
COMMUNITY PERCEPTION OF ECOSYSTEM SERVICES AND MANAGEMENT IMPLICATIONS OF THREE FORESTS IN WESTERN PART OF KENYA

A., Kisiwa*, K., Langat, S., Gatama, S., J., Kiprop, J. Cheboiwo and J., Kagombe

Kenya Forestry Research Institute, P.O. Box 20412-0200 Nairobi, Kenya

ABSTRACT

Understanding local community perceptions of forest Ecosystem Services (ES) is critical in crafting viable conservation strategies or management plans sensitive to livelihoods of the local people. This is because One major driver of forest degradation is lack of appreciation of ecosystem values and low perception of forest ecosystems by diversity of stakeholders. Current conservation discourse recognizes the integration of local views and perception of forest Ecosystem Services (ES). This study investigated forest ES their importance to local communities, threats and current and future flow in Mau, Cherangany and Mt. Elgon forest ecosystems. The study collected data using Participatory Rural Appraisal methods to identify the ES. The identified forest ES were ranked in a participatory exercises using weighted ranking method (Pebble Distribution Method (PDM)). Twenty-five ES were identified Water provision ranked the highest with importance value of between 15% - 24% in the 3 ecosystems. Water was also identified as the only ES that will remain important today, and 10 years to come. Main threats were identified as demand for wood products, encroachment and overgrazing. However, future importance value of the ES linked to this threats is predicted to reduce. This paper clearly demonstrates the high value of provisioning services by local communities relative to the other ES categories, which is critical in influencing the behavior of the local people and in enabling incorporation of local values in management plans and policies.

Key words: Ecosystem Services, Importance Value, Livelihoods, Perception

INTRODUCTION

The local perception of Ecosystem Services (ES) values

is key in influencing the behavior of the local people and enabling the incorporation of local values in management plans to ensure sustainable exploitation of the services. This is more so because everyone in the world depends on ecosystems of Earth and the services they provide, with forests providing ecological, economic, social and health benefits (MEA, 2005 and Richards, 2012). Kenya on the other hand is highly dependent on natural resources through the services they provide provisional, ecological, social and cultural services. Provisional services include food, water, raw materials and medicine which have direct economic value. Ecological services include both regulating and supporting functions associated to indirect use social and cultural services such as aesthetic and recreational (Nahuelhual *et al.*, 2007; MEA, 2005). However, severe degradation due to population pressure, expansion of agricultural land, poor governance, climate change, unsustainable land-use practices and lack of appreciation for the critical role of forests in improving human wellbeing have threatened the sustainable provision of goods and services which has subsequently jeopardized the value of ecosystems (FRA, 2000).

Most efforts in conservation have focused more on identifying the most important spots for management as biodiversity surveys. However, the information generated usually has little impact on most decisions which reflect diverse issues. The technical approach to conservation is by involving the most relevant stakeholders in decisions which balance biodiversity conservation and incorporates the values and preferences of stakeholders (Lynam *et al.*, 2006).

In most forest management, the desires and the objectives of forest industry are clear and easily understood by forest managers but local communities' needs and perception "remain veiled" to most outsiders unless a specific effort is made to understand them (Scott, 1998). Understanding stakeholders' knowledge and perception about ES, from different contexts, provides a valuable means of gaining insight into the opportunities and constraints that face ES

*Corresponding author: abdulkyz@yahoo.com

management in a multiuser landscape (Urgenson *et al.*, 2013). Community perception is necessary to facilitate the implementation of strategies aimed at improving the capacity of the poor to draw vital ES from landscapes with communities as potential partners in biodiversity conservation (Guthiga, 2008; Adams & Hulme, 2001). This study identified and determined the perception of local communities towards ES values, the perceived distribution of interests, and threats that might compromise the continued enjoyment of these services.

METHODOLOGY

Study Area

The study was conducted at Mau forest complex, Cherangany forest ecosystem and Mt Elgon forest ecosystem, the 3 major water towers of Kenya (Figure 1).

