The Impact of Participatory Forest Management on Local Community Livelihoods in the Arabuko-Sokoke Forest, Kenya

Paul Matiku*a, Mireri Calebb, and Ogol Callistusb

aNature Kenya, Nairobi, Kenya
bSchool of Environmental Studies, Kenyatta University, Nairobi, Kenya

*Corresponding author. E-mail: matiku@naturekenya.org

Abstract
This study examines the impact of participatory forest management (PFM) on forest-adjacent household livelihoods in the Arabuko-Sokoke forest in Kenya. It compares the impacts on households near PFM forests (PFM zones) with those near forests with no participatory management (non-PFM zones). The study questions were: does conservation of the Arabuko-Sokoke forest result in net household incomes?; does PFM increase net household benefits?; and are household benefits uniformly distributed within the 5 km PFM intervention zone? The hypotheses tested were: forest conservation benefits exceed forest conservation costs; PFM zones have higher household benefits than non-PFM zones; and benefits and costs reduce with distance from forest edge. In the year 2009, we collected data on household benefits and costs in PFM and non-PFM zones. Data were collected along 10 km transects at 1 km intervals, sampling 600 households up to 5 km away from the forest. The results show varied household dependence on the Arabuko-Sokoke forest. The forest benefits exceed costs in PFM zones but the forest is a cost in non-PFM zones, and costs and benefits reduce with distance from forest edge. The study concludes that, though not cheap, PFM is a tool that can help the Arabuko-Sokoke forest win the support of the adjacent local communities.

Keywords: participatory forest management, forest resources, household livelihoods, Arabuko-Sokoke

INTRODUCTION
The history of forest reserves in former British colonies is a history of struggle between competing stakeholder groups and present day policies of governments of independent African states (Barrow et al. 2002). Forest reservation took place throughout most of Eastern and Southern Africa during the first half of the twentieth century in line with the colonial forest policy at the time to ensure a continued supply of hardwood from colonies to support British industry (Barrow et al. 2002; Sunseri 2005). Post-independence forest departments were set up to manage forest reserves to maintain colonial authorities’ user rights to valuable timber, and in part to protect important watersheds, ecosystems, and habitats (McGregor 1991; Sunseri 2005).

Local communities and their rights of access and use of forests were not a priority (Barrow et al. 2002) mainly because population densities and pressure on forests at the time was low, and this gave greater latitude for tolerance and compromise. As the human population increased, forest departments in Tanzania (Sunseri 2005), Kenya, Uganda (Barrow et al. 2002), and Zimbabwe (Matose and Clarke 1993), used the colonial forest statutes as a means to impose permit-based access systems, thereby significantly downgrading local peoples’ customary management systems and rights. With land and forest pressures increasing, permit-based access rights were compromised, as land was encroached, degraded, and cultivated, with the forest department reacting by blaming ‘encroachers’ and evicting them, including those who may have had legitimate secure customary rights (Barrow et al. 2002). The problems with this approach have led to the realisation that co-management and a greater role for local communities, the rural and urban poor, as well as the private
sector in the management of forests is needed (Barrow et al. 2002).

Collaborative approaches to natural resource management include watershed management (Natural Resources Law Center 1996), collaborative conservation (Cestero 1999; Brick et al. 2000), community forestry (Brendler and Carey 1998), community-based conservation (Western and Wright 1994), community-based ecosystem management (Gray et al. 2001), grass-roots ecosystem management (Weber 2000), integrated environmental management (Born and Sonzogni 1995; Margerum 1999), and community-based environmental protection (US Environmental Protection Agency 1997). Specific models have been developed, such as coordinated resource management (Anderson and Baum 1988; Cleary and Phillippi 1993), and collaborative learning (Daniels and Walker 2000).

Warah (2008) defines participatory forest management (PFM) as an arrangement where key stakeholders enter into mutually enforceable agreements that define their respective roles, responsibilities, benefits, and authority in the management of defined forest resources. The necessity of ensuring clear incentives for communities to limit local resource use to sustainable levels, including the provision of non-forest alternative sources of income and subsistence and of legitimate participation in forest management are cited as important components of sustainable natural resource management strategies across East Africa (Barrow 1988; Emerton 1995a,b, 1996a,b,c Emerton and Mogaka 1996). Laws and policies have been passed by governments to allow collaborative natural resources management, specifically with respect to forests. These include: Kenya: Forest Act, 2005; Tanzania: Forest Act, 2002; Uganda: Forestry Policy, 2001, National Forestry Plan, 2002, and National Forestry and Tree Planting Act, 2003; Ethiopia: Forestry Conservation, Development and Utilization Proclamation, 1994; Zanzibar: Forest Resources Management and Conservation Act, 1996 and Forest Policy, 1995; South Africa: National Forests Act, 1998, and Sustainable Forest Development in South Africa, 1996, among others (Alden and Mbaya 2001).

While there has been strong intent to devolve power, what matters is how it has been carried out. Ribot (2004) assessed the degree to which proclaimed decentralisation involving natural resources were being established in law and in practice and evaluated how these decentralisation reforms affected social and environmental outcomes in Asia, Africa, and South America. Ribot’s (2004) findings show that local governments have been able to demonstrate capacity and initiative in natural resource management. Further, his findings indicate that local people have been empowered to protect their forests from outside commercial interests, and local councils and local people have increased their revenues from resource use. Ribot (2004) also showed that marginal and disadvantaged groups played a greater role in natural resource management and benefited more from local resources, and some cases of sustained forest management were also observed.

However, Ribot (2004) concludes that natural resource decentralisation increases the vulnerability of local people when management burdens are transferred without financial or institutional resources. Ribot’s conclusions further indicate that ‘decentralised’ projects mobilise local people as mere labour rather than empowering them to make decisions for themselves. Further, he concludes that decentralisation creates new forms of exclusion through double standards that require complex management plans from local communities while allowing large-scale commercial interests to enter and use the resource with little planning and even less monitoring. His conclusions also indicate increased public exclusion through privatisation of public resources such as forests to individuals, corporations, NGOs, and customary authorities; and the delegitimising of fledging local democracies by failing to give them discretionary powers and by creating competition when public resources are privatised or managed through donor-led participatory processes.

Despite the prominence of strategies linking conservation and development as primary conservation tools and strong arguments for and against their effectiveness (Wells et al. 1992; Barrett and Arcese 1995; Oates 1999; McShane and Wells 2004), there have been limited quantitative comparative assessments of PFM impacts on local community livelihoods. Previous conservation studies have focused on proposals for a range of natural resource management tactics. These include providing appropriate development opportunities (Abbot et al. 2001), emphasising local community involvement (Western 1994; Getz et al. 1999), adopting shared management (Murphree 1994), ensuring local autonomy (Muller 2003), guaranteeing rights to harvest (Fearnside 1989; Browder 1992), promoting knowledge (Jacobson and McDuff 1998), awarding direct cash compensation (Ferraro and Kiss 2002), and encouraging tourism (Honey 1999). Studies of forest conservation have also focused on local community dependency on forests (Suda 1992; Emerton 1993), illegal felling of timber (Emerton 1992, 1995a; Marshall and Jenkins 1994), and forest costs (Emerton 1995a; Thomson 1993; Thomson and Ochieng 1993), but few have focused on the efficacy of forest conservation tools or the net forest benefits that accrue to communities adjacent to forests.

This study assesses the impact of participatory forest management on the household livelihoods of residents near the Arabuko-Sokoke forest and answers the following questions: 1) does forest conservation result in net benefits to local communities living adjacent to the forest?; 2) does participatory forest management (PFM) enhance net incomes to forest-adjacent households in the Arabuko-Sokoke forest?; and 3) are household benefits uniformly distributed within the 5 km intervention zone? The hypotheses tested by the study are: 1) forest conservation benefits exceed forest conservation costs; 2) PFM areas have higher benefits compared to areas without PFM; and 3) benefits and costs reduce with distance from forest edge.

