

ECONOMIC VALUATION OF UNDERUTILIZED FORESTRY PRODUCTS IN SOUTH NANDI FOREST

SIMON ROP K¹, KOSGEI ARUSEI J² & ELIUD KIREGER³

¹School of Natural Resource & Environmental Management, University of Kabianga, Kericho, Kenya

²University of Eldoret, Eldoret, Kenya

³Kenya Agricultural and Livestock Research Organization, Nairobi, Kenya

ABSTRACT

The public views on resource use in relation to conservation by communities adjacent to South Nandi Forest were obtained through interviews and questionnaires. Sixty questionnaires were distributed to 5 of 9 villages surrounding the forest over a period of 3 months. A design and implementation of different activities (community forest management, institutional strengthening programmes, monitoring and livelihood programmes) to sensitize the population in accordance with community based associations was done. 88.3% of the population benefits readily available fuel wood while practicing agroforestry, 91.7% food crops, 68.3% apiculture and 51.7% livestock. Comparative market survey with the past showed 100% income increase. It was generally observed the community involvement in the conservation of natural resources is a success at South Nandi Forest ecosystem with high level of population awareness as shown by formation of community forest associations (CFA's) and water users associations (WRUA's). The forest provides the communities with food such as mushrooms, honey and meat, fuel wood, building materials such as poles, and creepers for tying, wood for carving and traditional medicine.

KEYWORDS: Agro forestry, Community, Livelihood, South Nandi Forest, Conservation

INTRODUCTION

Many parts of Kenya depend on agriculture for their livelihood and income generation. Improvement in farming systems yields better results in production quality and quantity. Agroforestry and conservation practices on farms are one are some of the improvement tools. The western part of South Nandi forest is a closed canopy forest and grassland and a viable site for biodiversity conservation and utilization. An important aspect of the conservation of the natural resources is the education and involvement of the indigenous population. The local community surrounding the forest depends on the resources (hunting, gathering, farming, extraction of forest products) of this forest for livelihood. These activities are consequences leading to vegetation degradation, excessive erosion, reduction in soil fertility and farmland shortage and bush fires. All these impacts lead sometimes to permanent and irreparable loss of plant and animal biodiversity. South Nandi forest microclimate supports commercial and small holder tea farming, dairy and food production; and water supply to rural and urban centres, is yet to be appropriately included in the national economic valuation (Norton-Griffiths, M., *et al.*, 1995).

Massive environmental transformation has far-reaching impacts on social, economic and ecological systems (Pretty, 1995). Though excluding local communities can protect natural resources, it is better through participatory

approach in the implementation of conservation strategies. The area surrounding South Nandi forest is among the most densely populated area in Nandi County (Recha, J. W., *et al.*, 2013). In addition to pressure to provide staple food crops and livestock for local needs, the desire to increase tea production as a cash crop has led to further encroachment on the forest.

Natural resource programmes in developing countries which do not actively incorporate local users will ultimately fail (Bromley *et al.*, 1989). Many Kenyan farmers in high potential agricultural areas fear venturing into eco-agriculture and nature based enterprises, as tangible success stories are hard to come by and places where they can see the impacts are few and far between (Joel, *et al.*, 2013). Nature Kenya's work with local communities near the South Nandi forest has produced profitable technologies and indicators show a success stories (Ongugo, *et al.*, 2014). Nature Kenya introduced forest-adjacent communities to eco-agriculture and nature-based enterprise tools and technologies through the project "Improving livelihoods through sustainable Government, non-governmental organization (NGO), private partnerships in South Nandi Forest, Western Kenya", with funding from the department for international development (DFID), the UK aid agency (Moskowitz, 2015). Some of the people and groups involved realized great success, which can now serve as case studies for adoption of the technologies. The Nature Kenya project built the group's capacity through training on tree nursery establishment and management; woodlot establishment and management; beekeeping and honey processing; product value addition; enterprise management; business planning and marketing; leadership and group management; the participatory forest management process and how to engage with the Kenya forest service; and exchange tours to learn from their fellow community implementers (Klopp, 2012).