Mau Complex

Mau Ecosystem (0°30' S, 35°20' E) situated within the Rift Valley Region and encompasses Baringo, Bomet, Keiyo-Marakwet, Kericho, Nakuru, Nandi, and Narok counties, forms the largest closed-canopy montane forest ecosystem in East Africa covering approximately 400,000ha. This ecosystem is the main catchment area for 12 rivers draining into Lake Baringo, Lake Nakuru, Lake Turkana, Lake Natron and the transboundary Lake Victoria (Nabutola, 2010). Mau forest complex is the largest indigenous forest with scattered trees in the plains to shrub land and forests to the hilly uplands. The species diversity has immense sacred and cultural values to forest dwelling indigenous Ogiek community. The complex supports wood based industries and trade and many local communities are dependent on forest resources for livelihoods (Langat *et al.*, 2016; Olang and

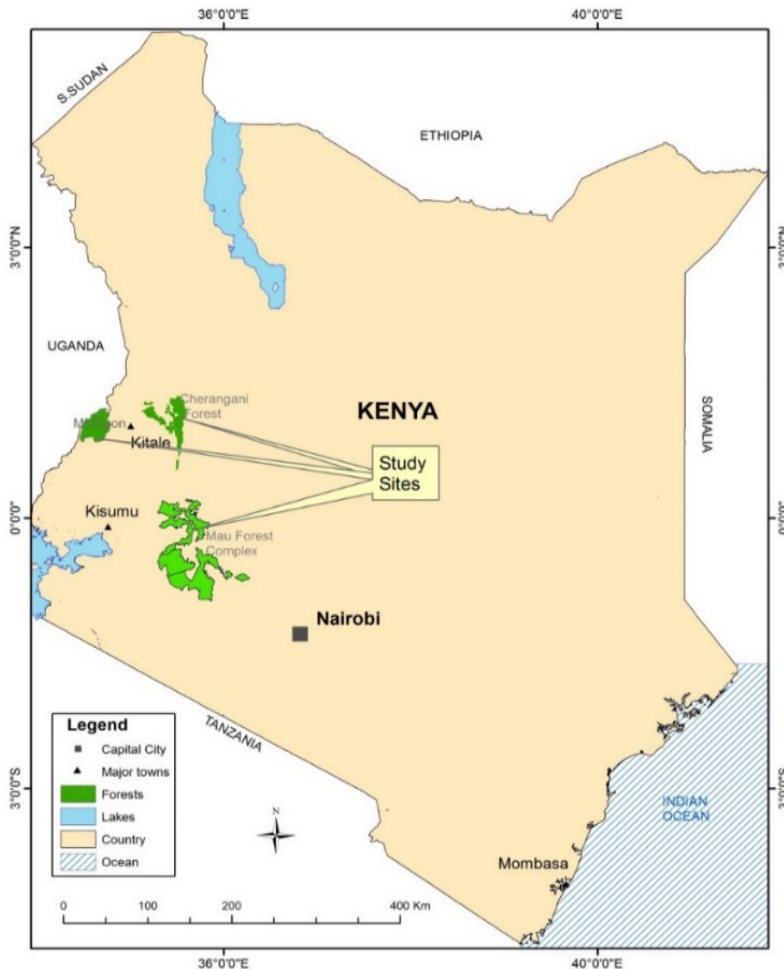


Figure 1. Location of Mau Complex in Rift valley, Cherangany Hills and Mt Elgon ecosystems in western Kenya

Kundu, 2011; Nabutola, 2010)..

Cherangany Forest Ecosystem

Cherangany forest (1°16' N, 35°26' E) is located within an area that is defined at comprises of forest reserves approximately 114,416 ha and constitute Elgeyo/Marakwet, West-Pokot and Trans-Nzoia Counties. It sits between Lake Victoria and Lake Turkana basins which are fed by two major rivers of Nzoia River and Kerio River, respectively. The forest ecosystem is home to diverse flora and fauna with some being endemic such as the *Capysjuliae* butterfly which may attract scientist from across the world (KFS, 2015).

