

Journal of Ecology and The Natural Environment

Volume 9 Number 10, November 2017

ISSN 2006-9847



*Academic
Journals*

ABOUT JENE

The **Journal of Ecology and the Natural Environment (JENE)** (ISSN 2006-9847) is published Monthly (one volume per year) by Academic Journals.

Journal of Ecology and the Natural Environment (JENE) provides rapid publication (monthly) of articles in all areas of the subject such as biogeochemical cycles, conservation, paleoecology, plant ecology etc.

The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published shortly after acceptance. All articles published in JENE are peer-reviewed.

Contact Us

Editorial Office: jene@academicjournals.org

Help Desk: helpdesk@academicjournals.org

Website: <http://www.academicjournals.org/journal/JENE>

Submit manuscript online <http://ms.academicjournals.me/>

Editors

Dr. Abd El-Latif Hesham

*Genetics Department, Faculty of Agriculture, Assiut University,
Assiut 71516,
Egypt*

Dr. Ahmed Bybordi

East Azarbaijan Research Centre for Agriculture and Natural Resources, Tabriz, Iran

Dr. Sunil Kumar

*Natural Resource Ecology Laboratory,
Colorado State University
1499 Campus Delivery, A204 NESB, Fort Collins,
Colorado-80526,
USA*

Prof. Gianfranco Rizzo

*University of Palermo
Dipartimento DREAM – Viale delle Scienze - Building
9. 90128
Palermo,
Italy*

Dr. Bahman Jabbarian Amiri

*Kiel University, Germany,
Ökologie-Zentrum der CAU
Abt. Hydrologie und Wasserwirtschaft
Olhausen Straße, 75
Kiel,
Germany*

Dr. Bikramjit Sinha

*National Institute of Science Technology and Development Studies,
Pusa Gate, Dr. KS Krishnan Marg, New Delhi 110012,
India*

Prof. Gianfranco Rizzo

*University of Palermo
Dipartimento DREAM – Viale delle Scienze - Building
9. 90128
Palermo,
Italy*

Associate Editors

Dr. Marko Sabovljevic

*Dept. Plant Ecology, Faculty of Biology,
University of Belgrade
Takovska 43, 11000 Belgrade,
Serbia*

Dr. Sime-Ngando Téléphone

*CNRS
LMGE, UMR 6023, Université Blaise Pascal, 63177,
Aubière Cedex
France*

Dr. Bernd Schierwater

*ITZ, Ecology and Evolution, TiHo Hannover
Büenteweg 17d, 30559 Hannover,
Germany*

Dr. Bhattacharyya Pranab

*North-East Institute of Science & Technology
Medicinal, Aromatic & Economic Plant Division,
North-East Institute of Science & Technology,
Jorhat-785006, Assam,
India*

Prof. Marian Petre

*University of Pitesti, Faculty of Sciences
1 Targul din Vale Street, Pitesti, 110040, Arges
County,
Romania.*

Prof. R.C. Sihag

*CCS Haryana Agricultural University
Department of Zoology & Aquaculture, Hisar-125004,
India*

Prof. Kasim Tatic

*School of Economics and Business, University of Sarajevo
Trg oslobođenja 1, 71000 SARAJEVO,
Bosnia and Herzegovina*

Dr. Zuo-Fu Xiang

*Central South University of Forestry & Technology,
498 Shaoshan Nanlu,
Changsha, Hunan, China.*

Editorial Board

Dr. Zuo-Fu Xiang

*Central South University of Forestry & Technology,
498 Shaoshan Nanlu,
Changsha, Hunan, China.*

Dr. Pankaj Sah

*Higher College of Technology, Muscat,
Department of Applied Sciences,
(Applied Biology) Higher College of Technology,
Al-Khuwair, PO Box 74,
PC 133, Muscat
(Sultanate of Oman)*

Dr. Arti Prasad

*Mohan Lal Sukhadia University,
Udaipur, Rajasthan, India.
123, Vidya Nagar, Hiran Magri,
Sector-4, Udaipur, Rajasthan,
India*

Parviz Tarikhi

*Mahdasht Satellite Receiving Station
(Postal): No. 80, 14th Street, Saadat Abad
Avenue, Tehran 1997994313,
Iran*

Bharath Prithiviraj

*Post Doctoral Research Associate
Knight Lab, Dept. of Chemistry &
Biochemistry University of Colorado at
Boulder
USA*

Dr. Melissa Nursey-Bray

*Australian Maritime College, Tasmania,
Australia*

Parvez Rana

*Department of Forestry and Environmental Science
Shahjalal University of Science and Technology
Bangladesh*

Mirza Hasanuzzaman

*Faculty of Agriculture, Sher-e-Bangla
Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207,
Bangladesh*

Dr. Giri Kattel

*Murray Darling Freshwater Research Centre, La
Trobe University
471 Benetook Avenue, Mildura, Victoria 3500,
Australia*

Dr. M. Rufus Kitto

*Faculty of Marine Science-Obhur
station, King Abdulaziz University,
Jeddah 21589, Saudi Arabia*

Dr. Özge Zencir

*Kemah Vocational Training
School, Erzincan University,
Kemah, Erzincan, Turkey.*

Dr. Sahadev Sharma

*Laboratory of Ecology and Systematics,
Graduate School of Engineering and
Science, University of the Ryukyus, Senbaru
59, Nishihara, Okinawa-903-0213 Japan*

Dr. Hasan Kalyoncu

*University of Süleyman Demirel,
Faculty of Art and Science,
Department of Biology,
32100 Isparta/Turkey*

Hammad Khan

*Department of Zoology and Fisheries,
University of Agriculture,
Faisalaad, Pakistan*

Mirza Hasanuzzaman

*Faculty of Agriculture,
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207,
Bangladesh*

Abdurrahman Dunder

*Siirt University, Science and Arts Faculty,
Department of Biology,
56000, Siirt, Turkey*

Meire Cristina Nogueira de Andrade

*College of Agronomic Sciences,
São Paulo State University, Brazil.*

Imran Ahmad Dar

*Dept. of Industries and Earth Sciences,
The Tamil University,
Ocean and Atmospheric Sciences & Technology Cell,
(A Unit of Ministry of Earth Sciences, Govt. of
India).*

S. Jayakumar

*Department of Ecology and Environmental
Sciences,
School of Life Sciences,
Pondicherry University,
Puducherry - 605 014, India*

Umer Farooq

*University of Veterinary & Animal Sciences
Lahore, Pakistan*

ARTICLE

Socioeconomic Factors that determine community participation in forest management and conservation of adjacent ecosystems: A case of Aberdare forest, Kenya

165

Elizabeth W. Wambugu, Gilbert Obati Obwoyere and Bernard K. Kirui

Review

Socioeconomic Factors that determine community participation in forest management and conservation of adjacent ecosystems: A case of Aberdare forest, Kenya

Elizabeth W. Wambugu^{1*}, Gilbert Obati Obwoyere² and Bernard K. Kirui²

¹Kenya Forest Service. P. O. Box 30513 – 00100 Nairobi, Kenya.

