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Full length Research paper

Assessment of factors influencing utilization and conservation of forest resources in Kipini Division of Tana Delta District, Kenya

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Forest resource utilization poses a challenge to the balance between fragile ecosystems and impoverished populations. As population increases, the demand for forest resources and the resultant degradation are expected to increase. Many benefits can be derived from conservation initiatives. Yet incidences of destruction by local communities are prevalent. This study examined the factors that influence utilization of forest products and attitudes of households towards conservation. The Logit and Negative binomial models were used for analysis. Descriptive and factor analysis were used to assess the attitudes towards conservation. Data was collected from 150 households in Kipini Division of Tana Delta District, Kenya. Logit model results showed that income, distance to the main road, management regime and occupation of the household head influence use of forest products. Results from Negative Binomial regression showed that intensity of use of forest products is influenced by the management regime, occupation of household head, income and distance to the main road. The results of the descriptive and factor analysis indicated that the local community has negative attitude towards conservation of forests. These findings imply that conservation can be enhanced by creating awareness of forest benefits to the community and training them on energy saving charcoal burners.

Key words: Forest use, intensity, attitudes, conservation, Tana Delta district.

INTRODUCTION

Natural resources form the bulk of resources that are important to many economies of the world in meeting economic and development needs. In these economies the majority of people are poor, they live in the rural areas, and are mainly dependent on agriculture or on natural resources and ecosystem services (World Resources Institute, 2005). The utilization of natural resources as a livelihood strategy is important especially to the communities residing adjacent to these resources (Sumati, 2006). Such communities collect process and/or market various kinds of natural resources either as a predominant activity or as part of a diversified portfolio of livelihood strategies designed to spread and minimize specific risks (Norfolk, 2004).

Forests, among the natural resources, have potentials and limitations for improving human welfare (Angelsen and Wunder, 2003). Forests improve human welfare by providing a range of resources including timber, non-timber forest resources, and recreation. Forests also supplement household income thus providing safety nets (Neumann and Hirsch 2000; Pattanayak and Sills, 2001).

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The poor however tend to destroy the environment by cutting down forests; overgrazing and cultivating marginal lands (World Bank, 2012).

The human activities affect soil nutrient content (Peh *et al*., 2005) which in turn affect tree growth, forest cover, birds and invertebrates (Peh *et al*., 2005; Shahabuddin and Kumar, 2006).

Further, grazing, removal of dead tree branches and dry leaves from the ground alter the nutrient dynamics while constant movement of cattle and humans erode the top soil layer (Belsky and Blumenthal, 2002) and browsing by goats and sheep affect re-growth, reduce perennial cover and increase exotic annual cover (Yates *et al.*, 2001).

There are various management systems that can be used to conserve forests. These approaches take different organizational forms such as centralized management (command and control), where state agencies assume the lead role; decentralized management, where local communities are involved at varying levels; private management where private entities own and manage the resource; and co-management, where the state, local communities, and other actors share management functions, rights, and responsibilities (Meinzen-Dick and Pradhan, 2002; Mburu and Birner, 2007).

In Kenya, the majority of the closed canopy forests (forest reserves) are managed by the Kenya Forest Service (KFS) under the Ministry of Forestry and Wildlife Services.

Some closed canopy forests also known as national parks/ national reserves are managed by the Kenya Wildlife Service (KWS). On the other hand forests under the trust lands are managed by the local county councils in the Ministry of Local Government holding the forests in trust for the local communities. Lastly, there are some forests that are managed by private individuals or organizations under private ownership. These different management regimes have set rules governing forest resource extraction and forest use. In Kipini Division, the conservancy/private regime had the strictest rules governing access and extraction of resources. It did not allow neighbouring communities to extract any products from the forest.

The KFS, on the other hand, allowed communities in the neighbourhood access to the forest and extraction of products. However, the extraction of products was limited to dead tree parts and other non-tree products. Residents can also secure a licence to cut live trees for poles or timber. In the community management regime, however, extraction of forest products was allowed subject to permission from the administrative authorities who in turn usually consult with the community elders before allowing extraction.

Hence, in the first two regimes, a licence is required, while in the community regime consent from authorities was the main requirement.

Problem Statement

FAO (2006) estimated the rate of forest destruction at 13 million hectares per year (for the period 1995-2005) with about 1.6 billion people relying on the forests, to some extent, for their livelihood. However, different forms of extraction may have different levels of impact (Shaanker *et al*., 2004; Shahabuddin and Kumar, 2006). Economies thus employ various resource management strategies in an attempt to address the challenge of balancing resource conservation and utilization.

Forests play many important roles in the ecosystem. They provide direct benefits to communities around them and act as habitat for various plant and animal species. Tana delta forest is one of the most unique forests in Kenya. The forest is home to numerous plants and animal species. It is host to 350 bird species; endangered marine turtles; two endangered primates namely the Tana River Red Colobus and the Crested Mangabey monkey; hippopotamus; elephants and the Nile crocodile. There are also various fish species in the coastal waters and fresh water river and ponds. The forest patches are endowed with mangrove and tropical forests especially along the Tana River. The forests are therefore important to Kenya because they comprise lowland evergreen riverine tropical forest types which are rare in Kenya and even in Africa, due to its biodiversity (Karere *et al*, 2004 and Owino *et al.*, 2008). Further, Witu forest, in Kipini Division has a great potential for eco-tourism. The forest does not exist as one continuous forest block but as several blocks with one main block in Kipini location and several other pocket forests of different sizes in Kilelengwani and Ozi locations. Some of the tourist attractions offered by the forest include birdlife, mollusks, crustacea and crocodiles.