Mount Elgon Ecosystem

Mt Elgon ecosystem (lies between 0°52' and 01°25'N, and 34°14' and 34°44'E) is an extensive trans-boundary resource between Kenya and Uganda and covers 2223 Sq. Km of which 1078 sq. km is on the Kenyan side (KFS, 2015; Kipkoech *et al.*, 2011; SGS Qualifor, 2007). The ecosystem provides biological, aesthetic, tourist, cultural, forest resources, educational, employment and carbon sink values which are significant and could mitigate poverty and likely negative impacts of climate change (SGS Qualifor, 2007). Mt. Elgon ecosystem is a habitat to 37 “globally threatened” species (22 mammals, 2 insects and 13 bird species) and is also home to 9 endemic animals, making the area a priority for species conservation (Makenzi, 2016). Two hundred and forty bird species 67 reptiles, amphibians and 179 species of butterflies are found in Mt Elgon region (Larsen, 1991; Davenport, 1996; Makenzi, 2016).

Despite their significance, the three Water Towers are facing encroachment, overgrazing, forest fires, illegal harvesting and human conflicts, conversion of agricultural land and human settlement challenges (KFS, 2015).

Data Collection

Participatory rural appraisal methods were used in data collection which involved Focus Group Discussions (FGD) and key stakeholder’s meetings with different approaches used to obtain specific data using a prepared checklist.

Key stakeholder’s forums and Expert meetings

Stakeholders were pooled from key government agencies

(Kenya Forest Services, Water Resource Management Authority, Kenya Wildlife Service, water service providers and Universities), County governments (Nakuru, Kericho, Elgeyo Marakwet, Uasin Ngishu, TransNzoia and Bungoma) Private Organisations (saw millers and tea plantations and forest products traders) and Civil Society Organisations (NGOs and Local CBOs). Four meetings were carried out to identify key ecosystem services, contextual issues and threats to the ecosystem.

Community Meeting

Community meetings were held in study sites of Mau (South West Mau), Mt. Elgon (Kaboywo), and Cherangany (Toropket) involving FGD which included local administrators (village elders), Community Forest Association (CFA) officials, Water Resource Users Associations (WRUA) officials, religious leaders, and key community leaders (men, women and youth). In South West Mau, two FGD were held at Chemare and Sotit with 15 and 20 participants, respectively. Whereas, in Cherangany and Mt Elgon FGDs were conducted in Kinnai with 30 participants and in Kaptama with 40 participants. Discussions focused on the history of the ecosystem, products and services as well as seasonal fluctuations and their relative importance to different stakeholders and threats.

Ranking of Ecosystem Services

Identified goods and services were ranked using the weighted ranking method-Pebble Distribution Method (PDM) through focus group discussions (FGD) in community meetings and stakeholder’s forums (Figure 1). The method utilized counters with the approach that the least important service was given one counter and thereafter other goods and services scored relative to that service (Lynam *et al.*, 2006). Community members discussed among themselves as they redistributed counters until consensus was prevailed. This approach was also applied to assess the seasonal availability of ES, levels of threats, and level of benefits received from the ecosystem by various stakeholders. The relative weight assigned to the different ES through the Pebble Distribution Method (PDM) was used to determine the relative importance value (RIV) of each E.S (Lynam *et al.*, 2006).

$$\text{Relative Importance Value (RIV)} = \frac{\text{Relative weight (Counters)}}{\text{Total Weight (Counters)}}$$