²Department of Natural Resources. Egerton University, Faculty of Environment and Resources Development, Egerton University, P. O. Box 536, 20115 Egerton, Kenya.

Received 9 September, 2017; Accepted 13 November, 2017

Forest ecosystems are important to ecological, economic and social wellbeing, particularly for the adjacent communities who depend on it. Understanding the socioeconomic dynamics that make households choice to be involved in forest conservation is crucial for sustainable management of natural resources. This study therefore examined the socioeconomic factors that influenced households' participation in forest management. Multistage probability sampling technique was used to select 202 respondents from households adjacent to Aberdare forest ecosystem. Data collected was analysed using Chi-square test, Spearman's rho correlation and multinomial logistic regression. The factors that influenced participatory forest management included forest management approach ($\chi^2 = 17.551$, $p < 0.001$), distance to the forest reserve ($\chi^2 = 29.071$, $p < 0.001$), distance to the national park ($\chi^2 = 27.303$, $p = 0.008$), gender of household head ($\chi^2 = 10.719$, $p = 0.002$), land tenure ($\chi^2 = 34.313$, $p < 0.001$), sources of income ($\chi^2 = 31.353$, $p < 0.001$) and importance of the forest ecosystem ($\chi^2 = 29.241$, $p < 0.001$). The factors that significantly influenced the regression model were farm size, household size, annual income, forest management approaches (FMA), land tenure, and importance of the forest ecosystem where R^2 was 0.703. The study established that, although the proposition that natural resources need protection from anthropogenic destruction is widely accepted, communities are interested in collaborating with resource managers for long-term resource conservation. This study therefore recommends strategies for harnessing this high interest through broadening the economic benefits base on spur community involvement in conservation, a prerequisite for sustainable forest conservation. These include promotion of agroforestry practices, supporting non-extractive benefits and formation and capacity building of community associations to enhance participation in forest ecosystem management.

Key words: Benefit-cost sharing, economic and non-economic benefits, forest ecosystem, forest management approach, forest reserve, national park, livelihoods.

INTRODUCTION

Forests ecosystems contribute significantly towards the diversification of livelihoods of adjacent communities

through provision of goods and services for their sustenance. This importance has been increasingly recognized from the last three decades (Tesfaye, 2017). It is widely believed that decentralizing the management of natural resources to include the adjacent communities can increase both efficiency and equity (Agrawal and Chhatre, 2006; Hauck et al., 2015). Efficiency increases because there is more local input resulting in better targeted policies and lower transaction costs; and equity and democracy benefits are more likely to accrue to the local communities. Decentralization in many parts of the world has taken many forms ranging from de-concentration to devolution of power (Coulibaly-Lingani et al., 2011; Hersi and Kangalawe, 2016).

The implication of community involvement is often implied in many references using concepts such as Participatory Forest Management (PFM), Joint Forest Management (JFM), Community Forest Management (CFM) and Community Based Forest Management (CBFM) (Robertson and Pratley, 1998; Burgess et al., 2007; Mutune et al., 2015; Hersi and Kangalawe, 2016). These involvement approaches are described as a multi-stakeholder approaches that involve the private sector, institutions and communities in both management activities and benefit sharing.

In Kenya, community involvement in conservation of natural resources is termed as PFM. PFM is defined variously but in this research, it is based on the definition that terms it as “an arrangement where key stakeholders enter into a mutually enforceable agreement that define their respective roles, responsibilities, benefits and authority in the management of defined forest resources” (KFS, 2015). The stakeholders include forest-adjacent communities who rely on forests for their livelihoods and are vulnerable to management changes undertaken without consultations (Mutune et al., 2015; Tesfaye, 2017).

In Kenya, other than the local communities, other stakeholders have clearly defined involvement arrangements in form of leases, licenses and agreements that incorporate or have inbuilt benefit sharing components. For most of the stakeholders, their cost and benefit share is apportioned in the agreements signed in form of prices set for the goods and services traded (Maingi, 2014). The introduction of PFM in Kenya has reportedly improved forest condition and to some extent alleviated poverty (Mogoi et al., 2012; Ogada, 2012; Matiku et al., 2013).

A study of forests and livelihoods in the context of sustainable management requires the understanding of the links and interactions among the resources, users,

and institutions that mediate them (Lise, 2000; Himberg et al., 2009). Therefore to enhance sustainability, the deliberate studying and understanding of the history of human experience and the current interactions with ecosystems is crucial. This requires disaggregation and inclusivity of the local communities through PFM (World Bank, 2004; Musyoki et al., 2013). However, the studies that analyse the impact of PFM on livelihood fail to trace the causal attributes that determine household involvement in PFM (Agrawal and Gupta, 2005; Mogoi et al., 2012; Engida and Mengistu, 2013; Thenya, 2014).

Forest management approaches (FMA) that focus on incorporating local people into forest management need to take cognition that communities are not homogeneous. Thus, any intervention should take into account that unsustainable resource extraction is frequently the result of many decentralized decisions made daily by individuals and households regarding use of forest resources and not the consequence of collective decision-making (Agrawal, 2009; Mwangi et al., 2011).

It is therefore essential to understand the household-level socioeconomic conditions and incentives that make the resource valuable to individual members of the community (Mbairamadji, 2009; Mutune et al., 2015). Mogoi et al. (2012) further recommended that taking into consideration the benefits and costs at the household level are crucial because this is the level where conservation management measures should be undertaken. Hence, this calls for thorough analysis of households' interaction with the forest ecosystems including the benefits they derive from the ecosystem as well as the costs they incur (Engida and Mengistu, 2013; Matiku et al., 2013; Musyoki et al 2013) to ensure sustainable community involvement in the management of forests. In order for community to be adequately involved in PFM, household socioeconomic characteristics play a role not only in the resource usage but also in the preceding decision making process. Understanding the factors that influence community participation in natural resource management activities is crucial to forest resource managers and policy makers (Engida and Mengiste, 2012; Langat et al 2015).

Therefore, this study examined the households' socioeconomic factors (household size, age, gender and educational level of respondents; land tenure and duration, household members engagement in the farm or elsewhere, landholding, sources of household food and income, distance to and interaction with the forest ecosystem, and alternative sources of meeting forest based needs) that influence community involvement in PFM in the area adjacent to Aberdare forest ecosystem

*Corresponding author. E-mail: wambugu_ew@yahoo.com.