The local population and the international community share a common interest in the conservation of the forest (Shepherd, *et al.*, 2013). It is generally believed that, local people will develop a vested interest in management of resources as it shown by development of community forest association (CFA's) around the forest (Ming'ate, *et al.*, 2014). Under these circumstances adopting participatory approach in a community based system of forest management will ensure long term conservation and sustainable use of resources (Ogada, *et al.*, 2013). To resolve the problem of human pressure on forest resources, eco-agriculture sustainability approach should have in place structures and functions, aimed at educating and creating awareness amongst the local population targeting the rational use of these natural resources and enhancement of farmer livelihood (Musyoki, *al.*, 2013). This study aimed to investigate extends and reasons for resource exploitation in South Nandi forest and the improvements in livelihoods following the introduction of participatory conservation measures.

METHODOLOGY

The Study Site

South Nandi forest is located between latitude 00° 05'S and 35° 00'E 00° and longitude 00'S and 35° 00'E. South Nandi was once contiguous with Kakamega forest (Otieno, *et al.*, 2014) and the two forests are still no more than a few kilometres apart at their closest points (Figure 1). Rainfall is high, 1,600–1,900 mm/year depending on altitude. The forest is drained by the Kimondi and Sirua Rivers, which merge to form the Yala River flowing into Lake Victoria (Mitchell, 2004). The landscape is gently undulating and underlain by granitic and basement complex rocks, which weather to give deep, well-drained, moderately fertile soils (Kokwaro, 1988). The South Nandi area has high agricultural potential and high human densities, particularly to the Western side. Biogeographically, South Nandi forest is often considered an

Eastern extension of Kakamega forest. However, it is higher in altitude than Kakamega and floristically less diverse (Girma, *et al.*, 2014). In effect, South Nandi forest is transitional between the lowland forests of West and Central Africa (the easternmost outlier of which is Kakamega) and the montane forests of the central Kenya highlands (Mitchell, 2004). Common trees include *Tabernaemontana stipitata*, *Macaranga kilimandscharica*, and *Croton megalocarpus*, *Croton macrostachyus*, *Drypetes gerrardii*, *Celtis africana*, *Prunus africana*, *Neoboutonia macrocalyx* and *Albizia gummifera*. South Nandi forest was gazetted in 1936 as a Trust Forest covering 20,200 ha, since when c.2, 200 ha have been excised for settlement, c.340 ha planted with tea, and 1,400 ha planted with exotic tree species. Of the remaining area, at most c.13, 000 ha is closed-canopy (Wagner *et al.*, 2008).

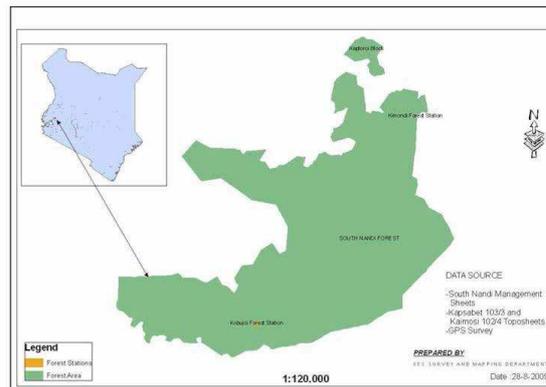


Figure 1: Location of South Nandi Forest

DATA COLLECTION

Information was obtained from two major sources classified as primary and secondary data. The secondary data was obtained from literature review of the reports of the project and forest management plans of Nandi County at the library. The primary data was obtained through interview of resource person and a total of sixty questionnaires were administered in 5 of the 9 villages of South Nandi forest chosen according to proximity to the forest and representing 42% of the total population of the area. The questionnaires were issued to people of the age 20-60 which is considered to be most active group involved in the exploitation of forest resources (FAO, 1999).

A market survey was also conducted on the cost of commercial forest items at Kaptaroi, Kaptumek, Chepkumia, Kapsasur (kimondi) and kabujoi markets on the wholesale and retailers in these villages. An evaluation of livelihood improvement was done by comparing present and past market trends of forest products.