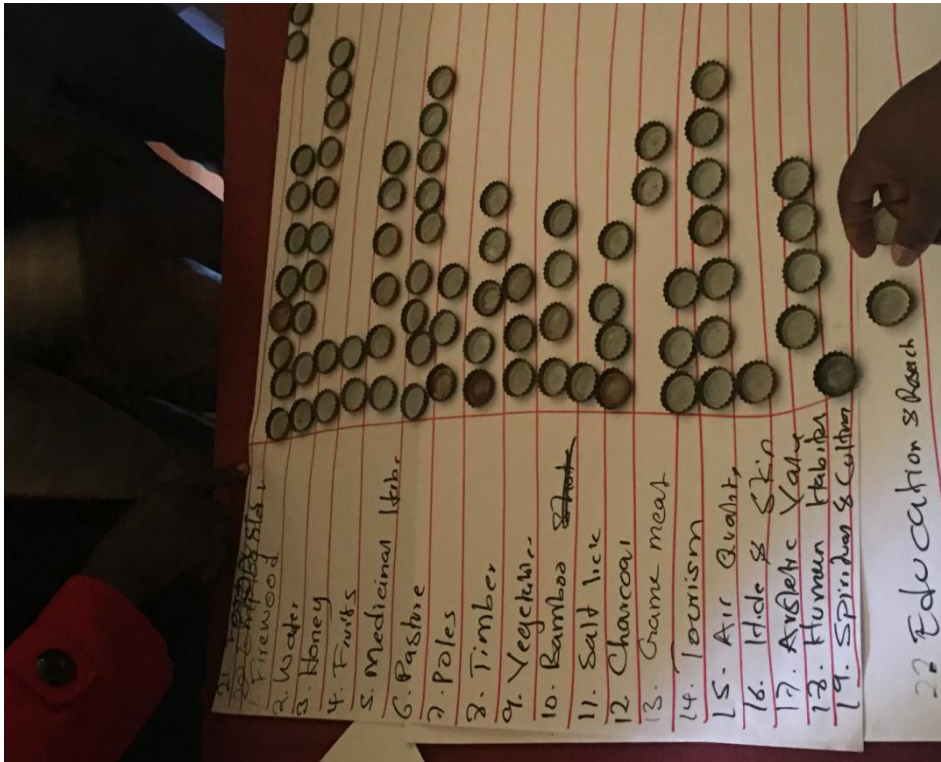


Figure 2. Community members determining the relative importance value of key ES using the Pebble Distribution Method

RESULTS AND DISCUSSIONS

Identification and ranking of ES by local communities

Twenty-five ES were identified across the 3 ecosystems (Table I).

Services perceived to be very important were those of direct use value with water ranked the highest greater than 15 % in the three entire ecosystem, followed closely by firewood and pasture. Maize (*Zea mays* L.) which is a staple food in Kenya was ranked among the most important ES in Mt. Elgon. The Kenya Forest Service has introduced the Plantation Establishment for Livelihood Improvement System (PELIS) where the forest adjacent communities are allocated land in clear felled areas for growing of annual crops for own use. This arrangement benefits both parties (local communities in terms of land for growing food crops and KFS in terms of reducing overhead costs of establishing plantation . ‘Other ES ranking over 5% in more than two ecosystems were medicine, timber, air quality and honey. The perceived importance of provisioning ES is likely due to the fact that these values go into direct household consumption or

directly support other economic activities. The findings are consistent with other studies where provisioning services are usually valued most, although differences are seen on importance of specific ES in different regions (Rodriguez *et al.* 2006).

Furthermore, there was lack of awareness on intricate linkages between household livelihood activities and other intangible values (regulation and supporting functions). Air quality, is valued at more than 6% in Mau and Cherangany ecosystem as compared to the other cultural, supporting and regulating values, which is consistent with a study by Zhang *et al.* (2015). This observations could be attributed to the much heightened awareness on pollution and importance of trees in reducing greenhouse gases from the environment. The fact that the community did not identify most regulating, supportive and cultural values highlighted in the MEA 2005 such as soil formation, nutrient cycling, regulation of disease and pests, pollination and flood regulation means that they do not appreciate these services. This perception can impact negatively against intervention on management of the ecosystem for such services.

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TABLE I - ECOSYSTEM SERVICES AND THEIR RELATIVE IMPORTANCE VALUE TO LOCAL COMMUNITIES IN MT ELGON, CHERANGANY AND MAU.