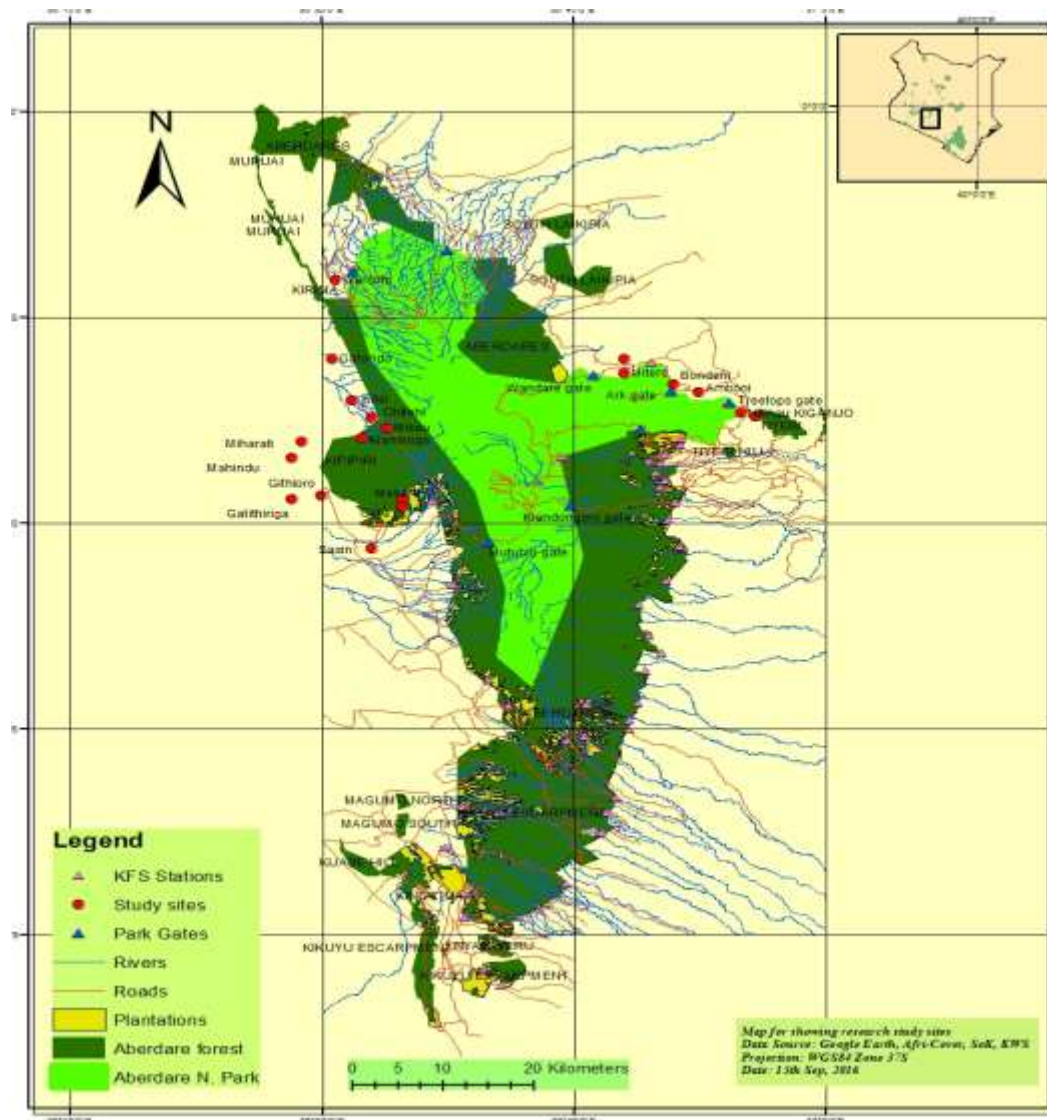


Figure 1. Map of Aberdare Forest Ecosystem showing study sites.
Source: KFS office reports (2016).

The study also aimed at recommending ways to promote community involvement in PFM to enhance natural resource conservation while improving rural livelihoods.

METHODOLOGY

The study area

The study focused on Aberdare Forest which is a unique ecosystem where a Forest Reserve and a National Park extend, and border with farmlands (Figure 1). The ecosystem is one of the five major water towers in Kenya. The forest

ecosystem as used in this study comprised of Aberdare Forest Reserve, Aberdare National Park and adjacent farmlands within a radius of 5 km from the ecosystem boundary. It is located between longitude $36^{\circ} 30' E$ and $36^{\circ} 55' E$ and latitude $0^{\circ} 05' S$ and $0^{\circ} 45' S$. The forest ecosystem is approximately 226,522 ha, whereby the Forest Reserve covers an area of 149,822 ha and the National Park covers 76,700 ha (KFS, 2010). Aberdare forest is adjacent to four administrative counties which are Nyandarua, Nyeri, Murang'a and Kiambu. The study was undertaken within the first two counties, based on the fact that Nyeri is the only county where the National Park shares a common boundary with farmlands, and then it gives way to the Forest Reserve which is in

Table 1. Data on study sites and distribution of the households surveyed.

Forest type	County	Locations	No. of sub-locations	Total no. of households	HH interviewed
Conservation area (forest reserve)	Nyandarua	Wanjohi, Geta, Kipipiri, Kinangop North	12	23,824	115
Protected area (national park)	Nyeri	Mweiga, Endarasha	4	3,246	87
Total	2	6	16	27,070	202

Source: KNBS (2010) and Field Survey (2013).

Nyandarua County. The site in Nyandarua was also one of the oldest sites where PFM was piloted. Thus, this provided forest adjacent populations that were similar in many aspects, main difference being FMA in line with the policies of the managing institutions. The Kenya Forest Service (KFS) manages the area gazetted as Forest Reserve using conservation (allows sustainable extractive use) FMA whereas Kenya Wildlife Service (KWS) manages the National Park using protection (mainly non-extractive use) FMA (Nelson and Chomitz, 2011). The adjacent community depends heavily on the forest ecosystem, and also play a significant role in conservation either as agents of destruction or catalysts of conservation (World Bank, 2005; Rhino Ark, 2011) (Figure 1).

Data collection and analysis

Field research was adopted in this study to provide a comprehensive perspective of the social phenomena in the area (Mugenda and Mugenda, 2003). A three level sampling procedure was employed. First, the forest adjacent area was stratified on the basis of being adjacent to Forest Reserve or National Park. Secondly, the area was stratified on the basis of sub-locations directly adjacent to the forest ecosystem. Thirdly, through systematic random sampling, the sample frame (households) was identified within the selected sub-locations. This involved having a transect walk in the farmlands and selecting the eighth household alternately on either side of the route.

Socioeconomic data was collected using semi-structured and non-scheduled-structured questionnaires which were administered to the selected households. Some of the key issues that were raised included household information (household size, age, gender, educational level, gender of household head, landholding, land productivity, sources of household food and income), and interaction with the forest ecosystem (utilisation of forest products, participation in forest conservation activities, perception of the importance of

forest ecosystem, costs of procuring forest products and alternative sources of meeting forest based needs).

The decision over the total number of respondents selected was influenced by availability of time, financial and physical resources. It was also guided by World Agroforestry Centre procedural guidelines (Nyariki et al., 2005) and Ongugo (2007) for characterization of studies at household level. They suggest that a sample size of 40 to 80 households spread over two or three communities which have populations with similar characteristics and attitudes is adequate to make inferences about a larger population. On the understanding that the forest adjacent populations in the area are similar in many aspects, the survey drew a sample size of 202 households as shown in Table 1.