MATERIALS AND METHODS

Study area

The Arabuko-Sokoke forest, which covers an area of 400 sq.
km within 3°20'S and 39°55’E (Figure 1) along the north coast of Kenya, is the largest remaining protected fragment of coastal forest mosaic that once stretched from southern Somalia to northern Mozambique (Robertson and Luke 1993). The forest, by nature of its diverse soil types, encompasses three main forest habitats: the dense, almost impenetrable mixed forest, the structurally similar but lower canopied Cynometra-Manilkara forest, and the more open Brachystegia woodland at the core of the forest. These forest types represent different habitats in the forest community.

The Arabuko-Sokoke forest is part of the East African coastal forest/Eastern Arc forest complex that ranks among the top 25 biodiversity hotspots on Earth (Myers et al. 2000). It is ranked the second most important forest for threatened bird conservation on mainland Africa (Collar and Stuart 1985) and is one of 19 Important Bird Areas (IBAs) in Kenya that are prioritised as critical sites for intensive and immediate conservation action (Bennun and Njoroge 1999). The forest is home to six globally threatened bird species and an additional five bird species that are coastal endemics. Of the six globally threatened species, two, the Sokoke scops owl and Clarke’s weaver, are known only from the Arabuko-Sokoke forest and one other site (East Usambara mountains in Tanzania and the Dakatcha woodlands, respectively). A further eight bird species (of a total of 270 species) found in the Arabuko-Sokoke forest are regionally threatened. The Arabuko-Sokoke forest also has an exceptional diversity of amphibian fauna, including the coastal endemic Bunty’s toad. There are three rare near-endemic mammals (Ader’s duiker, golden-rumped elephant shrew, and the Sokoke bushytailed mongoose). A small population of around 100 elephants lives in the forest and there are six taxa of butterflies that are coastal endemics. An unknown number of other invertebrate species could also be forest endemics.

The forest is surrounded on all sides by village communities. There are 51 villages with a total population of about 110,000, represented by 8,000 households (Gordon and Ayiemba 2003). The average household size is more than 13, and 55% of the households consist of multiple families. Between 1989 and 1997, the population density of Malindi district rose from 47 to 60 people per sq. km (Government of Kenya 1997). Prior to the protection of the forest (i.e., before it was gazetted) by the colonial government of Kenya in 1932, the local people used the forest freely for their subsistence needs. Subsistence agriculture is the main occupation of the surrounding population (Gordon and Ayiemba 2003). This includes the cultivation of maize, cassava, and beans, with income supplemented by cash crops such as cashew, mango, and coconut. Agricultural land is generally poor, and crop yields are low. The mean size of farm holdings is 6.9 ha (0.5 ha per capita), with farms growing an average of 1.6 ha of maize (Gordon and Ayiemba 2003). Most households own goats (average of five per household), but tsetse flies and a lack of grazing land are constraints to cattle keeping. Local people’s usage of forests includes: collection of water, fuel wood, building poles, and herbs; butterfly farming; and hunting of wildlife for meat (Gordon and Ayiemba 2006). The Arabuko-Sokoke forest also has touristic importance mainly due to its unique bird diversity and location along the coast. Bird watching is a dominant tourist activity that allows some youth bird guides a reliable income, although the lack of an organised system for recording and charging birder fees makes it difficult to assess the full range of direct financial gain.

In 1991 the average declared household income in the forest-adjacent community was estimated at KES 17,300, providing a per capita income of only KES 1,470 (USD 20 at current rates) (Mogaka 1991). Poverty was worsened by crop raiding by animals from the forest (mainly elephants and baboons), causing considerable losses of maize, cassava, mangoes, and coconuts. Elephants also caused deaths, injuries, and destruction of property and were the single most important cause of hostility towards the forest (Gordon and Ayiemba 2003). There is no government compensation for loss of crops or injuries caused by wildlife; only in the event of death is any compensation paid, and that too of only KES 30,000 (USD 400), and usually only after persistent claims.

The Arabuko-Sokoke forest is an interesting and important case not just because of its importance to biodiversity conservation but because of its history and role in the process of decentralisation within Kenyan forestry. To appreciate this we need first to understand the changes that have been made to the law (even if not practiced) since 2005. Second, we need to understand the changes in and around the Arabuko-Sokoke forest which preceded, and then followed, the 2005 Forest Act.

The Kenya Forest Act, 2005, was developed and enacted to end the colonial and pre-colonial command and control of forests while at the same time recognising that state agencies had failed to protect forests surrounded by disgruntled local communities. Section 46 of the Forest Act allows members of a community resident around a forest area to register a community forest association (CFA) under the Societies Act, 1998 (Chapter 108), in order to participate in the conservation and management of state or local authority managed forests. Communities registered in this manner can invoke Section 47 of the Forest Act to protect, conserve, and manage forests and formulate and implement forest programmes consistent with the traditional forest user rights of the community in accordance with sustainable use criteria (Matiku et al. 2011b). They are supposed to assist the Kenya Forest Service—the state agency responsible for forest management—in enforcing the provisions of the Forest Act, especially with respect to illegal harvesting of forest produce. Section 13(2) of the Forest Act, 2005, allows establishment of forest conservation committees under the Act, to, among other functions, assist local communities to benefit from royalties and other rights derived from flora or fauna traditionally used or newly discovered by such communities (Matiku et al. 2011b). Under Section 18 of the Forest Act, 2005, a Forest Management and Conservation Fund is established to be used for maintenance and rehabilitation of forests, promotion of community-based forest projects, establishment of nurseries and seedling production, and facilitation of education and research activities, among other uses (Matiku et al. 2011b).
Act allows owners of private forests to apply for exemption from paying part or all land rate charges and to obtain loans from the Fund and seek technical advice on appropriate forestry practices, while Section 52 of the Act deters any person from engaging in prohibited activities in the forest, and provides harsh penalties such as fines of not less than KES 50,000 or imprisonment of not less than six months, or both, to those who contravene this provision (Matiku et al. 2011b). According to the Forest Act, 2005, illegal activities may include cutting or extracting forest produce or collecting honey and beeswax without a license or permit, or clearing the forest for cultivation, or any other activities that are likely to be destructive to the forest. The low capacity of the Kenya Forest Service means that they are unable to patrol and guard the entire forest perimeter; hence the disparate need to engage local communities in forest conservation (Matiku et al. 2011b). Unfortunately, the Forest Act has remained largely unimplemented as the institutional structures for the Kenya Forest Service have not been completed and devolution of forest management powers is yet to take place (Matiku et al. 2011b).

However, participatory forest management in Arabuko-Sokoke predates the enactment of the Forest Act, 2005. In 1993, community engagement began through butterfly farming with funding from the Global Environment Facility Small Grant Programme of the United Nations Development Programme that provided USD 50,000 to Nature Kenya (the East Africa Natural History Society) for butterfly farming start-up activities. The main objective of the butterfly farming project was to reduce pre-colonial and post-colonial negativity among the local people by providing incentives for local communities to support forest conservation objectives. A study by Mogaka (1991) showed that 96% of forest-adjacent dwellers wanted the forest cleared for settlement. In the absence of a legal instrument to implement participatory forest management, the government bowed to pressure from local people around the forest who needed free and unlimited access to harvest butterflies from the forest. In October 2000, the government provided written consent to pilot participatory forest management in the Arabuko-Sokoke forest. This legitimised previous efforts and investments, especially butterfly farming and capacity-building, that were aimed at promoting local community engagement in forest management.

