

RESEARCH ARTICLE

Available Online at <http://www.aerjournal.info>

Using Forest Incomes to Improve Rural Livelihood and Reduce Wealth Inequalities in Nandi County, Kenya

J. Sumukwo

Department of Applied Environmental Social Sciences, University of Eldoret, P.O. Box 1125, Eldoret; sumukwoj@gmail.com

Abstract

Non-timber forest products provide a variety of economic benefits to forest-adjacent communities in developing economies. However, the value and significance of forest incomes to rural livelihoods have not been appreciated, as shown in their exclusion from national or/and county income accounting, resulting in incorrect forest management policies and development plans. This paper presents demand-side analysis of the contribution of non-timber forest products' incomes to rural livelihoods in Nandi County, Kenya. Using survey data of 276 households located within a five km radius of Nandi forest, the study examined household income diversification strategies and the income equalizing effects of forest income by applying inverse Simpson index of diversity and Gini coefficient computations, respectively. Results show that forest-fringe households used off-farm and portfolio of forest activities for income diversification. The non-timber forest income had a strong equalizing effect (Gini reduction of 9%), contributing 26% of the household income (average of Ksh. 68,261 per annum) while farm and off-farm incomes contributed Sh.139,147 (53%) and Sh. 55,134 (21%), respectively. Restricting access of the rural poor to non-timber forest products would lead to increased income inequalities with substantial loss to households' welfare. The study recommended that forest management programs, which enhance supply of forest economic benefits to adjacent communities, be an integral component of conservation efforts.

Key Words: Forest Income, Income Diversification, Rural Livelihoods, Non-Timber Forest Products, Kenya

Introduction

Tropical rain forests provide wealth of direct and indirect environmental benefits such as biodiversity conservation, carbon sequestration, hydrological services, cultural services, provision of scenic beauty, (World Bank, 2008) soil erosion arrests (Tisdell, 2005 & Croitoru, 2007) and direct products such as wood, wood *fuel*, fruits and medicinal herbs among others. Rural households in Sub-Saharan Africa have also used forest resources directly to construct diversification programs to generate income and meet other livelihood needs (Dolisca, McDaniel, & Teeter, 2007; Vedeld, *et al.*, 2007; Tesfaye, *et al.*, 2011). Income diversification is defined as the process by

which rural families construct a diverse portfolio of activities in order to survive and improve their living standards (Ellis, 1998). Empirical studies, for example, Cavendish, (2000), Shackleton and Shackleton (2007), Kamanga, Vedeld and Sjaastad (2009), Illukpitiya and Yanagida (2010) and Das, (2010) show that non-timber forest products (NTFPs) contributes approximately 20% to over 50% of total household incomes. In spite of this contribution the value of these forest goods and services has, for many years, been neglected or underestimated and have not been factored in household or national income accounting (Emerton, 1997). In this study, non-timber forest products consists of all biological materials

of forest plants (excluding timber products) that include medicinal plants, foods and fibres, firewood, mushrooms, vegetables, honey and livestock fodder.

The economic impacts of forest products to household income in the rural economy is mainly understood in terms of provision of domestic subsistence and consumption requirements, natural insurance protection from idiosyncratic and covariate shocks (Fisher & Shivey, 2005; Sumukwo, *et al.*, 2013), and direct monetary contribution through sales (Shackleton & Shackleton 2004; Heubach, Wittig, Nuppenau, & Hahn, 2011). We choose to analyze the impacts of forest incomes on rural livelihoods, instead of other environmental incomes, for the following reasons: it has been proven in empirical studies that forest-related income contributes significantly to rural income in many underprivileged and poverty-stricken areas (Cavendish, 2000; Paumgarten & Shackleton, 2009; Babulo, *et al.*, 2009; Illukpitiya *et al.*, 2010; Sumukwo, 2013). Secondly, external effects associated with impacts of forest products pose a great concern to policy makers compared to many other environmental resources; although there is available literature on income from forests than other natural resource sources (Vedeld *et al.*, 2007). Such information is limited in developing countries as environmental resources have no market price. Economic contribution of forest products in developing countries has been under-researched (Shackleton *et al.*, 2006). Presently, the bulk of valuation literature to date has mostly concentrated on tropical forests in Latin America, but there is growing interest in NTFPs valuation in Africa (Turpie, *et al.*, 2003; Croitoru, 2007; Falco, *et al.*, 2010; Heubach *et al.*, 2011). The implementation and efficiency of the present policy instruments for addressing the allocation and extraction of non-timber forest products in Kenya among the adjacent communities is a source of increased concern (Emerton & Tessema, 2001). The continued unsustainable

extraction of these natural resource goods in Kenya shows its sub-optimal allocation.

Kenya national economic survey does not factor economic valuation of forest resources as a policy instrument for enhanced income growth and management of the scarce natural assets in the rural areas (Republic of Kenya, 2010). By ignoring the role of NTFPs in household income, as evidenced by their exclusion in national or county income accounting, policy planners not only distort the economic values of these resources but also send a misleading *information* that whatever is not marketed, or have a market price, does not have economic value and hence *is* not worthy of protection (Delang, 2006). There exist, therefore, substantial gaps in our understanding of the actual functioning of forest incomes in improving rural livelihoods and reduction of wealth disparities due to the fact that conventional household income accounting does not incorporate income from environmental resources (Babulo *et al.*, 2009).