Despite its significance, the Lower Tana River Forest (LTRF) complex currently faces serious threat. Settlement into the forest has increased significantly in the last one decade owing to a number of factors (Okello, 2011). New settlers clear the forest to make way for farming. At the same time the felling of trees for timber, building material, fuel wood and charcoal has increased with the increase in demand for these products (Muoria *et al*., 2002; Luke *et al*, 2005, Owino *et al.,* 2008). The problem is that the resultant conflicts in land use between agriculture and forestry, and the increased extraction and intensity of use of tree products have complicated the conservation of the LTRF complex.

The level of forest use and the degree of reliance on forest products differ across households. The factors that condition a household's reliance on a particular economic activity and on forest products in particular may vary. Past studies (Wells and McShane, 2000; Bawa *et al.*, 2004 and Volker and Waibel, 2010) have pointed out that forest utilization is affected by factor resource endowment of the household, the household's demographic and economic characteristics, and exogenous factors such as

markets, commodity prices and technologies. Hence, understanding the factors that determine household's activity choice and reliance on forest products is essential for both conservation and development-targeted policies. Determining the attributes of a household that are related to dependence on the forest will help predict which households are likely targets for conservation.

RESEARCH METHODOLOGY

Theoretical Framework

In the study area, markets for some of the forest products do not exist and/ or are imperfect; and if they exist, are characterized by high transaction costs. Consider a farm household that makes production and consumption decisions jointly (de Janvry *et al.*, 1991), i.e., whose decisions are non-separable. This means that the household's decisions about production (use of inputs, choice of activities and desired level of production) are affected by the consumption decisions/characteristics (consumer preferences, location and demographic composition). Under these conditions, the household maximizes the utility from consumption of home produced, market and leisure goods subject to a production function and a set of constraints.
Thus, the household's utilitymaximization problem can be expressed in a utility function as:

$$\mathrm{MaxU} = \mathrm{U}(\mathrm{C_a}, \mathrm{C_m}, \mathrm{T_q} - \mathrm{M_i}, \mathrm{H_h} \quad (1)$$

Where; C_a = consumption of home-produced goods,
C_m= consumption of market goods,
T_q = total time available to the household,
M_i = time spent on household production and off-farm wage earning (household labour supply) and
H_h = household characteristics

Subject to production constraint (Equation 2), household's income constraint (Equation 3), household total time constraint (Equation 4), market constraint (Equation 5) and environment constraint (Equation 6) expressed as:

$$Q = f(K, J, A) \quad (2)$$

$$P_m C_m = P_a(f(K, J, A) - C_a) - wJ + wM_i + Y \quad (3)$$

$$\mathrm{T_a} = \mathrm{L_h} + \mathrm{M_i} \quad (4)$$

$$\mathrm{L_h} - \mathrm{M_i} \geq 0 \quad (5)$$

$$\mathrm{C_a} - \mathrm{Q} \geq 0 \quad (6)$$

Where;
Q = the home output of both agricultural crops and forest products with f (.) being assumed to be increasing and concave in all its arguments
J = labour
K =capital
A = other exogenous factors that affect production including property rights, local and national policy and technology among others
P_m = price of market goods,
P_a = market price of home-produced goods,
w = wage rate and
Y= exogenous household income from non-wage and non-farm sources

The Lagrangian (L) equation for this optimization problem is given by:

$$L = U(C_a, C_m, T_a - M_i; H_h) + \lambda[P_a\{f(K, J, A) - C_a\} - wJ + wM_i) + I - P_m C_m] - \quad (7)$$

The first order necessary conditions;

$$\partial L / \partial C^a = \lambda(P_a - \frac{\gamma}{\lambda}) = \lambda P_a - \gamma = 0 \quad (8)$$

$$\partial L / \partial T^j = \lambda(w - \frac{\theta}{\lambda}) = \lambda w - \theta = 0 \quad (9)$$

$$Pa\, \partial f / \partial L = w - \frac{\theta}{\lambda} = 0 \quad (10)$$

In equation 8, the first order necessary conditions shows that the price (Pa) is a function of γ while in equation 9 , the first order necessary conditions shows that wage rate (w) is dependent on θ. This implies that as long as the market environment constraints are binding, market prices (Pa and w) cannot guide household decision-making because their market price is zero or very low in value. Instead the household is guided by shadow prices (shown in parentheses in Equations 8 and 9). Equation 10 also shows that the value of the marginal product of labour is not equal to the market wage rate. Shadow prices reflect the true opportunity cost and benefits. Households will respond to them rather than market prices while making utility-maximizing choices (de Janvry *et al*., 1991). It is the sign of γ/λ and θ/λ that determine the size of shadow prices and the relevant wage which would vary by household depending on whether a household is self-sufficient, net seller or net buyer of a produce or labour (Sadouletandde Janvry, 1995). These variations in prices and wages are caused by transaction costs in buying and selling, household preferences, production technology and access to employment oppor-

tunities. They are therefore included in the production function due to their influence on decision making in this case being maximizing utility of resource use.

Imperfections in the market here imply missing labor or credit markets. Rural labor markets are not completely developed. Although some labor transactions occur, the marginal value product of labor deviates from the market wage, implying that production and consumption decisions are non-separable. The marginal value product of labor is equated to a shadow wage that depends on household characteristics (household size and years of formal education of the household head) and other utility-related variables (collection time, distances to the forest and accessibility of the forest products).