The formal Arabuko-Sokoke forest PFM process therefore started in 2000 with the development of a management plan by the government in consultation with civil society organisations. Key government agencies were the Kenya Forest Department (now Kenya Forest Service), Kenya Wildlife Service, Kenya Forestry Research Institute, and the National Museums of Kenya. Civil society organisations included Birdlife International, Nature Kenya (Birdlife Kenya), East African Wildlife Society, Arocha Kenya, and local community groups led by the Arabuko-Sokoke Forest Adjacent Dwellers Association (FADA). The funding to implement PFM in the Arabuko-Sokoke forest came from diverse sources (Table 1). Kenyan government agencies engaged in the process provided in-kind co-financing in the form of staff time and forest management administration and infrastructure.

Stakeholder meetings with all of the stakeholders were held, where each theme was discussed at a time. Researchers presented their past findings on the distribution of key biological components including both rare and endemic plants and animals. They also presented socio-economic data that showed how local people perceived the forest. Local community representatives presented what they considered to be historical indigenous peoples’ uses of the forest. The approach to the development of the management plan was to build consensus regarding the sustainable management of the Arabuko-Sokoke forest for the benefit of current and future generations and for the conservation of invaluable plant and animal species. Stakeholders agreed that basic principles throughout the management plan formulation process would include keeping the forest as intact as possible, utilising it in ways that would not jeopardise biodiversity and forest ecosystem services for present and future generations.

The plan divides the forest into four main forest management zones: 1) the non-extractive zone, an area of forest lying further away from the villages and which is most important for biodiversity; no extraction of forest resources is allowed—this zone has two sub-zones: the biodiversity conservation sub-zone mainly for biodiversity research, and the ecotourism sub-zone for ecotourism and conservation awareness activities; 2) the subsistence zone, which lies closest to villages and is mostly used by villagers for subsistence—this zone has two sub-zones: the community use sub-zone for collection of permitted forest products (fruits, herbs, honey, butterflies, silk moths, medicinal plants, fuel wood), and the non-timber forest products sub-zone in which a more limited range of subsistence products (pole wood, grass, wood for carving, timber, firewood) may be collected; 3) the commercial zone, which consists mainly of plantations; and 4) the intervention zone, which is an area lying outside the forest boundary and consisting mainly of private land—the management options

| Grantor | Grantee | Amount (USD) |
|--------|--------|--------------|
| United States Agency for International Development | Nature Kenya | 1.2 million |
| European Union | Birdlife International | 1.444 million |
| Global Environmental Facility | International Centre for Insect Physiology and Ecology | 0.2 million |
| | Arocha Kenya | 0.05 million |
| Naturschutzbund Deutschland and Kinderhilfe | Nature Kenya | 0.4 million |
| European Union | Arabuko-Sokoke Forest Adjacent Dwellers Association | 0.25 million |
| | East African Wildlife Society | 1.5 million |
here include: ecotourism development, awareness raising, fuel wood and pole wood harvesting, non-timber forest products and medicinal plants collection and management, tree planting, rehabilitation of degraded areas, carving wood extraction, beekeeping, butterfly farming, mushroom farming, agroforestry, education programmes, water resources development, and capacity-building. The management options for all the management zones include: study and research, habitat improvement, awareness raising, and general capacity-building.

PFM implementation is donor dependent and delivery around the Arabuko-Sokoke forest has varied according to donor interests. As a result, some areas have received more attention than others depending on donor interest and also choices made by forest managers who have targeted places which were more accessible or where illegal activities were most prevalent. The selected pilot zones in the mixed forest and cynometra woodland received significant capital investments for activities defined in the management plans. For example, the Global Environment Facility funding through the International Center for Insect Physiology was mainly earmarked for supporting butterfly farming, beekeeping, and PFM process in the mixed forest PFM zone, where European Union funding through the East African Wildlife Society was also invested. The United States Agency for International Development funding through Nature Kenya together with European Union funding through Birdlife International was made for the entire forest but forest managers chose to invest significantly in the mixed forest PFM zone and the cynometra woodland PFM zone due to feasibility of activity delivery. The Arocha Kenya funding focused mainly on the construction of a boardwalk at Mida creek adjoining the mixed forest PFM zone. Likewise, the European Union funding through the Arabuko-Sokoke Forest Dwellers Association was used to erect an elephant fence and build community managed environmentally friendly simple accommodation (eco-bandas) and increase local community capacities in the mixed forest PFM zone. The local people, through the Forest Adjacent Dwellers Association (FADA), sought the funding to erect an elephant fence to reduce wildlife-human conflicts, especially crop losses due to elephant raids on farms stretching some 10 km on the eastern side of the forest within the mixed forest PFM zone.

To initiate the PFM process, forest managers mobilised the communities in the target zones. Local people were asked to organise themselves into resource assessment teams to determine the resource status in the forest under the guidance of forest managers. After forest resources were assessed (for pole wood, fuel wood, timber trees, medicinal plants, herbs, fruits, and other community uses), the local people sat with managers and developed forest conservation action plans tailored for the target zone. They then agreed upon which resources, especially pole wood, fuel wood, honey, butterflies, and silk moth, they could extract and the limits of that extraction. Regulations for extraction of products that could damage the forest, for example extraction of fuel wood, pole wood, and medicinal plants, were developed, and penalties agreed upon.

The local people organised themselves into and registered community forest associations (CFAs) as provided for in the Forest Act, 2005. CFA management plans were developed with implementation structures. The PFM implementation structure includes community representatives and government representatives who are supposed to have an office at the forest station which falls under the jurisdiction of the CFA.

Where PFM has been implemented in the mixed forest and cynometra woodland habitats, the focus has been mainly on capacity-building and income-generating activities targeting wealth creation for improving household livelihoods. Community-based institutions were established, their institutional capacity built, and household and group-based income generation supported alongside education and awareness programmes and forest monitoring. Unfortunately, the implementation of the Forest Act, 2005, has mainly focused on setting up the implementation structures of the Kenya Forest Service itself and as a result no PFM management plans have been signed for the Arabuko-Sokoke forest. Therefore, PFM implementation remains limited in the actual power sharing within a co-management approach. However, the investment and associated capacity-building was done and local people continued with forest protection measures without having to wait for signed management plans for sharing of forest management powers with the Kenya Forest Service. They also became aware that there were not many forest extractive uses (e.g., timber and pole wood) that they could continue to extract from the forest as freely as before. The involvement of local people in resource assessments led to the mutually agreed upon conclusion that the forest needs to be given at least 25 years to regenerate. However, as there was limited fuel wood and some poles that could be extracted from the forest, local people continued to engage in pole wood and fuel wood harvesting following the permit system inherited from colonial times, but which was now practiced with more mutual respect between the government enforcers and the local people.

**General methods**

In the year 2009, we collected data in PFM and non-PFM zones, assessing benefits and costs of the forest to households. The study used socio-economic methods of forestry research to collect data on the impact of PFM on household livelihoods. We interviewed heads of households as they had the knowledge, experience, and skill to provide reliable information (Harrison et al. 2002). Questionnaires were developed to cover forest benefits and costs and the impact of the forest and PFM on the livelihoods of forest-adjacent households up to 5 km from the forest edge (Appendix). The questionnaires were administered using a personal interview approach, which is recommended to avoid non-response bias (Harrison et al. 2002). Several measures were taken for data quality control and to minimise errors and biases. First, five interviewers were identified on the basis of their ability to understand and interpret the questionnaires written in simple English. After two days of training, each interviewer administered five pilot
PFM and local livelihoods in Arabuko-Sokoke forest

questionnaires. These were then adjusted to ensure clarity on all the questions. The testing also established that each questionnaire would take two hours to administer.