Farmers from different zones were selected with the aid of local authorities, Kenya forest service (KFS) officers and agricultural officers; evaluation of different farming practices was assessed. In relation to adjacent forest. The farms along the roadsides with intensify farm activities (animal rearing, food crop production and tree planting on farms) was evaluated.

RESULTS AND DISCUSSIONS

Agroforestry Activities

The following indigenous and exotic agroforestry tree species were identified to have been planted with the following importance in agroforestry practices in areas adjacent to South Nandi forest (Table 1)

Table 1: Plant Species Established Through Agro forestry to Enhance Ecological Processes within South Nandi Forest Ecosystem

Family	Scientific name	Utility/Product
Indigenous		
Araliaceae	<i>Polysciasfulva</i>	Traditional medicine, Increasing soil fertility
	<i>Scheffleraabyssinica</i>	Apiculture
Bignoniaceae	<i>Bersamaabyssinica</i>	Firewood, Fence
	<i>Cordiaabyssinica</i>	Traditional medicine, Timber
	<i>Kigelia Africana</i>	Traditional medicine
Euphorbiaceae	<i>Markhamiatomentosa</i>	Fodder, Live fence
	<i>Croton macrostachyus</i>	Traditional medicine, Fuel wood, live fences
Fabaceae	<i>Ricinuscommunis</i>	Increasing soil fertility, Apiculture, Medicine,
	<i>Albizagummifrea</i>	Traditional medicine, Fuel wood
	<i>Sesbaniasesbans</i>	Fodder, soil fertility
	<i>Tephrosia candida</i>	Increasing soil fertility, Fuel wood, Apiculture
Pentapetaceae	<i>Dombeyaburgessiae</i>	Fodder, Fuel wood, Apiculture
Lognaniaceae	<i>Achyrospermumschimperi</i>	Increasing soil fertility, Fuel wood, Medicine
Moraneae	<i>Ficusoreodryadum</i>	Increasing soil fertility, Fuel wood, Live fences
Myrtaceae	<i>Syzygiumguineensis</i>	Traditional medicine
Rutaceae	<i>Zanthoxylumgillettii</i>	Increasing soil fertility, Fuel wood, Apiculture
Mysinaceae	<i>Maesalanceolata</i>	Fuel wood, Apiculture, Live fence
Rosaceae	<i>Prunusaficana</i>	Traditional medicine, Timber for construction
Mimosaceae	<i>Erythrinnaoeppegiana</i>	Traditional medicine, fuel wood, Live fence, Soil fertility
Ulmaceae	<i>Acacia angustissima</i>	Soil fertility, Fuel wood, Ornamental
Exotic		
Fabaceae	<i>Calliandracaalothyrus</i>	Soil fertility, Fuel wood, Fodder, Ornamental
Mimosaceae	<i>Leucaenialeucocephala</i>	Soil fertility, Fuel wood, Fodder, Ornamental
	<i>Crotalaria spp</i>	Soil fertility, Fuel wood, fodder, Ornamental
	<i>Eucalytuspp</i>	Fuel wood, Apiculture, Live fences
Myrtaceae	<i>Grevillearobusta</i>	Live fences, Ornamental
Proteaceae	<i>Ardisiacymosa</i>	Live fences
	<i>Measopsisspp</i>	Live fences, Ornamental
Cypressaceae	<i>Cypressusrotudus</i>	Timber, Live fences
Pinaceae	<i>Pinusradiata</i>	Timber
Casuarinaceae	<i>Casuarinaequisetifolia</i>	Live fence, Ornamental