ES type	Ecosystem Services	Relative Importance Value		
		Mt. Elgon	Cherangany	Mau
Provisioning	Water	0.15	0.20	0.18
	Firewood	0.12	0.14	0.08
	Fodder/Pasture	0.10	0.12	0.08
	Maize	0.08		
	Medicine	0.06	0.10	0.10
	Timber	0.05	0.12	0.03
	Bamboo Shoots	0.04		
	Charcoal	0.04		
	Employment	0.04		
	Poles	0.03		0.06
	Vegetables/Mushrooms	0.03		0.03
	Honey	0.02	0.06	0.06
	Game meat	0.02		0.02
	Salt lick	0.01		
	Hides and skin	0.01		
	Fruits	0.01	0.04	0.03
	Twinning material		0.04	0.03
	Agricultural Tools			0.03
	Thatch grass			0.02
Aggregate		0.81	0.82	0.75
	Tourism	0.03	0.06	0.02
	Aesthetic	0.03		0.06
	Education and research	0.02		
Cultural, education	Cultural/Ceremonial sites	0.01	0.04	0.05
Aggregate		0.09	0.10	0.13
Regulation	Air quality	0.07	0.04	0.06
Supporting	Habitat- Biodiversity	0.03	0.04	0.06
Total		1.00	1.00	1.00

Table II summarizes main products derived from the forest throughout the year. Some products and services such as water, pasture, air quality, habitat- biodiversity, aesthetic value and water flow and air quality regulation are considered equally important throughout the year. Use of forests for cultural purposes occurs in the month of December when traditional initiation ceremonies take place. There is variation in the use of forest for various products and services due to product seasonality (e.g. mushroom, fruits, honey etc.) depending on rainfall patterns and flowering of specific plants and food scarcity on the farms. Forest are an important repository of food and other resources that can play a key role in contributing towards food security (Sunderland, 2011). It was notable that there was enhanced use of forest for game meat during dry months. Firewood was extracted more during the months of July, August, November and December which attract a number of festivities and when family labor is high during school vacations where child labor is utilized by local households for firewood gathering. This is consistent with suggestion by Cooke, (2000) that collection of certain resources such as fuel wood is predominantly undertaken by children and women in most rural communities dependent on environmental resources for their livelihoods.

Though some products were collected throughout the year across the 3 ecosystems, it was noted that extraction was high in some months. Medicinal plants, for example, were found collected more during dry seasons when dust concentrations are high, at the onset of rains and during

maizeflowering which leads to allergies, flu and general sickness due to high concentration of pollen in the air. For fodder, more livestock browse the forest in the dry seasons and during the onset of planting.

Perception of Local Community on distribution of benefits from forest ecosystems.

Five categories of beneficiaries were identified by the community across the three ecosystems. Table III presents the perceived magnitude of benefits appropriated from the three forest ecosystems by various stakeholders. All ES benefit local communities with an exception of tourism in Mau and Mt. Elgon, which was perceived by local communities to be benefiting government and foreigners. In Cherangany, there was established sports tourism and most local and international athletes visit high altitude sports center which have significant impacts on local communities. Tourism in the 2 other ecosystems of Mau and Mt. Elgon was not perceived of importance to local people mainly because most local communities do not perceive any direct linkage between international tourism and their well-being. For a long time, forest conservation has been promoted in official circles as a means of earning foreign exchange and this may have influenced local communities to feel alienated from this benefit. Other products like manure and thatch grass are perceived to exclusively benefit the local people. Furthermore, pasture from Cherangany is perceived to benefit only the local community. The government benefits were in form of revenue from licenses fees and permits while traders on the other hand benefited more from trade.

TABLE II - PRODUCTS AND SERIES DERIVED FROM THE FOREST WITH RESPECT TO MONTHS OF EXTRACTION AND MAGNITUDE (NUMBERS INDICATE RELATIVE WEIGHT OF USE ACROSS MONTHS).