Second, field data on forest benefits and costs were collected following methods used by Dosman et al. (2002) and Adamowicz et al. (2004) who assessed subsistence hunting of the Aboriginal people, and also methods prescribed by Emerton (1992) and Mogaka (1991a) who applied similar techniques to assess subsistence forest uses in Mount Kenya and Aberdares forests in Kenya. The study asked local people in the Arabuko-Sokoke forest to answer questions linked to the impact of the forest on people. Questions covered natural resource stocks from which the goods and services needed for livelihoods were derived, including: access to farming land; agricultural productivity; marketing of crops; access to grazing land for livestock; access to water for livestock; marketing of livestock; access to drinking water; access to trees for timber; access to firewood; access to medicinal plants; and access to non-timber forest products. Also, questions linked to financial capital, the financial resources people use to achieve their livelihood objectives, as well as stocks (cash) that contribute to consumption and production were asked. These included household income from employment related to the forest and losses incurred because of the forest, for example losses of crops and livestock. Other questions asked were linked to physical capital as the basic infrastructure to support livelihoods, and the tools and equipment people use to function productively. These questions were also asked to assess the forest effects on household building materials (e.g., timber), effects on road development or maintenance, and water infrastructure (Matiku 2012).

In all cases local people were asked to attach values to the forest’s positive or negative effects for the identified quantities based on what known commodities in the market would cost (Dosman et al. 2002). Households were asked to estimate material benefits and material costs or direct financial gains or losses in Kenyan Shillings (KES) over a period of one week or one month or annually, depending on the nature of forest effect, or material benefit or cost, or financial gain or loss. For example, households were asked to assess the annual pole wood benefit by: how much they would pay for a pole in the market even if it were not the same species as the one they would get from the forest; or how many fuel wood head loads they collect per week and how much they would pay for a head load of fuel wood if they were to buy it in the nearby market; or how much water the household uses per week from the forest water pools and how much they would pay for a 20 litre jerri can from a water vender. The value of forest products without a market value, for example grazing in the forest, was assessed by asking households how much they would pay per year or dry season if they were to rent land for grazing from a household who had surplus grass.

Third, the study adapted the techniques of Adamowicz et al. (2004) (based on Dosman et al. 2002) but also allowed storytelling to get details on qualitative values of forest products, similar to the techniques used by Emerton (1992) and Mogaka (1991a). The latter used ‘participatory environmental valuation’ by asking farmers to rank the number of times a forest value was equivalent to a well known commodity, for example a goat sold in the nearby market. Finally, data on PFM impacts on household livelihoods were collected following Barrett and Arcese (1995), McShane et al. (2004), Brooks et al. (2006), and Morgan-Brown et al. (2009), who used interview methods to assess the efficacy of conservation and development initiatives in different parts of the world.

The sampling frame

The study sampled households in four zones, namely PFM and non-PFM zones in both the mixed forest and cynometra woodland (Figure 1). Households were sampled at 1 km, 2 km, 3 km, 4 km, and 5 km distances from the forest edge on transects walked along these set distances for a total of 10 km.

Households were sampled in two ways. First, the number of households in the study areas was listed after a physical household count during reconnaissance. Each household was given a number. Households were categorised into each of the 1 km, 2 km, 3 km, 4 km, and 5 km distances from the forest edge to capture differences in benefits and costs and household perceptions resulting from household distance differences from forest edge over the 10 km transect length. A household was assigned to a distance category if the household land was traversed by the sample distance delimitation. Second, random sampling was used to pick 30 sample households from each sampling distance for each of the mixed forest and cynometra woodland PFM and non-PFM study zones. The 30 households were randomly selected for each distance category, leading to 150 households for each zone and a total of 600 households overall (Figure 1).

Interviewers visited the sample households by walking from one household to the next. Each head of household was interviewed by a trained interviewer who conducted oral interviews where they asked the questions in the questionnaire in series, and recorded answers against each of the questions. Heads of households who could not understand English were asked in the local Giriama language by the interviewer, who translated the questions. The heads of households were allowed to engage in discussions and storytelling to better understand the questions as they provided answers. Where a head of household was found to be absent, the next household in close proximity and not included in the sample was chosen for the interview. Interviews were conducted at any time of the day depending on the time the interviewers arrived at the household. Data collection took place in April 2009.

Data collection and variables

Interviewers asked households to indicate the ways in which the forest was an asset or liability to their livelihoods and quantify in Kenyan Shillings the annual household benefits and/or costs. Specific data were collected on livelihood strategies in the community, role of the forest and its resources in people’s livelihoods, use of the forest by local people, effect
of the forest on people’s poverty, direct and indirect costs and direct and indirect benefits to local people, and willingness to accept forest conservation.

**Data analysis**

Simple benefit-cost analysis was done by computing the total annual household benefits and costs. Benefits and costs were compiled at weekly, monthly or annual intervals depending on the variable. Only data where households specified the types of benefits and costs and their associated quantities and filled corresponding values were considered in the compilation. Weekly and monthly household benefits and costs were computed and extrapolated to cover one year so as to be in line with the annual costs. Annual and daily household average benefits and costs were computed to allow comparisons with district annual or daily computed averages. Benefits and costs in Kenyan Shillings were converted to US Dollars at the prevailing rate of KES 75 to the Dollar. Opportunity costs were not included in the analysis. Data were aggregated at two levels: forest ecosystem PFM and non-PFM zones; and habitat specific PFM and non-PFM zones. This categorisation allowed the capture of intra-habitat benefit and cost differences within the mixed forest and cynometra woodland PFM and non-PFM zones. Chi square analysis of variance in Start View statistical programme was used to compare the proportions of benefits with the costs at 1 degree of freedom and 95% confidence limits.

**RESULTS**

The results from all the data when not separated into PFM and non-PFM zones show that households of minority communities living adjacent to the Arabuko-Sokoke forest depend on it for their daily sustenance in one form or another (Table 2). The most important household benefit is licensed and unlicensed fuel wood collection by head loads (amount of wood carried by one woman) of fuel wood, averaging 25 head loads per household per year. This accounts for KES 3,819/annum (USD 51) of household income for 25% of the studied households. Building materials in the form of poles collected from the forest come second, accounting for an annual household income of KES 3,779/annum (USD 50) accruing to 23% of the households. Households either use poles from the forest for domestic construction needs or sell them to their neighbours who are unable to harvest pole wood from the forest. Non-timber forest products including butterfly pupae sold at the Kipepeo marketplace, traditional honey from the forest or modern beehives placed in the forest, and fruits collected for domestic consumption come third, benefiting 25% of the studied households at KES 2,909 (USD 39) for each household per year. Herbal medicine from herbs collected in the forest comes fourth, benefiting 19% of households and accounting for some KES 650 (USD 9) of household annual income. Households benefiting from herbal medicine either make savings because they do not purchase medicine from pharmacies or sell their medicinal collections to herbalists. Forest-related employment accounts for the highest household cash annual income of KES 25,000/annum (USD 333). However, such employment opportunities are limited and only 4% of households benefit from them. The employment is in the form of monthly incomes for community members employed to facilitate collection, packaging, and marketing of butterfly pupae, honey, and mushrooms, among other products that are processed at the Kipepeo marketplace (a bulking centre for all nature-based products that ensures international and local market standards). Other employment types constitute cash earnings from casual wages for trained local people who provide beehive extraction services, earnings from guiding tourists in the forest, and tokens received from conservation projects. The least important household benefits are drinking water from the forest and livestock grazing in the forest, which benefit 2% and 0.3% of the studied households respectively (Table 2). These forest benefits reduce as distance from the forest boundary increases from 1 km to 5 km (Figure 2).