The agroforestry identified plants were in a ratio of 1:3 on the trees planted on farms with respect to indigenous and exotic species respectively. Over thirty six percent (36.7%) of the plants identified was utilized to improve soil fertility of and ten percent (10%) of these fertility plants were exotic species. Indigenous plants indicated had in the past suffered from deforestation through logging and charcoal making activities. Forty three percent (43.3%) of the plants are used for fuel wood which is the main source of cheap energy for domestic heating and cooking. Agroforestry farming systems has generally helped in providing readily available and affordable domestic energy source. Apiculture 10% utility, Live fence 33.3%, traditional medicine 33.3%, and ornamental 23.3 % utility. The least utility was 13.3% of the plants providing a direct as fodder or vegetable source. From the environmental point of view, some of these fodder plant species supporting bee-farming were also used to provide livestock feed. It was found that farmers kept their bee hives in the reserved forest so as to benefit from nectar and protection of hives from animals and bush fires.

The Local radio station (FM) communicating in the local dialect, newspaper's, Kenya wildlife service (KWS) and Kenya forest service (KFS), and formation of community based organisations such as Kabujoi community forest

associations (CFA's) and Chesumei-Yala River water users associations (WRUA's), helped in creating awareness about conservation objectives and activities especially towards ecological and socioeconomic impacts on the adjacent forest communities. Such associations and programmes on livelihoods of communities advised on making the best use of existing crop and grazing and non-agricultural uses of forest which can generate revenue for the local economy. As a result, bee-keeping programmes has increased and the number of hives in the forest is increasing. Other activities include wood carvings and bark and herb harvesting for traditional pharmacology. South Nandi forest boundaries are surrounded by dense human populations dependent on forest resources, making the need for understanding human-ecosystem interactions essential (Reid, 2012).

Agroforestry has been practice for many years in Nandi County and adopted fully in 2008 with introduction of forest policy/requirement of 10% tree cover on farms (Cheo, 2010). Initially people planted trees along the farm boundaries, such as Cypress, Eucalyptus, Croton, Nandi flame, wattle trees but now they have established woodlots, and fruit trees are being planted by most households. The land area under trees varies from several acres to 0.1 acre (KFS, 2015). The trees are used domestically and commercially for fuel wood, construction, timber, industrial uses e.g tannin, fruit trees are mostly for domestic consumption and little for commercial reasons (KFS, 2015). Tea farms and coffee bushes have a positive effect on the microclimate (Acevedo, 2011), and this has made most households and public institutions to established tree nurseries for domestic and commercial purposes. Collection of wild saplings are done from the neighboring forests.

Ecotourism is another possible source of revenue, since South Nandi forest has huge wildlife diversity especially the bird species. South Nandi forest is the most important site in the world for the threatened *Eremomelaturneri* (Brooks, *et al.*, 2001). The area supports exceptionally high densities of this little-known species (around 0.27 groups/ha, equating to 1.1 birds/ha), and an estimated population of 13,000 birds. The avifauna is mainly Afromontane, but with strong western affinities (Bennun, & Njoroge, 2000). At the Kobujoi resource Centre is the focal point for ecotourism and environmental education action. The forest area has big trees, huge rocks, snake areas, camp sites, and bird-watching sites. There bird surveys in 1996 recorded 111 species of forest birds, with 47 forest dwellers (Munyekenye, *et al.*, 2008). The threatened bird species are *Stephanoaetus coronatus*, *Glaucidium tephronotum*, *Indicator conirostris*, *Indicator exilis*, *Kakamegapoliothorax*, *Sheppardiapolioptra*, *Dyaphorophyia concreta* and *Hyliota australis*. Non-bird biodiversity are the ungulate *Tragelaphus eurycerus*.

Contributions of Agroforestry to Economic Livelihoods

Table 2: Perception of Agro forestry Activities by Local Communities

Community	Food Crop		Firewood		Bee-Keeping		Livestock		Indigenous Medicine		Pesticide		Timber	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Kaptunek	11	02	12	02	08	02	09	07	04	11	06	08	05	06
Kabujoi	12	00	09	02	12	01	07	03	02	10	05	01	07	09
Kaptaroi	10	02	12	02	10	04	08	07	05	09	13	04	03	05
Kimondi	10	02	09	01	05	04	04	06	01	10	08	05	06	08
Chepkunia	12	00	11	00	06	08	03	06	06	12	07	03	04	07
No of Questionnaires	55	05	53	07	41	19	31	29	18	42	39	21	25	35
Percentage%	91.7	8.3	88.3	11.7	68.3	31.7	51.7	48.3	30.0	70.0	65.0	35.0	41.7	63.3