Model Specification: Use of Forest Products

Use of forest products in this study refers to extraction of products from the forests e.g. fuel wood, medicinal herbs and thatching grass. To assess the use of products, respondents were asked whether they obtained any products from the forests in their neighborhoods or not. Therefore the response variable in this case was binary choice that is a "Yes" if the household collected products from the forest and "No" if it did not. The three most commonly used approaches to estimate such binary dependent variable regression models are (1) the linear probability model (LPM), (2) the logit, and (3) the probit. They are applicable in a wide variety of fields (Gujarati, 2004).

The LPM is not used in empirical research because it violates a major rule of probabilities that requires that the sum of the probabilities be equal to unity (Wooldridge, 2002). The logit and probit models, however, guarantee that the estimated probabilities lie between the logical limit of 0 and 1 (Wooldridge, 2002). Hence, the Logit and the probit models are the most frequently used models when the dependent variable is dichotomous (Maddala, 2001; Gujarati, 2004). Gujarati (2004) argues that the Probit and Logit models are quite similar. They generate predicted probabilities that are almost identical. Aldrich and Nelson (1984) indicate that in practice these models yield estimated choice probabilities that differ by less than 0.02.

The main difference between the logit and probit models is in the nature of their distribution which is captured by Cumulative Distribution Function (CDF). Probit has a normal distribution while logit has a logistic distribution which has slightly fatter tails than the normal distribution. The choice of probit versus logit regression therefore depends largely on the distribution assumption one makes. In practice many researchers choose the logit model because of its comparative mathematical simplicity (Kirui, 2011).

In this study, a logistic regression model is used to assess factors affecting the use of forest products by households.

Logistic Regression

Following Maddala (2001), the probability, *p*, that a household uses forest products is given by:

$$P = \frac{e^{z}}{1 + e^{z}} \quad (11)$$

Central to the use of logistic regression is the logit transformation of p given by Z

$$Z = \ln\left(p/1-p\right)^{2} \quad (12)$$

Where;

$$Z = Z\left(f, d, a\right) + \varepsilon \quad (13)$$

Z is a latent variable that takes the value of 1 if the household used forest products and 0 otherwise, ***f*** is a vector of farmer characteristics, ***d*** is a vector of farm level variables, ***a*** is a vector of asset endowment variables, and ε is the stochastic term assumed to have a logistic distribution. The empirical model estimated contains the following variables (letters in parenthesis indicate related category variables from the conceptual model):

1) Farmer specific variables (***f***) = age, gender

2) Farm specific variables (*d*) = distance to the forest from household, household size
and distance to market

3) Asset endowment variables (*a*):

i. Financial asset (income)

ii. Human capital (education)

iii. Social capital (group member)

Based on the above equation, the logistic regression model estimated in implicit functional form becomes;

Use of forest products (Z) = f (lnage, distance from forest, farm size, household size, lnincome, market distance, occupation, education, group membership and regime) + e (14)

Intensity of use of forest products

In order to assess the factors affecting the degree of use of forest products, this study specified the dependent variable as the number of head-loads harvested by a household in 2010/11. It therefore used the Poisson and the negative binomial regression models to isolate the determinants of the degree of use because the dependent variable is a count data variable. These count variable models are suitable for dependent variables that are countably finite. Count data are non-normal and hence are not well estimated by OLS regression (Maddala, 2001). The key models normally used to analyze count data include the Poisson Regression Model (PRM), the Negative Binomial Regression Model

(NBRM), the Zero Inflated Poisson (ZIP) and the Zero Inflated Negative Binomial (ZINB). Poisson and negative binomial regression models are frequently used in estimating models with nonnegative integer dependent variables (Greene, 2008). The ZIP and ZINB regression models are specifically used to account for the frequency of zero counts (i.e. when there are more zeros than would be expected in either a Poisson or Negative Binomial Model). The study identified only few zero counts therefore never warranted the need for ZIP and ZINB. The results of NBRM is discussed in this study since the response variables were nonnegative integers and the Poisson regression model, which was the first stage in analyzing count data, displayed over-dispersion.

Pearson chi-square ratio test (Pearson chi-square divided by degrees of freedom) was conducted to check whether Poisson model fitted the data well. Under this test, under-dispersion or over-dispersion occurs when the ratio is less than 0.8 or greater than 1.2 respectively. In that case, the negative binomial is recommended (Greene, 2008). In this study, the test detected over-dispersion hence negative binomial regression model (NBRM) was applied. NBRM model has the additional advantage in that it relaxes the Poisson regression model's assumption of equivalence of mean and variance.

Following Greene (2008), the negative binomial model is written as:

$$E(y_i|x_i,\varepsilon) = \exp(\alpha + X'\beta + \varepsilon) \quad (15)$$

The model requires that;

$$\text{var}\left(y_i\middle|_{xi}\right) = \left[1 + \alpha\exp\left(X'\beta\right)\right]\exp\left(X'\beta\right) \quad (16)$$

Where *X'* is a vector of explanatory variables similar to those included in the model, the β refers to the variable coefficients and α is the constant.

Hence the estimated NBRM is specified as:

Number of head-loads (Z) = f (lnage, gender of household head, regime, distance from forest, household size, lnincome, occupation, lnfsize, education, group membership) + e (17)

Attitude towards Forest Conservation

To analyse the peoples'attitude towards an issue, two main approaches used include descriptive statistics and inferential statistics. The descriptive statistics includes summing up of the responses and obtaining a scoreorusing the percentage of respondents in a given Likert scale category (Shibia, 2010)or scale averages for the particular question responses (Dolisca *et al.*, 2007 and Rishi , 2007). The second method uses factor analysis (Dolisca *et al.*, 2007). Some studies use a combination of descriptive statistics and inferential approaches (Dolisca *et al*., 2007).