The quantitative data from the survey was sorted, coded and analysed using the Statistical Package from Social Sciences (SPSS) version 21 and Microsoft Excel 2013. Data were displayed using frequency distribution tables and graphs so as to establish various patterns that characterize the phenomena in the study area (Mugenda and Mugenda, 2003).

Chi Square and Spearman’s correlation were used to test the association and relationship between diverse household socioeconomic factors and PFM. The results obtained were presented in various forms including text, tables, charts and figures. Multinomial logistic regression was used to determine the influence of these attributes on the level of community involvement in PFM. The general regression model applied was:

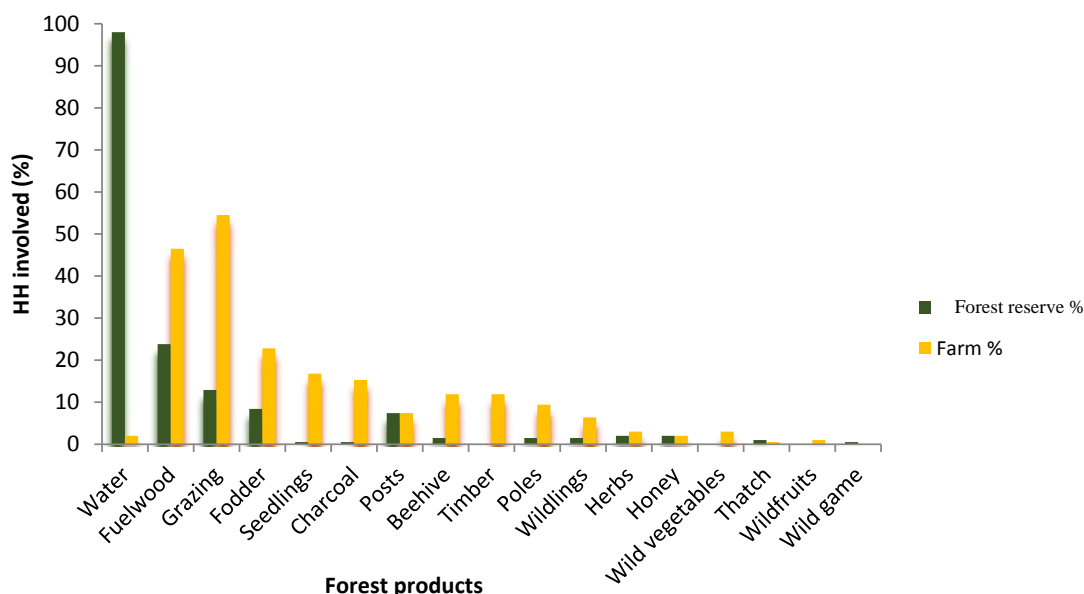
$$Y_i = b_o + bx_1 + bx_2 + bx_3 + \dots + bx_n$$

Where

- Y_i = the i^{th} observed value of PFM
- b_o = intercept
- b = independent variable coefficient
- x_1 to x_n are independent variables

Table 2. Community demographic profile.

Demographic factors	Unit	N	Minimum	Maximum	Mean
Age of respondent	Years	202	21.0	101.0	54.0
Duration of settlement	Years	202	1.0	50.0	32.0
Household size	No	202	1.0	30.0	6.7
HH members working in the farm	No	202	1.0	14.0	2.8
HH with members formally employed	No	44	1.0	6.0	1.5
Distance to Forest Reserve	km	129	1.0	6.0	2.9
Distance to National Park	km	86	1.0	5.0	1.6
Farm sizes	Acres	202	0.03	50.0	3.5
Land renting out	Acres	6	0.25	1.0	0.7
Land renting in	Acres	68	0.25	4.0	1.19

**Figure 2.** Distribution of household relative utilisation of diverse forest products derived from Aberdare forest ecosystem and farmland sources.

RESULTS

Characteristics of survey households

Males comprised 61%, where most (78%) were male-headed and the mean household size was 7 members. In most (52%) of the households, only 1 to 2 members were formally employed elsewhere. The average distances were 2.9 km and 1.6 km to the Forest Reserve and to the National Park respectively. Majority (61%) of the respondents had small farm sizes ranging from 0.3 to 50 acres. The distribution of other demographic factors are presented in Table 2.

Household utilisation of forest products

The results showed that the respondents utilised a wide range of products from the forest ecosystem as well as from the farmlands (Figure 2). The majority (98%) of the households used the forest ecosystem as the main source of water for the most part of the year. Provision of fuelwood and grazing in the forest were viewed as the second (25%) and third (13%) most important respectively. Further, the results indicated that many of the products utilised were acquired from the farmlands

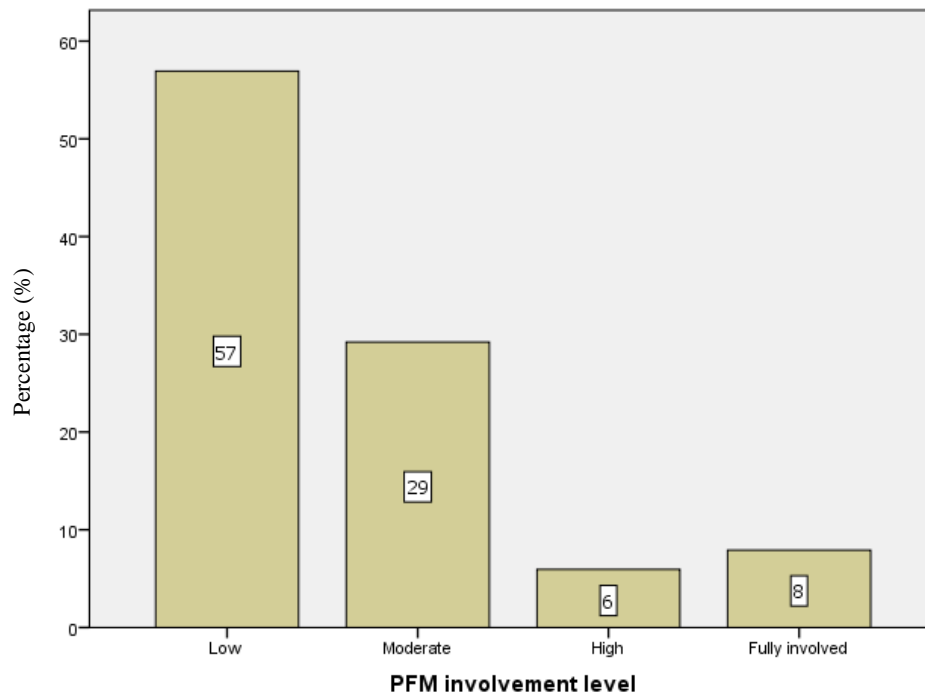


Figure 3. Distribution of household level of involvement in participatory forest management.