It was observed that the community is in more than one economic activity. About 91.7% of the population on food crop, 88.3% fuel wood, 68.3% apiculture with the forest as the main source. The percentage involved in apiculture is expected to increase, as value addition in honey products and processing, and bee-keeping methods has improved. For example wax, which formally was a waste product, is now used as skin oil, shoe polish and soap making. The high percentage of the population involvement in activities like fetching fuel wood and using food crop production demonstrates that they are indispensable basic commodities for the communities.

Based on the results on Table 3, the percent increase in income of the community utilization of forest products is 150% projection. A single farmer makes an income of US \$ 125.8. Responsibilities such as education, health and social involvement are dependent on income generated and farmers can conserve (Dehllot 1990), Canocoo and Bertei-Doku (1992). Ajayi (1993), Adegeye and Ayodele (1996), have reported similar situations where local communities involved in processing and sale of forest products for livelihoods. These activities either directly or indirectly impinge on forest and natural resources conservation. The community has a positive perception to the fact that agroforestry controls soil erosion and conserves the forest. The respondents reported that products found in the forest have contributed to economic improvements

Table 3: Contributions of Agroforestry to Economic Improvement for the Last Ten Years to Communities near South Nandi Forest

Items	Agroforestry Before 2000				Agroforestry After 2000			
	Qty/Person	Cost US\$	No of Persons	Amount US\$	Qty/Person	Cost US\$	No of Persons	Amount US\$
Apiculture	8 litres	1	30	240	20litres	1.5	30	900
Maize crop	13 bags	10	35	4,550	20bags	20	35	14,000
Vegetable	8 bags	2.5	20	400	15 bags	4	20	1,200
Livestock	6 Dairy	0.1	44	26.4	9 Dairy	0.35	44	138.6
Total		13.6	129	5,216.4		25.85	129	16,238.6

Using the quantity and price factor (Table 3) to compare yield from farm activities (Beekeeping, maize farming and dairy farming) one can appreciate the input of community forestry within a time frame of ten years. Since 2000, there has been a significant impact on the livelihood of the communities around the forest. Yield has increased and more revenue is obtained from sales of farm produce. For example maize yield has increased by 53.8% and income from it has risen by over 100%. Likewise vegetable yield has increased by 87.5%, dairy 50%, apiculture by 150%. These increases in yield improve the income of the household. Given the awareness and benefit of conservation more to community, adequate attention is and will be given to resource exploitation and use. Poverty is reduced as indicated by more children born, more children send to school, good medical care and feeding habits improvement.

CONCLUSIONS

The initiatives on participatory forest management (PFM) by the Nandi Forest Ecosystem with the enactment of the Forests Act 2005, and Nature Kenya conservation programmes have increased community structures that result in formation of community forest associations (CFA's) such as Kimondi/Iruruand Kobujoi CFA's in South Nandi forest ecosystem, that have conserve and protect the forests and adopt agroforestry technologies to improve their livelihoods.

The forest provides the communities with food such as mushrooms, honey and meat, fuel wood, building

materials such as poles, and creepers for tying, wood for carving and with medicinal plants which has economic value yet not valued as a revenue provider for the rural economy. The role the forest plays as source of clean water is well understood by the communities. The forest has cultural significance; many traditional ceremonies are held, making use of the forest their livelihood environments.

The livelihood programmes such as offered by Nature Kenya, provide advice on making the best use of existing crop, agroforestry practices, woodlot establishment, grazing land and non-agricultural uses of forest, as in eco-agriculture or eco-tourism, use of tree barks such *Prunus africana* and herbs as local medicine and an ingredient in pharmaceuticals; all these has to be harness to generate revenue for the local economy.

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