In this study, a combination of descriptive and inferential statistics was used to examine household's attitudes towards conservation. Descriptive statistics (percentages and mean scores) were used to describe respondents' attitude towards forest conservation. On the other hand, factor analysis was used to identify latent dimensions underlying the different variables that measured respondents' attitudes towards conservation. Responses to twelve five-point Likert-type scale items were subjected to a principal component factor analysis with Varimax rotation. The factors were subjected to the Kaiser-Meyer-Oklin and Bartlett's test (KMO and Bartlett's test) to determine the sampling adequacy. According to the test, samples that score above 0.7 are considered reliable for policy-related decision-making while those below 0.7 are considered unreliable. The above procedures were adopted for this study and used to discuss the attitude towards forest conservation.

Data and Variables

This study used data collected from households in Kipini Division of Tana Delta District. The division has three locations namely Kipini, Ozi and Kilelengwani. Each location is further divided into two sub-locations. Each sub-location has several villages of varying household populations.

Multi-stage sampling technique was used to select a representative sample from the population for interviews. First, the three locations were purposively selected. This was because each location represented a different forest management regime. A list of all villages in each location was then obtained with the help of the local administrators.The villages were clustered into two categories based on proximity to the forest. Six of the villages selected were close to the forest (distance of 0-5km) while the other four villages were far from the forest (distance 6-10km). A total of ten villages out of seventy villages were selected. A list of all households in the selected villages was then drawn.

The population sizes of each of the locationswereused to arrive at the number of households interviewed in each location. Hence the study sampled the respondents from the locations using thepopulation proportions.The division statistics based on the 2009 census estimates showed that Kipini location had approximately 4000 households while Kilelengwani location had approximately 2500 households and Ozi location had approximately 400 households. This procedure resulted in 72 households in Kipini location, 48 households in Kilelengwani location and 30 households in Ozi location. Overall 150 respondents/ households were interviewed.

Data was collected in each of the households through personal interviews using a pre-tested questionnaire. The household head or spouse was selected forinterviewin

each case. The data collected included household/ respondent characteristics and location characteristics. From this data the following model variables were obtained:

Use of forest products: this was a binary choice variable (1=a household extracts products from the forest and0=otherwise) that established whether a household collected any products from the forest or not. It covered the period between June 2010 and July 2011.

Age: is a continuous variable and was measured in years. Age was expected to have a negative effect on use of forests considering majority of respondents were in their youthful stage.

*Distance from forest edge:*this was a continuous variable measured in kilometers. The proximity to the forests makes households inherently dependent on them due to accessibility and availability of the resources. Distance from forest affects access to the forest for getting forest products and also increases costs in terms of time spent to walk to the forest and to gather fuel wood and other products in the forest. This might result in a larger proportion of the population of a village using fuel wood from the forest. Distance from the forest edge was expected to negatively influence respondents' decision to use resources.

Land size: this was a continuous variable measured in acres. Land holding is a form of physical capital that a household possesses. It is expected that the likelihood of resource use would be less for households with large tracks of land. Households with more land are likely to have access to farm fuel in the form of crop residue or fallow/unutilized land areas/ area of land under trees or grow trees on their land and therefore they are likely to be less dependent on fuel wood from the forest.

Household size: refers to the number of members in a given household. Household size was expected to positively influence use of forest products. Households with many members are expected to need more fuel wood for cooking and for construction of houses.

Income: this variable forms part of the financial capital owned by a household from all possible income generation sources that they were engaged in including remittances. It was measured as total income earned by household from various sources in a year (June 2010 - July 2011).

Households working in non-farm jobs such as business or salaried employment should depend less on the forest for their income and will consequently need to clear less forest to meet their needs.

When households diversify their income generating activities other than depending on forest products their tendency to rely on forests are likely to decline. This can slow down economic pressure to extract products from forests for sale to support their families; or generate resources that can be used to purchase inputs such as fertilizers; labor saving technologies or investments in activities that promote sustainable practices in natural resources management.

*Distance to market: w*as measured in kilometres. Respondents in villages closer to market places are more likely to allocate labor to the extraction of forest products, such as medicinal herbs, seeds and nuts for sale in the local market. Hence households living close to a market have greater incentives to extract and sell forest products as their income source. Thus market distance was expected to negatively influence the use of forest products.

Education: was measured as the number of years a respondent spent in formal schooling. The number of years of education of a respondent influences their level of understanding and decision making ability. A respondent with more years of formal education is likely to have access to alternative employment opportunities hence reducing the level of dependency on forest due to possibility of access to alternative fuel sources.

Regime: was measured as a categorical variable as earlier defined. The regimes influence the level of resource use through lack of enforcement and ill-defined property rights and corrupt governance structures. Therefore regime was expected to negatively influence use of forest products.

EMPIRICAL RESULTS AND DISCUSSIONS

Descriptive Statistics Results

The results of the descriptive statistics (Table 4.1) show that age of the respondents ranged from 20 to 100 years, with the mean age being 44 years and the mean household size was 4 members (Olunga, 2013). The overall mean of fuelwood head-loads collected was 178 per year and the regime with the largest mean of head-loads was community regime (309 head-loads/year) while that with the lowest mean of head-loads was the KFS regime (112 head-loads). Mean years of formal education was 6.8. Of the interviewed households, 117 (78% percent) were males while 33 (22 percent) were females. Mobile phones were owned by 78 respondents (52 percent).