Table 3. Relationships and associations between socioeconomic factors and PFM involvement level.

S/N	Factors	Degrees of freedom (df)	Chi-square		Spearman's	
			(χ^2)	p-values	r-values	p-values
1	FMA	3	17.551	0.000	0.191	0.333
2	Distance to FR	15	29.071	0.000	-0.345	0.000**
3	Distance to NP	8	27.303	0.008	0.109	0.007**
4	Gender	3	12.790	0.016	-0.227	0.006**
5	Gender of household head	3	10.719	0.002	-0.162	-0.365
6	Household size	9	15.340	0.028	0.209	0.004**
7	Household members on farm	9	21.277	0.39	0.144	0.081
8	Land tenure	12	34.313	0.000	0.158	0.333
9	Farm size	12	12.803	0.415	-0.112	0.028
10	Land renting	3	14.648	0.008	-0.265	0.004**
12	Sources of income	18	31.553	0.000	0.013	-0.076
13	Household annual income	12	22.571	0.063	0.090	0.001**
17	Importance of Forest Ecosystem	3	29.241	0.000	-0.252	0.008

**Correlation is significant at the 0.01 level (2-tailed).

except for wild game which was solely obtained from the forest.

Household level of involvement in PFM

The respondents indicated they were involved in PFM

within the adjacent forests in different ways which included provision of labour for activities such as tree planting (47%), harvesting of products (50%), policing (25%), firefighting and prevention (41%) and decision making (29%). Although all the households surveyed were involved in PFM, it was largely to a low extent

Table 4. Results of the logistic regression analysis.

Effect	β	Model fitting criteria		Likelihood ratio tests		
		-2 Log likelihood of reduced model	Chi-Square	Degrees of freedom (df)	Significance	
Intercept	10.825	209.696	0.000	0	-	
Farm size	-0.282	220.298	10.603	4	0.031	
Household size	0.308	219.698	10.002	4	0.040	
Household total income	0.000	219.474	9.778	4	0.044	
FMA	-1.386	221.109	11.413	4	0.022	
Gender of Household head	0.64	216.506 ^b	6.810	4	0.146	
Land tenure	-0.317	251.229	41.534	20	0.003	
Household land renting	1.091	220.399	10.704	8	0.219	
Importance of forest ecosystem	0.497	225.785	16.089	4	0.003	
Household socioeconomic status	-0.216	232.253	22.558	16	0.126	
Household income sources	-17.163	236.539	26.843	20	0.140	

$R^2 = 0.703$, $\alpha = 0.05$, $p = 0.05$.

(57%) as only 8% indicated being fully involved (Figure 3).

Association and relationships between socioeconomic factors and household PFM involvement level

The association and relationships between various socioeconomic factors with household PFM involvement revealed that on one hand, there was a negative and significant relationship in relation to the distance to the protected area, gender of respondent, household size, land renting, household annual income and importance of the ecosystem. On the other hand, gender of household head and source of household income had a negative relationship but was not significant. Further, the association between all the socioeconomic factors and PFM involvement level was strong and significant except for the number of household members working on the farm, farm size and household annual income. The results are presented in Table 3.

Influence of socioeconomic factors on household involvement in PFM

Results of the multinomial logistic regression analysis showed that various factors such as farm size, household total income, FMA and economic importance of the forest significantly influenced level of involvement in PFM as shown in Table 4. The Cox and Snell pseudo R^2 was 0.703 showing that the regression model was a good fit for the data ($\alpha = 0.05$, $p < 0.001$) as it predicted 70% of the variance. A strong positive influence was found

between level of involvement in PFM and household size, and economic importance of the forest ecosystem. Conversely, farm size, FMA and land tenure negatively influenced PFM involvement level. The results further depict that gender of the household head, renting of land, socioeconomic statuses and sources of income did not significantly ($p > 0.05$) contribute to the final model.

Regression model

PFM involvement level = 10.825 - 0.282 (Farm size) + 0.308 (Household size) - 1.386 (FMA) - 0.317 (Land tenure) + 0.497 (importance of forest ecosystem)

DISCUSSION

The goods and services that ecosystems provide, and the people who interact with them consist of complex systems that are mostly nonlinear, indeterminate and seldom predictable (Costanza et al., 2014). Therefore to enhance sustainability, understanding the history of human experience and the current interactions with ecosystems is essential.

Community utilisation of forest products

The findings of this study showed that the respondents utilised a wide range of products from the forest ecosystem as well as from the farmlands essentially to meet basic household needs. The reason being attributed to the fact that forest-adjacent communities operate behind a background of limited economic opportunities

(Hauck et al., 2015). The farmers are faced with multiple problems such as scarcity of land, food, biomass and increased land degradation. As such, most of the poor people in rural areas maintain diversified livelihood strategies because they cannot obtain sufficient income from any single strategy and also to reduce risks (World Bank, 2005; Yemiru, 2011). Many small-scale farmers are therefore not solely small agriculturists but they include forest products in their livelihood systems.

The majority (98%) of the households indicated that the forest ecosystem was the most important source of water followed by provision of fuelwood and grazing (Figure 2). Additionally, it was established that for products that were not available in the farmlands like charcoal, game meat and cedar posts, the community obtained them from the forest ecosystem, albeit illegally as also observed by Hersi and Kangalawe (2016) in Tanzania. Thus, the source depended on availability as well as ease of access (Mutune et al., 2015). These findings demonstrate that, for products and services available in the farmlands, communities were tending to shift to on-farm sources. This could be due to the high cost of acquisition in terms of time or high risks involved during illegal acquisition. Further, these findings portray that, if there are no alternative sources of products, the pressure on the ecosystem would continue unabated, efforts of ecosystem managers notwithstanding.

Based on these findings, it can be concluded that the local community place positive values and preferences of the forest for provision of household energy, livestock production and water supply. Water was regarded both as a product and a service to enhance farm productivity. Therefore, to engage the community in PFM, there is need to consider their basic livelihood strategies. This study therefore recommends increased efforts like promotion of agroforestry to make forest products available on the farmlands to reduce pressure on the forest ecosystems and improve community engagement in forest conservation.

Similar studies in Eastern Kenya, Southern Rift and Mt Kenya revealed that local utilisation of local forest resources by the forest adjacent communities is imperative and any action to deny the households from forest utilisation limits their livelihood opportunities (Emerton, 2001, Mogaka 2001; Langat et al., 2016).

Households' level of involvement in PFM

In this study, the community narrated the different ways they were involved in PFM within the adjacent forests. All members participated in PFM, although the majority (57%) of the households were to a low extent (Figure 3). Nonetheless, this demonstrates a high level of awareness and willingness to be involved in PFM which needs to be enhanced.