The results show that the forest has costs to households living around the Arabuko-Sokoke forest. The costs are three-fold:crop damage by wild animals, livestock predation, and livestock deaths due to tick- and tsetse fly-borne diseases from the forest. The number of households which incur forest
costs is highest for crop damage by wild animals, with 36% of households being affected. Livestock predation comes second, with 24% of households being affected, and livestock deaths due to ticks and tsetse flies comes third, with 14% of households being affected (Table 2). The mean annual household costs are highest for crop damage by wild animals, showing the highest computed cost of KES 17,569/annum (USD 234) per household, followed by livestock predation by wildlife with an annual household cost of KES 8,302 (USD 111), and livestock deaths due to ticks and tsetse flies from the forest amounting to a mean household cost of KES 6,241/annum (USD 83). For 2009, the total annual household cost adds up to KES 32,106 (USD 428) (Table 2). The forest costs reduce with distance from 1 km up to 5 km from the forest edge (Figure 3).

When household forest benefits are statistically compared with household forest costs, chi square variance analysis shows that the proportion of household income from the forest is significantly higher than that of household costs ($\chi^2 = 4.29E + 07, P \leq 0.001, df = 1$). The results also show that the net annual household benefit calculated by subtracting the costs from the benefits is positive, at KES 4,609 in 2009 or KES 13/day (USD 0.2/day at a base rate of KES 75 to the US Dollar) for the one-year study period. This net household forest benefit is 13% of the government daily average income for Malindi district, estimated at USD 1.3 in 2008.

When the data are disaggregated into the PFM and non-PFM zones the results show that in 2009, households in PFM zones have a net forest benefit of KES 28,383 or KES 79/day (USD 1/day). The households in the non-PFM zones show a net loss of KES 38,609 or KES 107 (USD 1.4/day) (Figure 4). Households in the PFM and non-PFM zones experience the same type of benefits and costs. The net benefits in the PFM zones result from higher benefits

| Forest benefit type                                      | Household mean income (KES) | Number of households (n=600) | % of households (n=600) |
|----------------------------------------------------------|-------------------------------|-----------------------------|-------------------------|
| Firewood extraction: licensed fuel wood collection by head loads (batch of wood carried by one woman) of fuel wood averaging 25.29 head loads per household per annum. | 3,819.4                      | 151                         | 25.2                    |
| Non-timber forest products: butterflies sold at Kipepeo market place, traditional honey collected from the forest or modern beehives placed in the forest, and fruits collected for domestic consumption. | 2,909.3                      | 149                         | 24.8                    |
| Building materials: mainly poles collected from the forest and used for local household construction and also sold to neighbours unable to harvest pole wood from the forest. | 3,779.9                      | 135                         | 22.5                    |
| Herbal medicine: the value of herbs collected from the forest, savings made by not purchasing medicine from pharmacies, and sale of herbs to herbalists. | 649.9                        | 113                         | 18.8                    |
| Forest-related employment: monthly wages for personnel working at Kipepeo market place, casual labour in providing beehive extension services, earnings from guiding tourists in the forest, and allowances received from conservation projects. | 25,556.5                     | 23                          | 3.8                     |
| Drinking water from the forest: for people and livestock | -                            | 14                          | 2.3                     |
| Livestock grazing in the forest                          | -                            | 2                           | 0.3                     |
| Forest cost type                                         | Household mean cost (KES)     | Number of households (n=600) | % of households (n=600) |
| Crop damage by wild animals: elephants, primates, warthogs, and porcupines | 17,562.9                     | 217                         | 36.2                    |
| Predation of livestock, including chickens | 8,301.7                      | 144                         | 24.0                    |
| Livestock deaths due to ticks and tsetse flies from the forest | 6,241.4                      | 84                          | 14.0                    |
(KES 44,515 or USD 593) from firewood extraction, herbal medicine, building materials, non-timber forest products, and income from forest-related employment, which are numerically higher than the forest costs (KES 16,596 or USD 221). In the non-PFM zones, net losses arise from a higher numerical total for forest costs (KES 60,240 or USD 803) due to crop damage by wild animals, livestock predation including chicken, and livestock deaths due to ticks and tsetse flies as compared to lower forest benefits (KES 28,250 or USD 377) (Table 3). Results in the mixed forest and cynometra woodland PFM and non-PFM zones show similar trends where the cumulative numerical benefits in PFM zones are higher than the costs and cumulative numerical costs are higher than the benefits in the non-PFM zones (Table 3).

When the data are disaggregated into distance from the forest starting with 1 km through to 5 km, the results show that households living next to the forest at a distance of 1 km incur a net loss of KES 21,370 per year. Households living at 2 km, 3 km, and 4 km incur net benefits of KES 939, KES 2,056, and KES 1,988 respectively, and households at 5 km distance incur a net loss of KES 7,531 due to the forest management regime (Figure 2).

When the data are separated for PFM and non-PFM zones, the results show a net positive benefit for households living 1 km from the forest in PFM zones with a net annual benefit of KES 32,683 and KES 13,762 in the mixed forest PFM zone and cynometra woodland PFM zone respectively (Figure 5). In the mixed forest PFM zone net household benefits are positive up to 3 km distance from the forest. In the cynometra woodland PFM zone net benefits remain positive through to the end of the 5 km distance. In the non-PFM zones households’ annual net income is negative up to 3 km distance in the mixed forest non-PFM zone and through to the 5 km distance in the cynometra woodland non-PFM zone (Figure 5). These results do show that costs exceed benefits in places where PFM has not been implemented. Computed net daily household benefits and costs show a cost of USD 0.79 at the 1 km distance from the forest which increases to USD 0.04, USD 0.08, and USD 0.08 at 2 km, 3 km, and 4 km distances respectively. In the non-PFM zones, households’ annual net income is negative up to 3 km distance in the mixed forest non-PFM zone and through to 5 km distance in the cynometra woodland non-PFM zone (Figure 5).

### Table 3

| Study zones             | Forest benefits to households (KES) | Forest costs to households (KES) |
|-------------------------|------------------------------------|---------------------------------|
|                         | Firewood extraction                | Herbal medicine                 | Building materials | Non-timber forest products | Income from employment related to forest | Total benefit | Crop damage by wild animals | Livestock predation (including chicken) | Livestock deaths due to ticks and tsetse flies | Total cost |
| PFM zones               | 9,397                              | 2,285                          | 3,550                 | 7,161                   | 22,123                        | 44,516        | 9,874                         | 3,747                          | 2,975                          | 16,596          |
| Non-PFM zones           | 4,846                              | 282                            | 4,150                 | 258                     | 18,714                        | 28,250        | 37,939                        | 19,973                         | 9,698                          | 67,610          |
| Mixed forest PFM zone   | 1,258                              | 1,451                          | 2,700                 | 4,981                   | 29,357                        | 39,747        | 8,100                         | 3,718                          | 8,750                          | 20,568          |
| Mixed forest non-PFM zone | 7,697                             | 393                            | 1,500                 | 281                     | 18,714                        | 28,585        | 50,476                        | 12,006                         | 9,877                          | 72,359          |
| Cynometra woodland PFM zone | 9,656                             | 1,148                          | 2,535                 | 2,909                   | 22,900                        | 39,148        | 8,187                         | 12,000                         | 3,526                          | 23,713          |
| Cynometra woodland non-PFM zone | 241                               | 203                            | 4,913                 | 224                     | 0                             | 5581          | 24,856                        | 31,003                         | 4,000                          | 59,859          |

KES 75 = USD 1
0.07 at 2 km, 3 km, and 4 km respectively showing net negative household benefit at 5 km distance from the forest in non-PFM zones. The net household forest benefits and costs reduce as distance from the forest edge increases (Figure 5).

**DISCUSSION**

The results from all the data when not separated into PFM and non-PFM zones show that households living adjacent to the Arabuko-Sokoke forest depend on the forest for their daily sustenance in one form or another. The results show that in the PFM zones, benefits exceed costs and result in net positive benefits. The findings are in line with previous studies; for example, Suda (1992) and Emerton (1993), who found that forest-adjacent communities within the 5 km buffer zone depend on the forest for their livelihoods. The results are also in line with Wass (1995) whose studies showed that forests support a wide range of direct uses, including timber and non-timber forest products as well as non-consumptive services, which benefit the local, national, and global population.