Products/services	Months of the year												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Food crops	Mt Elgon						0.05	0.15	0.10	0.10	0.15	0.20	0.25
	Cherangany	0.40	0.30	0.30									
Timber	Mt Elgon	0.40	0.30	0.30									
	Cherangany	0.10	0.10	0.20						0.10	0.10	0.20	0.20
Bamboo Shoots	Mau	0.15	0.04				0.08	0.08			0.23	0.23	0.19
	Mt Elgon			0.20	0.50	0.30							
Vegetables/ Mushrooms	Mt Elgon	0.10			0.40					0.50			
	Mau				0.40				0.40				0.20
Honey	Mt Elgon		0.70										0.30
	Cherangany	0.20	0.20	0.20							0.10	0.10	0.20
Game Meat	Mau	0.21	0.37	0.29									0.12
	Mt Elgon				0.60				0.40				
Hides and Skin	Mau	0.13	0.37	0.50									
	Mt Elgon				0.40				0.60				
Fruits	Mt Elgon			0.40					0.20				0.40
	Cherangany	0.20	0.20	0.10								0.20	0.30
Medicine	Mau	0.15	0.35	0.15	0.35								
	Cherangany	0.30							0.20			0.10	0.40
Fibre	Cherangany	0.20	0.10	0.10						0.10	0.10	0.20	0.20
	Mau		0.19	0.22	0.11							0.26	0.22
Poles	Mau	0.15	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.31	0.19
	Mt Elgon								1.00				
Tourism	Mau	0.10	0.15	0.25	0.50								
	Mau	0.10			0.25	0.15					0.20	0.30	
Thatch grass	Mau	0.10			0.25	0.15							

TABLE III. ECOSYSTEM SERVICES AND PERCEIVED DISTRIBUTION OF BENEFITS TO STAKEHOLDERS FROM THREE ECOSYSTEMS.						
Products/ Services	Ecosystem	Local people	Saw millers,	Traders	Government	Foreigners
Water	Mt Elgon	0.50		0.10	0.20	0.20
	Cherangany	0.30			0.50	0.20
	Mau	0.57	0.14	0.21	0.07	-
Firewood	Mt Elgon	0.50		0.30	0.20	
	Cherangany	0.66		0.16	0.18	
	Mau	0.60	-	0.20	0.20	-
Charcoal	Mt Elgon	0.40		0.60		
Pasture	Mt Elgon	0.90			0.10	
	Cherangany	1.00				
	Mau	0.50	-	0.33	0.17	
Timber	Mt Elgon	0.15		0.45	0.35	0.05
	Cherangany	0.6		0.06	0.34	
	Mau	0.62	0.15	0.23	-	-
Wild game	Mau	0.54			0.31	0.15
Honey	Cherangany	1.00				
	Mau	0.64		0.36		
Agricultural tools and basketry	Mt Elgon	0.70		0.30		
	Cherangany	0.65		0.35		
	Mau	0.60	-	0.40	-	-
Mushrooms and vegetables	Mt Elgon	0.45		0.55		
	Cherangany	0.50		0.50		
	Mau	0.55	-	0.45	-	-
Twining material	Cherangany	1.00				
	Mau	0.41	0.41	-	0.18	-
Fruits	Cherangany	1.00				
	Mau	1.00				
Medicine	Mt Elgon	0.70		0.15	0.15	
	Cherangany	1.00				
	Mau	0.64	-	0.36	-	-
Air quality	Mt Elgon	0.55		0.15	0.25	0.05
Biodiversity	Cherangany				0.6	0.4
	Mau	0.12	-	0.08	-	-
Cultural sites	Cherangany	1.00				
	Mau	1.00				
Wild break	Mt Elgon	0.60			0.10	0.30
	Cherangany	0.60			0.20	0.20
	Mau	0.30	0.10	0.10	0.30	0.30
Tourism	Mt Elgon				0.4	0.6
	Cherangany	0.26			0.50	0.24
	Mau				0.50	0.50

Perception of threats to forests by local communities

Main threats to the forest were identified and ranked from the most significant to the least significant. Overdependence on the forest, overgrazing due to overstocking, encroachment, pests and diseases, illegal harvesting of forest goods and fire were identified as the most significant threats (Table IV). Poverty was one of the main threats in Mau, yet it was not mentioned in the two other ecosystems but manifestations of poverty (deforestation, illegal harvesting) are highlighted. This could be because poverty is the main underlying cause of overdependence in forest resources as confirmed by Soltani *et al.* (2014). The community characterized by poverty and a long history of forest utilization and highly dependent on forest resources for their livelihood are likely to degrade the forest ecosystem.

TABLE IV. RELATIVE MAGNITUDE OF FOREST ECOSYSTEM THREATS AS PERCEIVED BY LOCAL COMMUNITIES OF MT ELGON, CHERANGANY AND MAU ECOSYSTEM.