Distance to the main road was on average, 23.8 kilometers indicating that most households were located in the interior. The mean number of forest benefits known to respondents was about 11. Of the 150 respondents, 125 (83.3 percent) were practicing farming as their main occupation. Results also showed that 72 (48 percent) of the respondents belonged to a group(s) that engage in conservation activities. Household mean income per annum was Ksh. 21814.06. The respondents in the KFS regime had the highest incomes compared to those from the community and Private/ Conservancy regime.

There were significant differences between variable responses in the three regimes with respect to farmer-specific, farm-level and asset endowment characteristics (Olunga, 2013). Specifically, there were significant differ-

Table 4.1 Summary statistics of variables used in the Poisson regressions Model.

Variable	Private		KFS		Community		Overall	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Gender of household head (1=male 0=female)	0.8	0.38	0.7	0.44	0.8	0.4	0.8	0.42
Age of household head (years)	44	11.75	45.1	11.21	41.1	17.65	44	12.71
Household size (count)	4.3	2.15	3.9	1.98	3.7	2.66	4	2.17
Forest benefits known (count)	8.8	3	12.3	5	9.9	5	10.7	5
Group membership (1=Yes, 0=No)	0.6	0.5	0.4	0.5	0.3	0.49	0.5	0.5
Group members with farm forest (count)	0.48	0.5	0.29	0.46	0.19	0.4	0.34	0.48
Total income of household ('000)	27.1	34.0	22.4	33.2	9.5	13.0	21.8	31.5
Total land size (acres)	7.9	4.78	9.6	4.1	5.8	3.63	8.3	4.47
Main occupation of household head	0.9	0.32	0.8	0.41	0.8	0.37	0.8	0.37
Distance from forest (km)	3.3	2.06	4	2.37	1.9	0.58	3.4	2.17
Use forest products (1=Yes, 0=No)	0.5	0.5	0.4	0.49	1	0.2	0.5	0.5
Distance to the market (km)	13.6	6.65	8.3	5.97	1.5	0.51	9	7.03
Distance to main road (km)	28.7	5.18	18.9	5.05	27.3	1.51	23.8	6.62
Education (Years)	6.2	4.21	7.8	3.84	5.4	4.26	6.8	4.14
Quantity of fuelwood head-loads collected per annum ('00)	2.04	3.14	1.12	4.12	3.09	3.66	1.78	3.77
Land under trees (acres)	1.1	1.38	1.4	1.51	1	1.21	1.2	1.42
Own mobile phone (1=Yes, 0=No)	0.5	0.5	0.6	0.49	0.3	0.49	0.5	0.5

Source: Authors' Computation, 2013.

rences in number of forest benefits known to respondents,distance to the main roadand market and ownership of land. When comparisons were made between different regimes, significantdifferences were observed in farm sizes, distance to the main road, the forest and the market, years of education and land ownership among respondents in the conservancy/reserve regime and those from the KFS regime. Significant differences were also observed when the respondents from the community regime and the conservancy regime were compared. These differences were significant in the case of incomes, farm sizes and distances to the market.

Factors Affecting the use of Forest Products

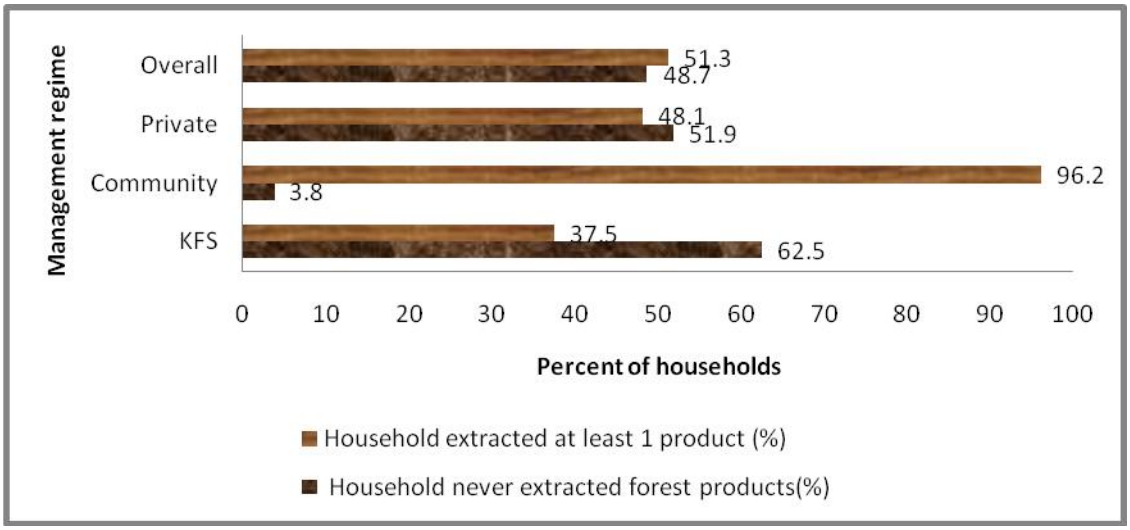
In order to assess the use of forest products by the households, respondents were asked whether they ever extracted products from the forest between June 2010 and July 2011 (Figure 4.1). Although forests were within the reach of most households (from .01km to 10 km distance) only 51% of the Householdssurveyed extracted products from them (Olunga, 2013). The mean number of years for formal education was six among those who extracted products and seven years among non-extractors of forest products.

The use of the forest products differed among the different regimes. The community regime had the highest percent of extractors of forest products (96%) followed by Private (48%) and the KFS regime (38%).

The forest products used by the households were fuel wood, charcoal, poles, medicinal herbs and thatching grass (Table 4.2). Of all the users of forest products, 94% used fuel wood while other products were used by less than 40% of the households. The least extracted product was thatching grass which was used by 5% of the households.