This reliance of local people on the forest indicates an obvious link between the livelihoods of forest-adjacent households and forest resources, which unless well checked could go against forest conservation objectives. It is critical that the extraction of resources by local people is maintained at sustainable levels in order to lead to sustainable human well-being as described by the Millennium Ecosystem Assessment (2005) and Scoones’ Sustainable Livelihoods Framework (1998). The Millennium Ecosystem Assessment (2005) states that sustainable human well-being is linked to sustainable ecosystem services that include provisioning (e.g., food, water, fibre, and fuel), regulating (e.g., climate, water, and disease regulation), cultural (e.g., spiritual, aesthetic, recreation, and education), and supporting (e.g., primary production and soil formation) services. Previous studies by Ngala (2010) and Mogaka (1991) show that extensive resource extraction by forest-adjacent households is a major threat to the conservation values of the forest.

Results of the study also show that the Arabuko-Sokoke forest incurs costs to forest-adjacent households. Unlike in the PFM zones where households receive net benefits, in the non-PFM zones, costs exceed benefits and result in losses to the local people. These findings are supported by past studies, especially by the Kenya Forests Management Programme (1994), whose findings indicate that indigenous forests incur a range of costs, including the direct costs of management as well as non-management costs incurred by local people due to the existence of forests; and studies by Thomson and Ochieng (1993), whose findings show that the presence of forests incurs costs to the local population through the damage they suffer from forest dwelling-animals. It would be expected that the value local people attach to forest conservation and also their support for forest conservation objectives would be largely dependent on the balance between forest benefits and forest costs to forest-adjacent households. A recent study by Sinclair et al. (2011) shows that supporting school fees for educating children from poor households adjacent to the forest improves household attitudes towards the Arabuko-Sokoke forest. It would seem that PFM arrangements succeed in getting local people to receive more benefits from the forest. It is also probable that local people in the PFM zones feel less inhibited in declaring materials they extract from the forest since local people’s access to the forest is largely agreed upon by forest managers as they help keep away illegal loggers and commercial fuel wood collectors. Such forest protection by the local people would be expected to enhance resource quantities available for their own access and use. While local people in non-PFM zones receive fewer benefits from the forest, it is probable that lack of PFM arrangements in the non-PFM zones—which means that local people do not monitor and protect forest resources—has led to resource depletion by commercial fuel wood collectors and illegal timber loggers. Matiku et al. (2011a) found that measures of forest quality were significantly higher in the PFM zones than in non-PFM zones in the Arabuko-Sokoke forest.

Our study results also show that forest-adjacent households...
receive the most benefits from forests. Notably, the study only 
quantified ecosystem provisioning services (water, fibre, herbal 
medicines, and fuel). The result may be different if ecosystem 
regulating (e.g., climate, water, and disease regulation), 
cultural (e.g., spiritual, aesthetic, recreation, and education), 
and supporting (e.g., primary production and soil formation) 
services were also considered in the study. These regulating 
services accrue in equal proportions to all households 
regardless of their distance from the forest. However, by 
using provisioning services which are the immediate needs 
of poor local households, the study results do show that local 
households closest to the forest derive the most benefits from 
the forest compared to households further away from the forest.

Forest costs also reduce with distance from 1 km from the 
forest edge up to 5 km from the forest edge in the cynometra 
woodland. This may indicate that if costs were to be the only 
determinant of household placement relative to the forest, 
households would prefer to place their homesteads further 
away from the forest within the cynometra woodland. The 
observation that in the mixed forest net benefits increase up 
to 3 km after which net losses are incurred is an interesting 
observation that needs further study. However, closeness 
of the mixed forest to the marine system, another common 
resource, might mean that some of the households further away 
from the forest may be dependent on fishery resources in the 
sea unlike those in the cynometra woodland. It is expected 
therefore that the decisions the heads of households would take 
when considering where to locate their homes with respect to 
the forest would depend on the cost-benefit equilibrium. 
However, the land around the Arabuko-Sokoke forest is already 
privately owned and households do not have a choice but to 
remain in their current land holdings where the soils are poor 
with low agricultural returns for both food and cash crops. 
This therefore means that households’ day-to-day well-being 
is dependent on whether the benefits they get from the forest exceed the costs they incur due to the presence of the forest.

These results are consistent with study findings by Allaway 
and Cox (1989), Thomson and Ochieng (1993), and Emerton (1995a), that show that the presence of forests incurs costs to the local population through the damage they suffer from forest dwelling-animals. All these studies point to the lack of national data for animal damage, but studies carried out in individual forests in Kenya confirm the findings. For example, households living adjacent to Shimba Hills National Reserve, which contains indigenous forest, claimed a total of USD 45,000 in 1987–1988 as compensation for the damage caused to their crops by wildlife (Thomson and Ochieng 1993). In the area around the Aberdares forest, an estimated 36% of adjacent households lost crops to wildlife in 1991, and 61% suffered damage to fences and farm buildings (KIFCON 1992). 

Households living on the southwestern side of Mount Kenya Reserve regularly suffered crop damage from wild animals, and lost between 50% and 83% of their harvest in 1993 (Thomson 1993). In all these cases, households were estimated to have suffered substantial financial losses as a result of wild animal damage. In the Arabuko-Sokoke forest, PFM investment has addressed this problem by erecting elephant barrier electric fences in target areas. Although the study did not look at the elephant fence per se, the results show that households in fenced PFM areas incur much lower costs linked to crop losses. However, the interviewed households did not identify the elephant fence as a benefit to their livelihoods. This may be linked to the inconvenience created by the fences as they prevent easy access to the forest to extract forest products.

Keeping land under forest cover precludes the possibility of 
carrying out alternative land-uses (Allaway and Cox 1989). 
However, it is reasonable to assume that the most likely 
alternative land-use in Kenya would be small-scale agriculture 
(Allaway and Cox 1989). If these findings in the literature 
are something to go by, one would expect that households in the Arabuko-Sokoke forest would convert forest land to agriculture if the costs of conserving the forest are not offset by the benefits from the forest. Prior to PFM implementation in the Arabuko-Sokoke forest, Mogaka (1991) found that 96% of the forest-adjacent households did not support forest conservation and 56% wanted the forest de-gazetted for settlement and agriculture. The reasons given at the time were that the forest is a source of poverty and hunger for the local people due to crop raids by wild animals and diseases from tsetse flies from the forest. After 15 years of PFM implementation in the Arabuko-Sokoke forest, the results of this study show that household benefits from the forest exceed costs in PFM zones. This net household forest benefit is 13% of the government daily average income for Malindi district, estimated at USD 1.3 in 2009. This means that the net impact of the Arabuko-Sokoke forest to forest-adjacent households is positive, improving the livelihoods of the households by 13%.

Warah (2008) defined PFM as an arrangement where key 
stakeholders enter into mutually enforceable agreements 
that define their respective roles, responsibilities, benefits, and 
authority in the management of defined forest resources. 
In the Arabuko-Sokoke forest, PFM initiatives have been 
implemented without signed management agreements 
since 1993. The PFM initiatives in the Arabuko-Sokoke 
forest have supported a range of forest conservation- and 
household-livelihood initiatives including: institutional 
development and capacity-building, forest management 
planning with utilisation and conservation zones, beekeeping, 
butterfly farming, mushroom farming, and ecotourism. 
Although there are no signed PFM agreements between 
the government and local communities in the Arabuko-Sokoke 
forest, the results show that PFM has increased benefits for participating households. Households in PFM zones are better off than those not living adjacent to the forest. This shows that forest areas that have received PFM investment have increased household benefits compared to non-PFM zones where the forest is a cost to households. There is no economically viable reason why households in non-PFM zones should be expected to support forest conservation objectives.