Consequently, this high interest requires a strategy for harnessing in order to contribute to forest management while addressing livelihood improvement. This can be done through representation of the communities in forest management pursuant to the Forest Conservation and Management Act, 2016 of Kenya, which requires forest adjacent communities to form and register Community Forest Associations (GOK, 2016). Contrary to widely accepted propositions that natural resources need protection from the destructive actions of people (Mogoi et al., 2012; Matiku et al., 2013; Tesfaye, 2017) these findings illustrated that communities are increasingly collaborating with resource managers for long-term resource management

This study established that there was a strong and significant association between FMA and community involvement in PFM (Table 3). That notwithstanding, of those who expressed reported being fully involved, most (86%) were living adjacent to the Forest Reserve. This therefore implies that the high interest in participating in forest management was motivated by some anticipated benefits as has been shown in other studies in Kenya (Musyoki et al., 2013; Langat et al., 2016). Hence, the level of interest is highly correlated with direct benefits that accrue and meet immediate household needs.

The distance to the forest ecosystem had a strong and significant association with PFM but an inverse relationship (Table 3). The households found beyond a radius of 5 km to the forest ecosystem had fewer opportunities of economic benefits regularly streaming to households and consequently depicted low participation. These findings are consistent with Thenya (2014) and Langat et al. (2016) in their studies on PFM implementation experiences in Kenya. The high interest from those living adjacent to the protected area can be elucidated by the fact that farmers are rational being and they look at the cost effectiveness of their activities (Maingi, 2014). Therefore, those living close were willing to participate more in economic activities as well as those activities that reduced human-wildlife conflict compared to those who lived far as they experienced less problems. This suggests that efforts to promote PFM should target mainly the community living about 5 km of the forest ecosystem boundary.

These findings showed that PFM involvement level was significantly associated with both gender of the respondent and household head. This could be explained by the low participation of women, particularly, those in female-headed households. This can be attributed to the fact that women are among the poor households which have inadequate resources including labour leading to inadequate participation (Agrawal, 2009; Mwangi et al., 2011).

Considering that forest adjacent communities engaged in forest activities as a livelihood strategy, women and female-headed households appeared to be

disadvantaged. This requires forest managers to promote a pro-poor, balanced and gender-sensitive approach. In other findings, the poor were reported not to afford subscription fees and levies required to obtain forest products as well as time to attend PFM activities (Thenya, 2014; Mutune et al., 2015). Other studies observe that women have been disadvantaged as exploitation and marketing of wood products as the major product exploited from forests has been the male activity for a long time (Mwangi et al., 2011; Thenya, 2014). Since forests are a source of many other products and services, Mbuvi et al. (2015) observed that the introduction of PFM has led to the exploitation of products that were considered minor such as ecotourism, butterfly farming and honey production some of which surpass timber in value. This research recommends promotion of exploitation of natural resources such as fish farming, beekeeping, tree nurseries and mushroom farming which would allow higher women's participation as well as accrue more benefits from forest.

Additionally, this study recommends development of mechanisms of enhancing benefits based on non-extractive ecosystem services such as payment for environmental services (PES), carbon trade and ecotourism (Everard et al., 2016). This would enhance the ecosystem benefits for both men and women as well communities adjacent to both forest reserve and National park, and hence increase level of participation in conservation of the ecosystem.

There was a positive association and relationship between size of household and level of PFM involvement. This can be explained by the fact that PFM activities are labour intensive and compete with agricultural activities. Therefore, large households could raise adequate labour to undertake both activities whilst smaller households struggled to raise adequate farm labour. This agrees with the findings of Thenya (2014) from Mt Kenya Ecosystem, Mutune et al. (2015) from Sururu and Eburu forest within Mau Complex, and Ogada (2012) from Kakamega forest. This could further be attributed to a higher dependence on forest resources that is associated with large households (World Bank, 2005; Hauck et al., 2015).

There was strong and significant association between land tenure and PFM involvement level but these had an inverse relationship. The households that were resettled by the government or inherited land referred to the forest as "our forest" implying they had a feeling of ownership to the forest rather than feeling it belonged to the government (Lise, 2000; Langat et al., 2015). Hence, although PFM envisages near total community participation, community members with insecure land tenure were inadequately involved hence inclusivity is not adequately achieved (Mogoi et al., 2012).

Some households had inadequate land leading to renting additional land or cultivating in the forest. This had a significant association with PFM involvement as

those renting land showed more interest compared to those who had adequate land. However, the relationship was negative as the larger the farm size, the lower the interest in PFM involvement. This is because those with small farms required the forest for cultivation and collecting wood and non-wood products that were insufficient in their farms (Thenya, 2014; Mbuvi et al., 2015). This implies that PFM is a livelihood strategy for resource challenged households and ways to enhance it necessitates supporting livelihood improvement activities.

However, according to Yemiru (2011), these factors can lead to forest degradation or to positive changes (for example, afforestation, improved forest management, and better technology) depending largely on social structure as extensive migration could lead to deforestation and soil erosion or re-afforestation. These findings also exemplified a strong significant relationship between household level of income and PFM involvement level. This implies that contrary to the common believe that PFM is for the poor households (Mwangi et al., 2011; Mutune et al., 2015), more low income households portrayed low participation compared to the higher income category. The reasons of the apathy could be the unclear benefit sharing mechanisms especially of tangible benefits.

These findings agree with a study conducted in Mfyome, Iringa in Tanzania (Burgess et al., 2007) which showed that while overall revenues from community based forest management (CBFM) had increased dramatically, poorer members of the community who had been highly dependent on open-access harvesting were becoming wage labourers. Since majority of the forest adjacent community members were largely in the poor well-being category, this calls for pro-poor approach to PFM implementation. These observations need to draw attention to the government, researchers and PFM proponents as one of the key objectives of PFM is livelihood improvement, particularly the rural poor. This study, underscores the importance of formulation and implementation of benefit sharing mechanisms to ensure that both the government and citizens of all walks of life meet their constitutional obligations in conservation.

Community perception on the importance of the ecosystem had a strong and significant association with PFM involvement. Additionally, the relationship was inverse where the majority of the community members who stated that they valued the ecosystem for non-economic reasons, indicated low involvement in PFM. The plausible explanation for this could be as explained by Mzee Kagandu.

".... We value the ecosystem more for non-economic reasons because after all, where are those economic goods? We don't get them!"

On the contrary, more of those who valued the ecosystem

for economic reasons showed higher involvement in PFM. This therefore demonstrates the need to increase benefits from the ecosystem that adjacent communities can identify with. This study therefore recommends valuation of both economic and non-economic benefits from forest ecosystems, and developing a benefit sharing mechanisms to positively influence community involvement in conservation.

Influence of socioeconomic factors on community involvement in PFM

Various PFM studies indicate that participation of rural communities in management of protected forests may vary according to socioeconomic and demographic backgrounds of the individuals (Lise, 2000; Mogoi et al., 2012; Engida and Mengistu, 2013; Mutune et al., 2015). Further, individual community member's characteristics may influence decision making on whether or not to participate in PFM.