Threats	Ecosystem		
	Mt. Elgon	Cherangany	Mau
Fire	0.15		0.03
Encroachment	0.15	0.26	0.07
Illegal Harvesting/ Poaching	0.05		0.15
Poverty			0.08
Pests and Diseases		0.18	0.02
Grazing/overstocking	0.20	0.22	0.02
Charcoal Burning			0.13
Low staffing			0.07
Corruption by government officials			0.03
Perception of Low Value			0.07
Climate change		0.14	0.05
Population growth/ settlements		0.06	0.08
Pollution	0.05		
Deforestation/ overdependence	0.30		
Technology (power saws)			0.02
Demand for wood products	0.30	0.30	0.07
Invasive species	0.20		0.10

Identification and ranking of ES by stakeholders

Key stakeholders held discussions to identify forest ecosystem services (ES) and their relative importance today and in the next 10 years so as to inform on management priorities. Most important ES were weighted 5 with the least important weighted 1. As shown in (Table V) only water supply was identified as most important and will remain as important for the next 10 years in all the ecosystems. Most supportive and regulatory services were perceived as less valuable today but will be more valuable in future due to lack of appreciation of their current value (Table I). Fodder, fuelwood, wood products, timber and agricultural uses are among the ES perceived to reduce in value in the next 10 years. The services / products diminished importance in future is because people are likely to find substitutes for these ES.

CONCLUSION AND RECOMMENDATIONS

The findings of our study have a number of policy implications and therefore, decision making on sustainable management of these ecosystems can be anchored on these derived importance values. Policy makers including county and national government should therefore take full consideration of the spatial and temporal ecosystem service provisioning in national and county integrated development plans. The importance of understanding community dependence on forests when making decisions about natural resource management cannot be overlooked. The ways in which households rely on forests as well as threats to those benefits vary across space and time.

ACKNOWLEDGEMENT

The authors acknowledge the Center for International Forestry Research (CIFOR) in Nairobi and the Kenya Forestry Research Institute (KEFRI) for facilitating and coordinating activities related to this work. They also appreciate the United States Agency for International Development (USAID) for funding the work and to the US Forest Service (USFS)-International Programs for the technical support. Much appreciation goes to the local communities and administrators in Mau, Cherangany, and Mt. Elgon who took part in the surveys. Other agencies and organizations (KFS, KWS, WRMA, WSB, WSP, KWTA) and County government, Civil Societies and private institutions who took part in the survey are equally thanked Mr. Geoffrey Maina (Egerton University) provided georeferenced maps and all other professional and peers in various fields, whose expert opinions informed this study are appreciated.

TABLE V - ECOSYSTEM SERVICES AND THE STAKEHOLDERS' PERCEIVED IMPORTANCE VALUES TO SOCIETY

		Importance (0-5), 5 being the most important					
		Now			Next 10 years		
		Mau	Mt. Elgon	Cherangany	Mau	Mt. Elgon	Cherangany
Provisioning	Fodder	3	3	3	2	3	3
	Food	3	3	3	3	3	3
	Fuelwood	4	4	4	2	3	3
	Water supply	5	5	5	5	5	5
	Hydro power generation	3	0	1	4	1	3
	Medicinal	3	2	2	4	3	3
	Honey Harvesting	5	1	1	5	2	2
	Wood products	4	4	2	4	3	1
	Timber	5	4	4	3	4	4
	Agriculture use (food)	3	5	5	3	4	4
	Biodiversity conservation	5	4	4	5	4	4
Cultural	Tourism and recreation	5	2	2	5	4	4
	Aesthetic	2	2	2	4	3	3
	Cultural and spiritual	3	1	1	2	1	1
	Education and research	3	2	2	4	4	4
Regulating	Air purification	4	4	4	5	4	4
	Regulation of Water Flow	4	4	4	5	5	5
	Climate regulation	3	4	5	5	5	5
	Water Purification	3	2	2	5	5	5
Supporting	Soil conservation	4	4	4	5	5	5
	Pollination	5	3	3	5	4	4

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