The results show a net positive benefit for households living 
within 1 km from the forest in PFM zones, both in the mixed 
forest and cynometra woodland. This is associated with the
extra benefits that households receive from PFM investment in the form of training on sustainable living, incomes from nature-based enterprises, trees planted together with food crops (on-farm woodlots) that provide incomes through sale of poles and fuel wood, butterfly farming, and value-addition of herbal medicine. In the non-PFM zones households’ annual net income is negative up to a 3 km distance in the mixed forest non-PFM zone and through to the 5 km distance in the cynometra woodland non-PFM zone. This is because there are no PFM resources to offset forest costs. The decisions that forest-adjacent households make either to support or object to forest conservation objectives are expected to be based on the equilibrium between the benefits and the costs due to the forest. Also, the next best option or alternative to forest conservation that delivers desired livelihood targets could be an important consideration. Cultural, education, and aesthetic values are important to the local people, but it is likely these would be considered as secondary to primary household needs.

The study results show that households in PFM zones are better off than those not living adjacent to the Arabuko-Sokoke forest. However, they need to be aware that their situation is better than those living far away because of the forest. In real life situations people worry about costs and care for their immediate basic needs regardless of whether their neighbours are in a worse situation or not. The household daily income of USD 2.4 for the PFM zones is still too small to make forest-adjacent households choose to conserve the forest for its national and global ecosystem values. In places where PFM arrangements have not being implemented, there is no reason why forest-adjacent households should choose to conserve the forest as forest costs make them poorer. These households would only support forest conservation if they are unaware of the impact of forest costs on their livelihoods or if the forest is forcefully protected by the government. Therefore for people to make the choice to conserve the forest, conservation measures should be accompanied by livelihood improvement initiatives.

**CONCLUSIONS**

The results show that PFM and associated investment enhance local peoples’ livelihoods. They also suggest that where livelihood options are limited and where there exists no scope for local people to offset forest costs, then forest managers have to find alternative ways of compensating forest-linked household costs to avert the risk for households to convert forest natural capital into fiscal capital just for survival. The results provide hope that through PFM, with substantial financial investment for capacity-building, joint management, income generating activities, and education and awareness as described by Warah (2008), and as supported by this study, it is possible for forest managers to enhance household support for forest conservation through alternative household livelihood improvement options.

However, the Millennium Ecosystem Assessment (2005) lists ecosystem values as beyond just provisioning services, on which this study is based. As the Arabuko-Sokoke forest provides regulating (e.g., climate, water, and disease regulation), cultural (e.g., spiritual, aesthetic, recreation, and education), and supporting (e.g., primary production and soil formation) services to the local people, albeit accruing nationally and globally, it is not prudent to use the results of this study to conclude that if PFM is not implemented local people will choose to clear the forest (or that if it is implemented they will choose to keep it). However, there is a need to assess the ways in which local people are culturally dependent on the forest and if they are willing to keep the forest just for cultural, education, and aesthetic values. Current results cast doubts about any likelihood of people choosing to keep the forest at the expense of their immediate household basic needs. As forest ecosystem services accrue beyond the borders of the forest, and given that this study has confirmed that households next to the forest incur the highest cost of keeping the forest, it follows logically that the national and global community should help offset the costs for the most affected households adjacent to the Arabuko-Sokoke forest. This support to local people in the Arabuko-Sokoke forest can take the form of PFM initiatives that are fully implemented and involve all of the communities surrounding the forest. This would not only enhance household forest-linked benefits but also ensure that local people are made aware of forest ecosystem services that are beyond their immediate day-to-day needs for food, water, health, and materials for shelter. However, the financial resources involved are huge and largely come from outside government sources. Assuming a similar investment in all forests in Kenya to generate the results observed in the Arabuko-Sokoke forest, the government budget for the Kenya Forest Service has to be increased mainstreaming PFM into core budgetary processes.

This casts doubts about the Kenyan government’s ability to find the financial resources needed to implement PFM as provided for in the Forest Act, 2005. Notably, the delay in setting up Kenya Forest Service structures under the Forest Act is due to lack of sufficient resources for core costs that do not include capital expenditure associated with PFM and other field-based activities. It is therefore too early to celebrate PFM as the tool to help sort out forest conservation projects, at least in the short term. Until sufficient resources are found to implement PFM, it is worthwhile to consider a mix of the old protectionist approach and the current PFM approach. Without sufficient education and awareness on PFM, local people are likely to interpret PFM to mean free and unlimited access into the forest to extract forest resources that were tightly controlled in the past using exclusionist forest protection rules. Since the PFM tool has merit, it is critical for forest managers to ensure that at least basic resources are immediately found to engage local people in non-PFM zones in the Arabuko-Sokoke forest and elsewhere in Kenya. It is also important to assess under what circumstances the PFM tool would work. The assumption in the Arabuko-Sokoke forest is that poor people cannot conserve the forest. However, it is unlikely that forests will always be surrounded by poor local communities who need to extract forest resources for their basic livelihood. What would happen if the local people surrounding a forest were not poor? The issues might be different and these need to be studied.
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APPENDIX

Data collection questionnaires for impact of forest on people

Social Impact Assessment (SIA) tool
Household GPS record
Name of enumerator. Date. Time start. Time end.

1. INTERVIEWEE/S INFORMATION

1.1. Name of village
1.2. Distance of house to the forest boundary or GPS reading
1.3. Does the household have an arrangement to access resources from the forest? Yes No

| Head of household (if male) | Name of person/s interviewed | Relationship if wife: W1, W2, W3, child, etc. | Age |
|----------------------------|-----------------------------|---------------------------------------------|-----|
| 1.4.                       | (Note: All other people contributing to the interview should be listed in the next column) | | |
| 1.5. Female-headed household (unmarried, separated, divorced or widowed) | | |
| 1.6. Child-headed household | | |

1.7. Socio economic data: Tick the applicable characteristics of the household

| Group 1 | Group 2 | Group 3 | Group 4 |
|---------|---------|---------|---------|
| Permanent brick house | Metal/tile/asbestos roof, wooden walls | Thatched roof/bamboo walls | No house or temporary shed |
| Has large crop field | Has small crop field | Has no crop field but has rain fed fields | Has no land |
| Has enough food to eat at all times | Occasionally has insufficient food | Often has insufficient food (more than 1/4 of the time) | Always has insufficient food |
| Cash crop annum income more than KES 50,000 | KES 30,000–50,000 | KES 5,000–30,000 | KES <5,000 |
| More than 20 cows | 5–20 cows | 1–4 cows | No cows |
| More than 20 goats | 5–20 goats | 1–4 goats | No goats |
| More than 20 chicken | 5–20 chicken | 1–4 chicken | No chicken |
| University education | Post secondary certification | Secondary to primary education | Primary to no education |
| Other: Specify | | | |

*If within the forest then “0”; otherwise estimate distance in kilometres to the nearest 0.1 km
*A household is defined as those who eat together, i.e., by the cooking pot or fire
*If interview is dominated by one person of several, mark “X” against this person’s name
*Of person/s interviewed to head of household, e.g., third wife (W3), son, daughter, (other) relative, neighbour, friend
*Under 18 years of age
*Refers to overall food security rather than self-provisioning, i.e., total rice from own production and/or purchase