In this study, farm size had an inverse influence as the probability for high level participation increased with decreasing farm sizes as also observed by Engida and Mengistu (2013) and Tesfaye (2017) both in Ethiopia (Table 4). This could be attributed to the fact that the surveyed sub-locations were densely populated, and thus land hunger was intense. The average farm sizes in the area were relatively small where over 60% had 3 acres or less (Table 2). This prompted the households with small land parcels to increase dependence on the forest and hence the increased involvement in PFM.

These findings have a bearing on claims that some of the proximate causes of forest degradation within the tropical regions are population pressure leading to land hungry small-scale farmers facing an ever increasing demand for food, fodder and fuelwood (Young, 2013). The land tenure also had a negative influence on PFM involvement (Table 4) where those households that had secure land tenure through resettlement by the government or inheritance referred to the forest as "our forest" implying they had a feeling of ownership to the forest rather feeling it belonged to the government (Ongugo et al., 2002). Thus, they were ready to protect and maintain it as provided for in a PFM arrangement.

Similarly, the FMA of the adjacent forest had an inverse relationship with PFM as the households adjacent to the National Park had fewer opportunities for participation. This is because the preservation management approach calls for strict protection and law enforcement by KWS leading to low opportunities for economic benefits streaming to households. With regard to level of economic benefit from forest, a higher level of economic benefits from forests encouraged the community to participate in the management of forest resources as also

illustrated by previous studies (Agrawal and Chhatre, 2006; Mogoi et al., 2012; Hauck et al., 2013; Mutune et al., 2015). Concurrently, Bush et al. (2011) in their study based on different management approaches in Uganda reported that a higher level of forest dependence gave the people a higher stake in its management, leading to a higher level of participation.

In this study, household size was an important determinant of level of participation in PFM as it depicted positive and significant influence. This could be attributed to households' dependency on forest based livelihoods which has been found to be closely related to large households and high population (Coulibaly-Lingani et al., 2011; Thenya, 2014). Hence, as can be expected, large families have a greater demand for forest products such as firewood, food and fodder and thus depend on forest resources to diversify household livelihoods.

The positive and significant influence of economic importance of the forest ecosystem on PFM involvement level was aptly elucidated by Maingi (2014). He observed that forest stakeholders including forest adjacent communities are economic agents who spend the much needed resources in forest management expecting returns from their invested outlays. Most of them look at PFM as an investment arrangement where after participating in a series of outlays expects a comparable series of returns. As elucidated by Himberg et al. (2009), these are critical issues when thinking about efforts to pursue community based approaches to forest management. Any conservation activities planned within and around protected areas require to be designed compensating both the local welfare loss and financial loss to maintain household participation.

In view of the influence of economic benefits on community involvement in PFM, the implementation of PFM especially for those adjacent to the National Park may therefore not be smooth. This is because many issues remain unresolved, such as the transfer of power and resources between the official traditional bureaucracy to community institutions, and the sharing of costs and benefits between KWS and communities. Further, the benefits that accrue from protected areas are not all obvious and may not be divided equitably among the different stakeholders.

This study, underscores the importance of promotion of agroforestry practices in adjacent farmlands, formation and capacity building of community forest associations to enhance their participation in conservation, broadening forest benefits to include non-extractive benefits to raise level of participation, particularly for communities adjacent to National Park, and development and implementation of an equitable benefit-cost sharing mechanisms that satisfactorily provide for a proportionate benefit sharing in line with contributions to ensure that both the government and communities meet their constitutional obligations in conservation.

CONCLUSION AND RECOMMENDATIONS

PFM has an enormous potential for contributions towards the objective of sustainable forest management and livelihood improvement. Since most of the socioeconomic attributes that influenced household involvement in PFM were related to household economic well-being, any arrangement that does not satisfactorily meet this anticipation cannot translate into sustainable forestry. These findings suggest that, in the event of forest returns imbalances, participating stakeholders will attempt to cover their benefit short falls by whichever means whether legal or not leading to forest degradation and deforestation. In conclusion, this study demonstrates that environmental demands as well as environmental supplies are predisposed to diverse household factors, subsequently, simplistic conceptions of the relation between rural households and the environment would certainly be wrong. The fundamental message from this research is that understanding the issue of dependency is critical in designing equitable and effective forest management policies.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGEMENTS

The authors acknowledge all participants in the interviews for providing meaningful information to understand the socio-ecological system of the Aberdare forest ecosystem. We thank Kenya Forest Service for providing an enabling environment for the field work and support from staff. The authors are also grateful for the assistance from Karatina University for partially financing the field work.

REFERENCES

- Agrawal B (2009). Gender and forest conservation: The impact of women's participation in community forest governance. *Ecol. Econ.* 68: 2785-2799.
- Agrawal A, Gupta K (2005). Decentralization and participation: The governance of common pool resources in Nepal's Terai. *World Dev.* 33(7):1101-1114.
- Agrawal A, Chhatre A (2006). Explaining Success on the Commons: Community Forest Governance in the Indian Himalaya. *World Dev.* 34(1):149-166.
- Burgess ND, Butynski, TM, Cordeiro NJ, Doggart NH, Fjeldsa J, Howell KM, Stuart SN (2007). The biological importance of the eastern arc mountains of Tanzania and Kenya. *J. Biol. Cons.* 134(2):209-231.
- Bush G, Hanley N, Rondeau D (2011). Comparing opportunity cost measures of forest conservation in Uganda; implications for assessing the distributional impacts of forest management approaches. University of Sterling. Sterling Economics Discussion Paper 2011-12.
- Costanza R, de Groot R, Sutton P, van der Ploeg S, Anderson SJ, Kubiszewski I, Farber S, Turner RK (2014). Changes in the global value of ecosystem services. *Glob. Env. Change* 26:152-158.
- Coulibaly-Lingani P, Savadogo P, Tigabu M, Oden PC (2011). Factors influencing people's participation in the forest management program in Burkina Faso, West Africa. *For. Pol. Econ.* 13(4):292-302.
- Emerton L (2001). *Valuing the Environment: Case Studies from Kenya.* Africa Wildlife Foundation, Nairobi. 43p
- Engida TE, Mengistu AT (2013). Explaining the Determinants of Community Based Forest Management: Evidence from Alamata, Ethiopia. *Int. J. Comm. Dev.* 1(2): 63-70.
- Everard M, Reed MS, Kenter JO (2016). The ripple effect: Institutionalising pro-environmental values to shift societal norms and behaviours. *Ecosy. Serv.* 21(B):230-240.
- GOK (Government of Kenya) (2016). *Forest Conservation and Management Act.* Government printer. Nairobi, Kenya
- Hersi NAM, Kangelawe RYM (2016). Implication of participatory forest management on Duru-Haitemba and Ufiome Forest reserves and community livelihoods. *J. Ecol. Nat. Environ.* 8(8):115-128.
- Hauck J, Stein C, Schiffer E Vandewalle M (2015). Seeing the forest and the trees: Facilitating participatory network planning in environmental governance. *Glob. Environ. Change.* 35:400-410.
- Himberg N, Omoro I, Pellikka P, Luukkanen O (2009). The benefits and constraints of participation in forest management. The case of Taita Hills, Kenya. *Fennia* 187(1):61-76.
- KFS (Kenya Forest Service) (2015). *Participatory Forest Management Guidelines.* Kenya Forest Service Nairobi, Kenya. P 37.
- Langat D, Maranga EK, Cheboiwo J, Aboud AA (2015). Forest use and dependence by forest adjacent households on East Mau forest ecosystem, Kenya. *J. Agric. Econ. Ext. Rur. Dev.* 3(10):326-337.
- Langat DK, Maranga EK, Aboud AA, Cheboiwo JK (2016). Role of Forest Resources to Local Livelihoods: The Case of East Mau Forest Ecosystem, Kenya. *Int. J. For. Res.* 2016(2016):1-10.
- Lise W (2000). Factors influencing people's participation in forest management in India. *Ecol. Econ.* 34(2000):379-392.
- Maingi D (2014). Equitable cost and benefit sharing – A key to success of Participatory Forest Management. Proceedings of the second National PFM Conference: Enhancing participatory forest management under the devolved governance structure. Kenya Forestry Research Institute, Muguga, Kenya. pp. 119-123.
- Matiku P, Caleb M, Callistus O (2013). *The Impact of Participatory Forest Management on Local Community Livelihoods in the Arabuko-Sokoke Forest, Kenya.* Cons. Soc. 11:112-29
- Mbairamadji J (2009). Ecosystemic forest management approach to ensure forest sustainability and socio-economic development of forest dependent communities: Evidence from Southeast Cameroon. *J. Field Act.* 3:1-8
- Mbui MTE, Musyoki JK, Ayiamba WO, Gichuki JW (2015). Determining the potential for introducing and sustaining participatory forest management: A case study of South Nandi Forest of Western Kenya. *Int. J. of Bio. Cons.* 7(3):190-201.
- Mogaka H, Simons G, Turpie J, Emerton L, Karanja F (2001). Economic aspects of community involvement in sustainable forest management in eastern and southern Africa. Nairobi, IUCN-EARO. P 151
- Mogoi J, Obonyo E, Ongugo P, Oeba V, Mwangi E (2012). Communities, property rights and forest decentralization in Kenya: Early lessons from participatory forestry management. *Cons. Soc.* 10:182-194.
- Mugenda OM, Mugenda AG (2003). *Research Methods. Quantitative and Qualitative Approaches.* Nairobi. African Press for Technology Studies Press.
- Musyoki JK, Mugwe J, Mutundu K, Muchiri M (2013). Factors influencing level of participation of community forest associations in management forests in Kenya. *J. Sust. For.* 35(3):205-216.
- Mwangi E, Meinzen-Dick R, Sun Y (2011). Gender and sustainable forest management in East Africa and Latin America. *Ecol. Soc.* 16(1):17–25.
- Mutune JM, Wahome RG, Mungai DN (2015). Local Participation in

- Community Forest Associations: A Case Study of Sururu and Eburu Forests, Kenya. *Int. J. Afr. Asian Stud.* 13:1-13.
- Nelson E, Mendoza G, Regetz J, Polasky S, Tallis H, Cameron DR, Chan KMA, Daily G, Goldstein J, Kareiva P, Lonsdorf E, Naidoo R, Ricketts TH, Shaw MR (2009). Modeling multiple ecosystem services, biodiversity conservation, commodity production, and trade-offs at landscape scales. *Front. Ecol. Environ.* 7(1):4-11.
- Nyariki DM, Kitalyi A, Wasonga VO, Isae I, Kyagaba E, Lugenja M. (2005). Indigenous Techniques for Assessing and Monitoring Range Resources in East Africa. Occasional Paper No. 2. Nairobi, Kenya: World Agroforestry Centre.
- Ogada MJ (2012). Forest Management Decentralization in Kenya: Effects on Household Farm Forestry Decisions in Kakamega. Regional Strategic Analysis and Knowledge Support System (ReSAKSS-ECA), International Livestock Research Institute, Nairobi, Kenya.
- Ongugo PO (2007). Participatory Forest Management in Kenya: Is there anything for the poor? Proceedings: International Conference on Poverty Reduction and Forests. Bangkok, Thailand. September, 2007.
- Ongugo P, Njuguna J, Obonyo E, Sigu G (2002). *Livelihoods, Natural Resource Entitlements and Protected Areas: The Case of Mt Elgon Forest In Kenya*. In: Proceedings of the 2nd Biennial Meeting of the International Forestry Resources and Institutions (IFRI) Research Network. Kenya Forestry Research Institute (KEFRI). Nairobi, Kenya
- Rhino Ark (2011). Environmental, social and economic assessment of the fencing of the Aberdare Conservation Area. Nairobi, Kenya: Rhino Ark Ltd.
- Robertson A, Pratley J (1998). From farm management to ecosystem management: In: Pratley A, Robertson A (Eds). *Agriculture and the environmental imperative*. CSIRO, Collingwood.
- Tesfaye SS (2017) Assessment of Local Community Perception of and Attitude Towards Participatory Forest Management (PFM) System and Its Implications for Sustainability of Forest Condition and Livelihoods: The Case of Chilimo-Gaji Forest in Dendi District, West Shewa Zone, Oromia, Ethiopia. *J Earth Sci. Clim. Change* 8(382):1-10.
- Thenya T (2014). Forest Based Income Generating Potential (IGP) high community expectations amidst low community transformation; an analysis of PFM implementation between 2005 and 2013. In: Proceedings of the second National PFM Conference: Enhancing participatory forest management under the devolved governance structure. Kenya Forestry Research Institute, Muguga, Kenya. pp. 104-110
- World Bank (2004). *Sustaining forests: a development strategy. Agriculture and rural development*. Washington, DC: World Bank. <http://documents.worldbank.org/curated/en/424531468781760578>
- World Bank (2005). *Livelihoods, Forests, and Conservation in Developing Countries: An Overview*. *World Dev. Rep.* 33(9):1383-1402.
- Yemiru T (2011). *Participatory Forest Management for Sustainable Livelihoods in the Bale Mountains, Southern Ethiopia*. PhD Thesis. Swedish University of Agricultural Sciences, Uppsala.
- Young JC, Jordan A, Searle KR, Butler A, Chapman, D. S., Simmons P, Watt AD (2013). Does stakeholder involvement really benefit biodiversity conservation? *Biol. Cons.* 158:359-370.



Journal of Ecology and The Natural Environment

Related Journals Published by Academic Journals

- *African Journal of Environmental Science and Technology*
- *International Journal of Biodiversity and Conservation*
- *Journal of Yeast and Fungal Research*
- *Journal of Entomology and Nematology*
- *Journal of Evolutionary Biology Research*

academicJournals