In order to examine factors explaining the use of forest products, a binary dependent variable that takes the value of 1 if the respondent extracted a product from the forest and 0 otherwise was used to fit a logit regression model. The results of the fitted regression model are

Figure 4.1. Use (Extraction) of forest products by households (N=77).



Source: Authors' Computation, 2013.

Table 4.2. Types of forest products extracted by households.

Products extracted	Number of users	Percent among product users
Fuelwood	72	93.5
Charcoal	13	16.9
Medicinal herbs	14	18.2
Poles	27	35.1
Grass	4	5.2

Source: Authors' Computation, 2013.

shown in Table 4.3. The Likelihood Ratio (LR) test statistic shows that the model fitted the data well (p-value = 0.0003).

The results of this study indicate that the prevailing management regime influences use of forest products (Olunga, 2013). Results show that belonging in the Private/ Conservancy regime or KFS regime reduces the likelihood of using forest products other factors constant. The households that are close to the KFS or the conservancy/private forest regime are less likely to use forest products relative to the households in the community regime. These findings show that regime management plays a critical role in determining the decision to use forest products. Indeed, the type of management regime determines the scope of monitoring and enforcement of rules.

The study findings also reveal that there is a negative and significant relationship between distance to main road and likelihood of using forest products. This suggests that the further the distance to the main road, the less likely the use of forest products. Infrastructure is expected to influence the ease of accessing places and facilities such as markets. Therefore, if distances to such facilities are large, the likelihood of extracting forest products for sales may be less.

The results further showed that the main occupation of the household head influences the use of forest products. The households practising farming as the main occupation were more likely to use the forest products than those whose main occupation was non-farm. In addition, the results showed that income influences the use of forest products. Increase in income has positive influence on likelihood of forest product use. This finding is in line with the findings of Hedge and Enters (2000) that indicated that higher income groups utilize more forest resources than the lower income groups when no forest use restrictions are in place. However, it is in contrast with findings of most past studies (Cavendish, 2000; Sanders and Zeller, 2004; Shackleton and Shackleton, 2006; Wambua, 2008) which suggest that as incomes increase the likelihood of dependence on forests declines. The probable reason for the positive relationship is the lack of alternatives for fuel wood in the study area due to remoteness. Households have to cover

Table 4.3Factors affecting the use of forest products: Logistic regression model.

Dependent Variable (1=Use 0=non use)	Coefficient	P-Value	Marginal Effects Coefficient	P-Value
Gender	0.44	0.415	0.08	0.411
Natural logarithm of household size	0.05	0.920	0.01	0.920
Education (Years of formal education)	0.01	0.834	0.00	0.834
Natural logarithm of distance to forest	0.25	0.218	0.05	0.207
Natural logarithm of income	0.09	0.049[b]	0.02	0.043
Natural Log of farm size	0.15	0.708	0.03	0.707
Natural log of distance to main road	-1.57	0.084[c]	-0.29	0.075
Regime				
Private/ Conservancy	-4.07	0.000[a]	-0.46	0.000
KFS	-5.16	0.000[a]	-0.67	0.000
Occupation	1.30	0.032[b]	0.24	0.022
Constant	6.33	0.062		
Number of observations	150			
Wald chi2(9)	32.64			
Prob> chi2	0.0003			
Pseudo R2	0.2306			
Log pseudo-likelihood	-79.9588			

Source: Authors' Computation, 2013.
*Note: p-value significance level **a** refers to 1%, **b** refers to 5% and **c**refers to 10%*

Table 4.4. Determinants of intensity of use of forest products: Poisson and Negative binomial regression results.

Dependent Variable= Quantity of fuelwood head-loads collected	Poisson Regression		Negative Binomial Regression	
	Coefficient	P-value	Coefficient	P-value
Log of age	-0.45	0.106	-0.11	0.739
Gender	-0.28	0.152	-0.19	0.325
Occupation	0.36	0.132	0.72	0.000[a]
Household size	-0.07	0.095	-0.06	0.348
Log of income	0.03	0.044	0.05	0.018[b]
Log of farm size	0.20	0.041	0.12	0.198
Log of collection frequency	0.58	0.000	0.94	0.000[a]
Log of distance to forest	0.27	0.006	0.25	0.089[c]
Regime				
Conservancy/Private	-0.20	0.395	-0.48	0.082[c]
KFS	-0.75	0.003	-0.77	0.003[a]
Constant	4.09	0.000	1.38	0.218
Number of observations	150			
Wald chi2(10)	508.58			
Dispersion	Mean			
Log pseudo-likelihood	-432.19			
Prob> chi2	0.000			
Lnalpha	-0.387			

Source: Authors' Computation, 2013.
*Note: p-value significance level **a** refers to 1%, **b** refers to 5% and **c** refers to 10%*

Table 4.5. Attitude towards forest conservation.

Attitudinal views/Dimensions	Percent of households within the response				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Importance of forest conservation	18	46	2	20	14
Tree nursery mgt and farm forestry	6	20.7	6	54.7	12.7
Methods of fuelwood conservation	5.3	26.7	8.7	50	9.3
Honey production techniques	11.3	46	5.3	34	3.3
Interaction with forest officers	4	38.7	12.7	36	8.7
Community surveillance	7.3	28.7	6	52.7	5.3
Consultations on forest related activities	3.3	34	6	45.3	11.3
Partnerships with other stakeholders	11.3	36.7	9.3	41.3	1.3
Confidence in future user rights	12.7	23.3	18.7	38	7.3
Interest in knowledge acquisition	2.7	3.3	4	74.7	15.3
General support for conservation activities	1.3	9.3	8.7	66.7	14
Labour and monetary contribution	8	28	10	50.7	3.3

Source: Authors' Computation, 2013.

long distances to get kerosene or cooking gas, making use of firewood more attractive.