Due to the growing awareness of the importance and value of forest incomes in improving rural livelihoods (Shackleton *et al.* 2007), there is appreciation for the complementary relationship between rural development and conservation of forest resources (Arnold & Pérez 2001, Kamanga *et al.*, 2009). Also, when economic units do not enjoy the benefits from the environment, it creates a perverse incentive structure that encourages unsustainable extraction. But if the economic signals released by forest resources are internalized by households, thereby enhancing income security and poverty reduction, then it provides necessary incentives to also internalize the costs of conservation. Instead where peripheral communities do not enjoy the full benefits of forest ecosystem services they are not motivated to conserve them either (Arnold *et al.*, 2001).

This study evaluates the impacts of forest incomes on rural livelihoods in Nandi County of Kenya. Majority of the residents

of Nandi are smallholder subsistence farmers who depend on one to less than a hectare farm plots for food production and income generation (Republic of Kenya, 2010). Nandi has poverty rates of over 46% as reported by the National Well-Being Statistics of 2010 (Republic of Kenya, 2011) and therefore the residents may use various forest products and environmental services for livelihood improvements. This paper attempts to examine the effects of non-timber forest products' income to rural livelihoods in Nandi County. The specific objectives include examining households' income diversification strategies, evaluating forest income dependency, and finally to determine income equalizing effect of forest products among the households in Nandi.

Materials and Methods

Conceptual Model

Economic valuation of environmental and natural resource goods is based on

$$X_{ij} = \alpha_0 + \alpha_1(X_{1i}) + \alpha_2(X_{2i}) + \alpha_3(X_{3i}) + \alpha_4(X_{4i}) + \alpha_5(X_{5i}) + \alpha_6(X_{6i}) + \alpha_7(X_{7i}) + \varepsilon_i \quad (i)$$

Where: X_{ij} is random utility valuation of forest goods in Kenya Shillings, (X_{1i}) is off-farm income, (X_{2i}) is household head education level, (X_{3i}) is the index of diversification, (X_{4i}) is the number of cattle owned by the household, (X_{5i}) is the household farmland size, (X_{6i}) is the household proximity to the forest (measured in km from homestead), (X_{7i}) is the years lived in the village, β_{is} are parameters not known but are to be estimated and ε_i is the stochastic term.

Description of the Study Area

The study was conducted among Kenya's rural households living adjacent to Nandi Forest Reserve in Nandi County. Nandi forest, located about 320 km west of Nairobi, is among Kenya's few remaining

consumer theory in which people are presumed to be motivated by utility maximization of goods and services (Sumukwo, Kiptui & Cheserek, 2012). The valuation of non-timber forest products is founded on the assumption that the management improvements is a normal good which can be expressed as arguments in a well-behaved utility functions (Perman *et al.*, 2003). This study uses random utility model based on consumer utility maximization where forest-adjacent households choose to extract forest products as means of diversifying portfolio of income activities. Dependency on forest income, as revealed in willingness to pay for the forest goods in the market place, is a function of several factors that can be expressed mathematically as:

tropical forests and is an extension of the Kakamega forest. The Nandi forest of about 38,000 hectares was designated a national forest reserve in 1936 as part of the government's forest conservation efforts and is surrounded by a densely populated agricultural landscape with over 430 inhabitants per km² (Republic of Kenya, 2011). The dominant livelihood sources in the area are rain-fed crop production, forest-related activities and animal husbandry. The main agriculture activities being tea growing, maize, beans, potatoes, horticultural crops, fruit trees, bananas, irish potatoes, sugarcane and pyrethrum production. Livestock husbandry in the region ranges from cattle over medium-sized livestock (cows, goats, sheep) to poultry (chicken & guinea fowls). Forest-related activities include extraction of firewood, building materials and non-timber forest products like livestock fodder, medicinal plants, and edible fruits (Babulo *et al.*, 2009). Other income sources are wage earnings, and business activities, both

formal and informal. It is estimated that over 60% of the region's household incomes are from the agriculture sector (Republic of Kenya, 2009).

Methods of Data Collection, Empirical Design and Sampling Method

A survey design was constructed to solicit household responses to income diversification strategies, forest resource use and the valuation of non-timber forest products in Nandi County. A pre-testing of the survey instrument was conducted among 40 randomly selected households prior to implementation of the survey and then the questions were adjusted accordingly. A structured questionnaire survey was carried out in twenty-four villages adjacent to the Nandi forest. The selection of the villages was based on their proximity to the forest from information provided by Chiefs of six locations in periphery of the forest. The villages are, on average, within a five kilometre radius of the forest edge as indicated in other studies such as Cavendish, 2000; Shackleton *et al.*, 2007; Kamanga *et al.*, 2009; Illukpitiya *et al.*, 2010 and Das, 2010.

In order to get samples representative of the population sample, the 2009 national census survey data was used to list all households in the study area in which a total of 276 households was chosen representing 16% of the household population of the selected villages. In order to provide every household within the research area equal chance of being interviewed sampling was done in two levels: multi-stage stratified sampling and systematic random sampling. The survey was done between January and April 2011. Secondary data was extracted from various published materials. Individual household heads were interviewed on local forest resource management.

In this study, the questionnaire survey was the main instrument used for the collection of household data. There was a general introduction of the study to the respondents on the intentions of this research. The

questionnaire design was structured as follows:

1. Socio-economic characteristics that included; household income level, farmland size, age, proximity of forest from homestead, gender, educational level, main occupation, number of livestock owned and household size.
2. The forest dependency information. The questions on income level, land size and distance to the forest were structured to encourage confidence in responding to the questions because some people take such issues as sensitive to be revealed. