas near Kiunga village settlement. During the dry season, it can take up to five hours every day (up to 8 kilometers from homesteads) for women and children



to access water for their families (Young 2012).

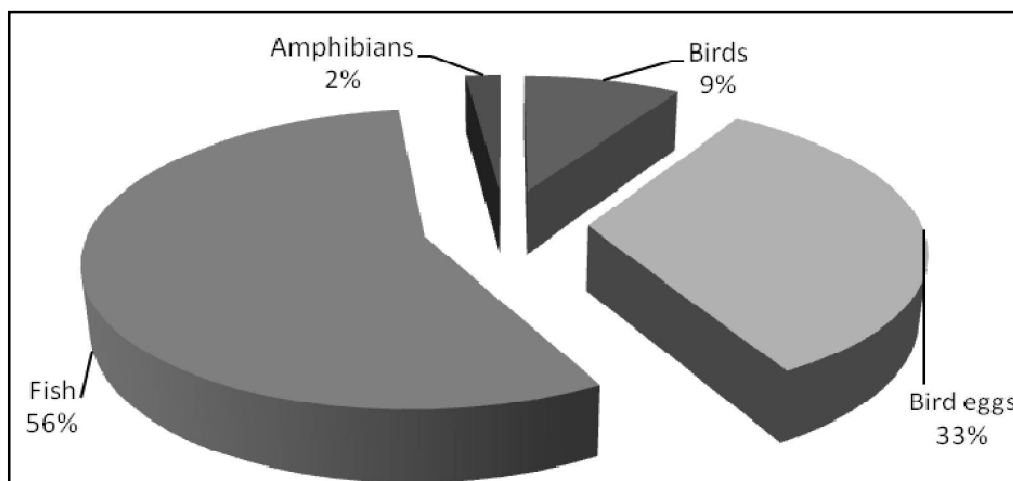


Figure 15: Secondary natural resources utilised by the Aweer

The study revealed that fungi and algae are also utilised by the community. Results showed that 62.50% of the respondents confirmed the use of fungi (mushrooms) while only 16.67% utilised algae. The macro-fungi such as mushrooms were used to supplement diet while algae were used as vegetables. Fish, birds, bird eggs and amphibians were also utilised by the community as protein supplements.

### Natural Resources Associated With Religion

The respondents revered 3 trees due to their spiritual values. The tree species associated with shrines [omota – Aweer] are the *wahar* [Aweer], *Afzelia quanzensis* Welw. [*mbamba kofi* - Kiswahili] and *Ficus* sp. L. [*thower* - Aweer] trees. The respondents held prayers near them during times of burials, initiations and general worship. The Aweer community shunned the hunting of elephants (*Loxodonta africana*) Blumenbach, and black rhinoceros (*Diceros bicornis*) Gray, as a result of superstitious beliefs. Warthogs and bush-pigs on the other hand, are insignificantly utilised due to Islamic religious beliefs (considered as swine).

### Natural Resources Avoided By the Aweer Community

Results showed that the Aweer community avoided encounters with snakes, lions,

elephants, hippos, crocodiles, and occasionally buffaloes. This is attributed to the fact that these wild animals had the potential to cause grievous bodily harm/injury (21%) or even human death (2%).

### Resources Associated With Other Resources

Forty-six tree species were associated with bee-hives. The Aweer community hung bee-hives on or in close proximity to *Phoenix dactylifera* L. [*tingir/tingiti* - Aweer], *Adansonia digitata* L. and *wahar* trees at 12%, 11.2% and 10.4% respectively. This is because the bees readily collect pollen from them and the honey associate from these tree species were considered sweet. Game species, particularly herbivores were associated with particular plant patches comprised mostly of *Chrysopogon plumulosus* Hochst, *Digitaria milanjiana* (Rendle) Stapf, *Digitaria abyssinica* (A.Rich.) Stapf, *Eragrostis ciliaris* (L.) R.Br., *Panicum maximum* Jacq. and *Panicum coloratum* L. The herbivores utilise these plants due to their palatability and grazing value. The Aweer livestock utilised *Grewia plagiophylla* K. Schum. patches as confirmed by Kuchar (1981).



## DISCUSSION

It is widely recognized that natural resources contribute significantly to socio-economic development. They offer economic activity and source of growth; livelihoods for people; and provide environmental services (NEPAD 2003; Khan 2008; IAASTD 2009; Comin *et al.* 2009; Chowdhury and Ahmed 2010). The indigenous forests, open savanna and wetlands of Boni-Lungi and Dodori National reserves provide a myriad of natural resource products and service to the Aweer community. The deep understanding of their environment, based on centuries of living close to nature, connected their lifestyles with the richness and variety of complex natural resources. The natural resources accessed are food, fuels, fibre, medicine, wood-fuel, construction material and water. The regulatory natural resources utilised

consist of purification of air and water, pollination of crops and natural vegetation, seed dispersal and translocation of nutrients, maintenance of biodiversity, partial stabilization of climate (carbon sequestration), and moderation of temperature extremes; while cultural and supportive resources are both spiritual and educational use respectively. The forest and its savanna possess a rich variety of plants with a wide range of industrial, medicinal and socio-economic importance, vital to the Aweer.

Natural resources provide 10 constituents of human well-being (Duraiappah 2004). The natural resources of Boni-Lungi and Dodori National Reserves and surrounding forests provide 9 of the 10 (Table 3), with the exception of being able to provide adequate and clean drinking water.

**Table 3: Constituents of Human Well-Being Items Provided By Boni-Lungi and Dodori National Reserves**

Item	Provisional Eco-services from Boni Dodori Reserves
1	Able to be adequately nourished
2	Able to be free from avoidable disease
3	Able to live in an environmentally clean and safe shelter
4	Able to have clean air
5	Able to have energy to keep warm and cook
6	Able to use traditional medicine
7	Able to continue using natural elements found in ecosystems for traditional cultural and spiritual practices
8	Able to cope with extreme natural events including floods, tropical storms and landslides
9	Able to make sustainable management decisions that respect natural resources and enable the achievement of a sustainable income-stream

*Source: Duraiappah in UNEP/IISD, 2004*

### Plants Utilised By the Aweer

The community obtains food, medicine and construction material from plant products, either as grasses, herbs, succulents or trees. Although food crops were planted, the supply was not adequate, a consequent of soil degradation, loss of soil and soil fertility, agricultural pests,

livestock pests and drought. Tree products were the most utilised form of plant resources for food, comprising mostly of fruits. The fruits are either consumed locally or sold. Some native grasses and herbs have been domesticated and are used as vegetables. This reduces their dependence on wild varieties and makes



them easily accessible. Using indigenous knowledge, the community continues to pass indigenous knowledge from generation to generation on edible plants, locations, cues and modes of preparation. This is supported by findings from Kuchar (1981). The *Annona senegalensis* Pers. fruits are edible and its fresh sepals and flowers used to make soup and flavor food respectively. Other edible plants presently utilised by the Aweer include *Boscia angustifolia* A. Rich. fruits and seeds (when cooked); *Capparis cartilaginea* Decne. fruit pulp; *Tamarindus indica* flesh and *Maerua triphylla* A. Rich. fruits.

As medicine, the community use medicinal plants to treat a host of diseases and ailments. This is attributed to the distance and access limitations to health facilities (inadequate numbers of conventional health centers, personnel and medicine). As pointed out by Kuchar (1981), some other plants and their parts used to treat diseases and ailments. *Uvaria acuminata* Oliv. (roots) are used for the treatment of dysentery, dysmenorrheal, snake-bites and breast diseases. The crushed *Boscia angustifolia* fruits when crushed in water were used as a laxative, while the inner bark when pounded and added to soup was used to remedy colds and snake bites. *Capparis cartilaginea* roots cure head-aches while the stems and barks are used as an anti-helminth. The community uses *Maerua triphylla* roots as remedy to snake-bites, head-aches, vertigo, urinary disorders, rheumatism and general pain treatment. Its bark is used to relieve chest pain, cough, swollen limbs; the leaves used to dress open wounds; and as an effective aphrodisiac. These findings on the wide array of edible plants utilised by the Aweer confirm that the community still possesses a depth of indigenous knowledge, worth documenting and establishing nutritive value.

The community also utilise plants for construction. Grasses are harvested for roofing in the dry season as it was easier to

dry. Dry grasses harboured fewer parasites and lasted longer, as opposed to wet grasses. Trees (saplings) were used to erect walls which were later plastered with mud. The plant matter (saplings, shrubs and grasses) were locally available and easy to access due to the cost and supply. The community use local plant material for construction, as opposed to conventional materials. This is attributed to the poverty in the area. The continued harvesting of these saplings could have a negative impact on forest sustainability, as this reduces the forest re-establishment potential, especially in highly degraded areas. Also, with the influx of immigrants into the area, there would be increased demand for construction materials, resulting into subsequent forest degradation unless harvesting effort is checked.

#### **Frequency of Natural Resource Utilised**

The frequency of natural resources utilisation is predominantly seasonal and monthly. This is attributed to the bi-modal rains that affect primary biomass production. This enables the annual and perennial plants to recruit, mature and fruits. The community use indigenous knowledge cues to determine best times to utilise the resources. Distance to natural resource locations also came to play, enabling the community access the resource sites only at the most appropriate times. Honey, for example, is harvested mid-way the dry season, when flowers are fruiting. Medicinal plant barks and roots are sun-dried without losing their potency, only to be used later in times of treatment. This reduced amounts of weekly and monthly trips, unless when extremely necessary. Seasonal utilisation promoted sustainable utilisation, by allowing the plants to regenerate.

The Aweer hunted for game using traps, snares and poisoned arrows, nets and stones. Ruminants were highly preferred compared to swine and non-ruminants. Porcupines (*Hystrix* sp.) Linnaeus, 1758



were the only rodents (small herbivores) consumed. They were mainly caught during instance of crop raiding. Meso-herbivores were highly preferred as opposed to meta-herbivores as they were easy to kill (effort, time and safety-less human injury encounters). The bush-meat supplements protein for the local community who could hardly afford livestock and chicken meats. According to Fitz Gibbon *et al.* (1995), around 60% of households living adjacent to the Arabuko Sokoke Forest, hunted there regularly. Fish were sourced from markets and wetlands. The birds consumed were vulturine, guinea fowls, helmeted guinea fowls and francolins; and eggs of ostrich and guinea fowls. Respondents cited that the influx of immigrants, increase in technology and loss of indigenous hunting techniques had resulted into increased bush-meat poaching and trade. They attributed this increase of bush-meat poaching to increased market demand, lack of appreciation towards the Aweer culture and high poverty levels within the study area.

### **Religion, Taboos and Superstition**

Religion, taboos and superstition also help the Aweer to sustainably utilise natural resources. These unwritten informal management systems carried precise control instruments and mechanisms based on shared norms, values and regulations. These informal rules and regulations governed resource exploitation, by establishing strong links with the ancestors and the low population densities. This helped to assure a sound ecological balance. Spirit mediums controlled large ritual groves and protected forests where no one was allowed to hunt, cut trees, graze livestock or cultivate (Little and Brokenshia 1987; Matose 1992; Odera 1997). Communal land ownership promoted sustainable harvesting practices, while religion shunned the consumption of warthogs. The respondents believed that killing elephants and rhinoceros (for ivory and rhino horns), key-stone mega-

herbivores within the study area would result into the poachers' children being prone to disease and death. These myths associated to elephants and rhinoceros could be the reason as to why elephants are still sighted in the area. Warthogs and bush-pigs are considered as unclean game (swine) by the Muslim religion. The results revealed that the Aweer community preferred to hunt adult and sub-adults animals. These enabled juvenile animals attain maturity and sustain recruitment. The respondents shared catch and used native gears, enabling interactions between individuals and the natural environment.

### **CONCLUSIONS AND RECOMMENDATIONS**

Despite the ecosystem goods and services derived from Boni Dodori National Reserves, their sustainability is currently threatened by loss of natural resources, land degradation and forest cover change, a result of unsustainable utilisation, shifting agricultural values and loss of traditional indigenous knowledge. The study recommends the promotion of unsustainable forest practices and alternative income generating activities, in a bid to reduce the resource use pressures on the forests. This will not only secure the ecosystem integrity, but also assure the sustainable livelihoods of the already vulnerable and marginalised Aweer community. The community should also be made aware of the negative impacts of shifting cultivation that they presently engage in, as it may result in increased food production for a short time but ultimately lead to reduced soil fertility (Kramer *et al.* 1997); extensive irreversible loss of biodiversity (Fahrig 2003; Tilman 2012); reduced resilience of many ecosystem services (Lal 1997; Howarth and Farber 2002; Foley *et al.* 2007); exacerbate poverty amongst forest dependent communities (Sneddon 2000; Naughton-Treves *et al.* 2005); reduced the forest carbon sequestration capacity and soil carbon (Angelsen 1995); and



proliferation of invasive species (DiTomaso 2009). Shift cultivation and environment degradation especially in wildlife areas also possess a health risk, as they are potential frontiers of zoonotic disease transmissions, especially for emerging infectious diseases (Daszak *et al.* 2001).

The study proposes the creation of community forest blocks with the option of accessing carbon markets. This has the potential of promoting good ecosystem stewardship and resilience; secure alternative incomes to the community; and ensure the conservation and preservation of native endemic and range restricted species.

The study also recommends the eradication of tsetse flies and provision of extension services; activities that will aid the community embrace livestock keeping, and reduce their dependence on game meat. This is essential as it will support the community absorb the shocks caused by ecosystem degradation, thus promoting sustainability.

There is need to preserve the indigenous knowledge of the Aweer community and develop natural resource mapping for natural resource management purposes. The community should be included in the development and implementation of a consultative forest management plan. Domestication of medicinal plants and promotion of bio-prospecting while promoting use of conventional medicine would ensure sustainability of the locally appreciated flora. The community could also be encouraged to have home and village level gene-banks (vegetables) and retain traditional practices that encourage genetic diversity. An in-depth ethno-botanical study should also be conducted and germplasm stored in gene-banks.

Finally, there is an urgent need to preserve and document the Aweer language, as new studies suggest that language loss has a

negative impact on biodiversity conservation (UNESCO, 2010).

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