Intensity of use of ForestProducts among Households

The factors that influence the extent to which households use forest products was assessed by estimating both Poisson and Negative Binomial regression models (Olunga, 2013). The dependent variable was the quantity of fuel wood collected (measured by the number of head-loads). The results of both models are presented in Table 4.4. The mean deviance and the Pearson chi-square ratio (the Pearson chi-square value divided by its degrees of freedom) were used to assess the degree of fit of the Poisson model. The estimated Deviance and Pearson ratios are shown below:

Deviance/df = 4167.773/141= 29.56

Chi-square/df =4382.065/141= 31.08

From these results, both ratios are significantly greater than 1 indicating that there is evidence of over-dispersion. Hence the Poisson model does not fit the data well. Consequently the discussion below is based on the results of negative binomial regression model. The Likelihood Ratio test of the model (NBRM) has a p-value of 0.000 showing that the model fits the data well.

As hypothesized the management regime influences the intensity of use of forest products. The relationship between the regimes and the quantity of forest product used is not only negative but also statistically significant. This implies that the expected number of head-loads of fuel wood decreases by 0.48 and 0.77 for the private and the KFS regimes, respectively. The decrease in expected number of head-loads of fuel wood collected is lower in the private regime probably because of challenges of monitoring the expansive borders by an inadequate number of staff. The hypothesis that management regime does not influence the intensity of use of forest products was therefore rejected. Results also show that household income influences the level of use of forest products. An increase in household income by ten percent increases the expected number of head loads by 5% holding other model variables constant. This result corroborates that of Hedge and Enters (2000) who found that the higher income groups utilize more forest resources than the lower income groups when no forest use restrictions are in place. However as in the case of the binary model results, the findings contradicts those of other studies (Cavendish, 2000;Shackleton and Shackleton, 2006 and Wambua, 2008) which reveal that as incomes increase the likelihood of dependence on forests declines.

Table 4.4 also shows that distance to the forest increases the expected number of head loads of fuel wood collected. Hence, there is higher use of forest products among households that are further away from the forest edge. If the distance to the forest were to increase by a kilometre, the expected number of head-loads would increase by 0.27, holding other factors constant. This finding however contradicts those of other studies on forest products extraction by households (Thapa and Chapman, 2010 and Hedge and Enters, 2000). Their studies found that the closer households are to the forest the greater the probability of extracting products. Fuel wood is a basic need for households and cannot be easily substituted with other sources of energy in remote villages due to distances and costs to access alternatives. Thus households are willing to travel as far as it takes to collect fuel wood. Another possible reason for going to further distances to collect forest resources is that people in that area may not easily identify the residence of people from far. Although the reporting may be done, apprehending the person may not be as easy as a resident whose home is known.

The main occupation of the household head also significantly influences the quantity of fuel wood collected. The expected number of head-loads of fuel

Table 4.6. Results of exploratory factor analysis.

Factor and item description	Factor loading
Factor 1:Education and knowledge on conservation	
We have been educated on importance of forest conservation	.792
We have received training on tree nursery development and farm forests use	.808
We have been informed on use of fuel conservation methods to conserve forests	.794
We are confident of land-use rights in the long term	.639
Factor 2:Interaction and application of knowledge	
We have changed our honey production techniques to minimize tree species losses	.982
There is consultation regarding forest related activities and forest conservation	.981
Factor 3:Social and economic commitment	
There is surveillance between community and forest guards regarding forest use	.629
There is partnership between the community and other stakeholders on forest conservation	.879
Am willing to invest my resources in terms of time and finances to protect forest destruction	.540
Factor 4:Personal initiative	
Am interested in knowing more about what to do regarding forest conservation	.822
Am willing to support conservation practices that will ensure forest protection	.826
Factor 5:Consultation and goal achievement	
We have interaction with forest guards thus conservation is now achievable	.902

Source: Authors' Computation, 2013.

wood collected is higher by 0.72 for households whose main occupation is farming relative to those who have other activities as the main occupation.

Attitude towards Forest Conservation

In order to assess households' attitude towards forests conservation, respondents were asked a series of questions that cover different aspects relating to forest conservation. These were in Likert scale format with the scale ranging from strongly disagree and strongly agree (i.e. on a scale of 1 for strongly disagree to 5 for strongly agree). Points were added from each statement and divided by the highest sum to calculate a score in percentage terms. The mean score of all respondents was 54.07±10.30. If a respondent scored above the mean score then they were considered to have a positive attitude based on the stated scale range 1-5 with 5 being strongly agree (positive statement). For purposes of statistical analysis respondents with neutral and negative attitudes were grouped together. The finding wasthat only 10% of the respondents had a positive attitude and 56% were on the borderline. The results of the analysis of responses to the statement are as shown in Table 4.5 (Olunga, 2013). The results show that 20% of the respondents received some form of education and training on forest conservation and 50% had been educated on fuel wood conservation methods. The communities' time value for conservation activitieswas low. Results also show that 48% of the respondents attended meetings and were enrolled in groups focusing on environmental conservation as also indicated in Table 4.1.

Regarding the stakeholder involvement in forest conservation initiatives and management 41% of the respondents knew about the existence of partnerships between the local communities, the KFS and the NGO's working with farmers within the area while 53% were aware of existence of forest surveillance in the community. Almost one-half (45%) of the respondents indicated that consultations among stakeholders on forest related activities was a positive contributor to forest conservation. However, studies conducted in other countries reveal that, where community members and other stakeholders are involved in environment management, the laid down strategies can be achieved given the local area conditions (Rishi, 2007).

The respondents' personal commitment to forest conservation was also considered in the study. Majority of respondents (75%) expressed their interest in learning about forests conservation. Overall, 67% of the respondents were willing to support efforts to protect the forest and about one-half of the respondents (51%) indi-

cated that they would invest their time and finances in conservation efforts.

Factor analysis was used to identify latent dimensions underlying the different variables that measured respondents' attitudes. Responses to the 12 five-point Likert-type scale items were subjected to principal component factor analysis. Factor analysis was selected to create measurement scales. In order to develop these scales, exploratory factor analysis with Varimax rotation was employed. The objective was to obtain fewer dimensions that reflected the relationships among these inter-related variables. An Eigen-value greater than one rule was applied in identifying the number of factors. The variables that had large loadings on the same factors were grouped together. Factor loadings value of 0.50 and above is normally considered good and significant. The analysis produced a solution with five factors that accounted for 75.2% of the total explained variance as shown in Table 4.6.

The Kaiser's overall measure of sampling adequacy obtained was 0.68, which borders on the recommended threshold of 0.7 suggesting that the data is marginally appropriate for factor analysis.

Four attitude variables concerning education and knowledge of conservation were loaded on factor 1 with the cross-correlation coefficients of 0.792, 0.808, 0.794 and 0.639. This factor accounted for 28.7% of the total variance and was termed 'education and knowledge of conservation' because these variables involve awareness of conservation practices by local people.

Higher scores and positive responses on this factor revealed a general need for promoting education on conservation practices.

Factor 2 had cross-correlation coefficients of 0.982 and 0.981. Because these variables imply application of acquired knowledge and interaction among stakeholders, factor 2 was then labeled 'interaction and knowledge application and accounted for 15.7% of the total variance. Three attributes (namely, surveillance, partnership and investment) were loaded on Factor 3 with cross-correlation coefficients of 0.629, 0.879 and 0.540. These attributes focused on social and economic issues. Hence Factor 3 was termed 'social and economic commitment'. It accounted for 11.4% of the total variance.

Factor 4 had cross correlation coefficients of 0.822 and 0.826 and these variables were labeled 'personal initiative' and it accounted for 10.8% of the total variance and the fifth factor which represented the achievement of the goal on conservation had a cross correlation coefficient of 0.902. It was termed 'consultation and goal achievement' and it accounted for 8.4% of the total variance. The cumulative percent of variance for all the factors explained was 75.2.

The findings on the attitude questions show that majority of the respondents had a negative attitude towards conservation (90%). The findings suggest the need for information on conservation; desire to know more (75%); willingness to support conservation activities (66%), and labour and financial contributions (51%).

CONCLUSIONS AND RECOMMENDATIONS

The purpose for this study was to determine the factors influencing the decision to use forest products and the attitudes of farmers on forest conservation. Regression techniques were used to examine decision to use and the degree of use of forest products. The logit regression model was used to assess the factors influencing the use of forest products whereas negative binomial model was used to examine the factors affecting the intensity of use of forest products.The studyalso used descriptive analysis and exploratory factor analysis to assess the attitudes of households on conservation.The data used was collected through personal interviews using pretested questionnaires from 150 households in Kipini division of Tana Delta district. The area was purposively selected to represent the three existing regimes (i.e KFS, community and private management systems) that govern forest product utilization.

The study found that the factors explaining the use of forest products include household income, distance from the household to the forest, regime and occupation of the households head. The study particularly found that the prevailing management regime had an inverse relationship with the decision to extract products from the forest. The farther a household was from the forest in the KFS or Private regime the lower the likelihood of extraction of forest products. The null hypothesis that prevailing management regime does not influence use of forest products was rejected. The study concluded that prevailing management regime have a significant role in determining extraction of forest products.

The study further found that occupation of the household head, household income, distance from household to the forest and prevailing regime explain the intensity of use of forest products. Specifically, the study found that prevailing management regime had an inverse relationship with the expected number of fuel wood head-loads collected by a household in the KFS and the private regimes compared to the community regime. It was concluded that the type of management system used in the conservation of forests affects the level of forest product utilization by the surrounding community.

The attitude of the community members towards conservation was mostly negative. This finding was contrary to our expectations. It is probably because as results indicate, most household heads do not have education on importance of forest conservation and also did not regularly attend forest conservation meetings organized by local leaders, NGOs and environmental agencies.

The distance to the forest edge was found to be a significant contributor to the use of forest products indi-

cating that households that extract forest products come from far and wide. This finding suggests the need for more effective monitoring and control of forest borders. The number of KFS and KWS ground staff needs to be increased to effectively deal with illegal utilization of the forest. An alternative approach may include community policing and community forest associations using youths to assist with guarding the forest borders.

The majority of households relied on farming as the main occupation which was found to have a significant effect on utilization of forest products. To minimize on the dependence on forests there is need to invest in sensitization and training on commodity value chains which could boost income. Secondly, there is need for provision of accessible credit to households for crop intensification. This will ensure that households have increased food supply and also increased crop residue to use as fuel wood instead of relying on the forests all-year-round as well as reducing expansion of agricultural land into forest demarcated areas.The youth and women development enterprise fund created by the government is a positive approach toward development. However the access of these funds is limited in most cases by lack of awareness by households and bureaucracies. Diversification of activities that can help generate income in the area would also act as an incentive to reduce reliance on forest products.

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