2. EFFECTS OF THE FOREST AREA AND RELATIVE IMPACT ON THE HOUSEHOLD

The following table presents a list of ‘effects’ that have been identified as potentially significant. Go through this list of effects one by one using the following process:

a. Quantify the benefit or cost in KES in column 2 if appropriate
b. Ask whether the effect is significant at either community or household level. If no, then leave blank. If yes, then mark a ‘+’ in column 3 if it delivers a benefit, or ‘-’ if a cost. Clarify with a brief explanation where necessary.
c. If the effect is significant ask how this ‘effect’ actually impacts the well-being of their household as a whole and score: High (3), medium (2), low (1) in column 4. It is very important to explain correctly—we want to know how much the effect impacts well-being, not the frequency, scale or intensity of the actual effect itself. Finally, ask who within the household is most impacted by this effect: The males (M), the females (F), or both equally (B)

| Direct or indirect effects of the forest on: | a) Benefit or cost | b) Impact on household | c) Most impacted | d) M/F/B | Explanation (including timeframe for effect) |
|---------------------------------------------|-------------------|------------------------|-----------------|---------|---------------------------------------------|
| Natural capital: Natural resource stocks from which the goods and services needed for livelihoods are derived | Has the forest had an effect on your access to farming land? | | | | |
| 2.1. | Has the forest had an effect on your agricultural productivity in any other way (specify)? | | | | |
| 2.2. | Has the forest had an effect on the marketing of crops? | | | | |
| 2.3. | Has the forest had an effect on access to grazing for livestock? | | | | |
| 2.4. | Has the forest had an effect on access to water for livestock? | | | | |
| 2.5. | Has the forest had an effect on your livestock productivity in any other way (specify)? | | | | |
| 2.6. | Has the forest had an effect on the marketing of livestock? | | | | |
| 2.7. | Has the forest had an effect on your access to trees for timber? | | | | |
| 2.8. | Has the forest had an effect on your access to drinking water? | | | | |
| 2.9. | Has the forest had an effect on your access to firewood? | | | | |
| 2.10. | Has the forest had an effect on your access to medicinal plants? | | | | |
| 2.11. | Has the forest had an effect on your access to non-timber forest products (specify which)? | | | | |
| 2.12. | Has the forest had an effect on rainfall amount or patterns? | | | | |
| Physical capital: Basic infrastructure to support livelihoods, and the tools and equipment people use to function productively | Has the forest had an effect on road development or maintenance? | | | | |
| 2.13. | Has the forest had an effect on the marketing of timber? | | | | |
| 2.14. | Has the forest had an effect on water infrastructure development or maintenance? | | | | |
| 2.15. | Has the forest had an effect on building materials, e.g., timber? | | | | |
| Social capital: Social resources upon which people draw in pursuit of livelihoods, e.g., vertical networks (patronage), horizontal networks, group membership, other social relations that facilitate cooperation, reduce transaction costs and/or act as safety nets | Has the forest had an effect on social relations/conflict within your community? | | | | |
| 2.16. | Has the forest had an effect on social relations/conflict with other communities? | | | | |
| 2.17. | Has the forest had an effect on the level of support to your community from NGOs/government? | | | | |
| 2.18. | Has the forest had an effect on your social status/influence within your community? | | | | |
| 2.19. | Has the forest had an effect on the level of security for people? | | | | |
| Direct or indirect effects of the forest on: | a) Benefit or cost | b) Impact on household | c) Most impacted | d) M/F/B | Explanation (including timeframe for effect) |
|--------------------------------------------|-------------------|------------------------|-----------------|---------|---------------------------------------------|
| 2.22. Has the forest had an effect on establishment of community groups? | | | | | If yes, specify number of members: |
| 2.23. Has the forest had an effect on community leadership capacity? | | | | | |
| 2.24. Has the forest had an effect on advocacy capacity? | | | | | |
| 2.25. Has the forest had an effect on community learning outside the village? | | | | | |
| 2.26. Has the forest had an effect on community ability to protect it? | | | | | |
| **Human capital:** Skills, knowledge, ability to work, and good health people need to achieve their livelihood objectives | | | | | |
| 2.27. Has the forest had an effect on availability of health benefits? | | | | | |
| 2.28. Has the forest had an effect on availability of education services? | | | | | |
| 2.29. Has the forest had an effect on population growth? | | | | | |
| 2.30. Has the forest had an effect on school attendance of your children? | | | | | |
| 2.31. Has the forest had an effect on your knowledge and skills? | | | | | |
| 2.32. Has the forest had an effect on the time you have available for your farming and other activities? | | | | | |
| 2.33. Has the forest caused any population in-migration? | | | | | |
| 2.34. Has the forest caused any population out-migration? | | | | | |
| **Financial capital:** Financial resources people use to achieve their livelihood objectives, including flows (e.g., pensions, remittances, regular income) as well as stocks (cash, savings, loans, debts) that contribute to consumption as well as production | | | | | |
| 2.35. Does your household have income from employment not related to the forest? | | | | | |
| 2.36. Does your household have income from employment related to the forest? | | | | | |
| 2.37. Does your household incur losses because of the forest? | | | | | |
| 2.38. Does your household incur fines because of the forest? | | | | | |
| 2.39. Has your household lost any farming land because of the forest? | | | | | |
| 2.40. Has your household lost farming crops because of the forest? | | | | | |
| 2.41. Does your household receive any financial gain from the forest? | | | | | |
| 2.42. Has the forest had any other effect on your household income (specify)? | | | | | |
| **Livelihood outcomes:** Other direct or indirect effects of the forest on livelihood outcomes, e.g., income, food security, self-esteem, sense of control and inclusion, physical security, health status, access to services, political enfranchisement, cultural heritage, etc. | | | | | |
| 2.43. Has the forest had an effect on availability of transport (other than effects on road infrastructure)? | | | | | |
| 2.44. Has the forest had an effect on your quality of life? | | | | | |
| 2.45. Has the forest had an effect on your household’s happiness? | | | | | |
| 2.46. Has the forest had an effect on your household ability to survive? | | | | | |

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2.48. Has the forest had an effect on your household's overall positive development?

2.49. Has the forest had an effect on your household's overall under-development?

2.50. Others (identify any other significant effects)

3. OVERALL IMPACT

3.1. Taking into consideration all of the benefits and costs listed in the previous section, how would you rate the overall impact of the forest on your household?

3.1.1 Positive: high (+3), medium (+2), or low (+1)

3.1.2 Negative: high (-3), medium (-2), or low (-1)

3.2. Is there a difference in the value of farming land adjacent to the forest, compared to that further away?

Please compare land of the same size and quality.

If this is not applicable to this household then mark ‘N/A’.

If this is applicable then tick the relevant code below and explain why.

3.2.1 Land adjacent to the forest is of more value.

3.2.2 Land further away from the forest is of more value.

3.2.3 There is no significant difference.

3.3. Any comments on overall impact

........................................................

4. OPINION SURVEY

4.1. Do you think that it was a good thing to create the forest?

4.1.1 Yes

4.1.2 No

4.1.3 Don’t know

4.1.4 Why?................................................................................................................................................................................................................

4.2. How do you consider/rate the relationship between you and the forest?

4.2.1 Good

4.2.2 Medium

4.2.3 Poor

4.2.4 Why?...............................................................................................................................................................................................................

4.3. Do you feel that you get a fair deal from the forest?

4.3.1 Yes

4.3.2 No

4.3.3 If not, what could be done to make this a more equitable arrangement/fairer deal?

4.4. Do you feel adequately involved in the management of the forest?

4.4.1 Yes

4.4.2 No

4.4.3 If not, what could be done to make the management more participatory?................................................................................................

4.5. Do you think the forest is well protected?

4.5.1 Yes

4.5.2 No

4.5.3 If not, what could be done to protect it better?...........................................................................................................................................

4.6. If your household is given a chance to decide whether the forest should or should not be protected, what would be your advice?

4.6.1 Protect it

4.6.2 Destroy it

4.6.3 Don’t know

4.6.4 Please give reasons for your advice............................................................................................................................................................

4.7. Other............................................................................................................................................................................................................................

Note: Data collected using this tool was used to answer questions broader than the few questions targeted by this article.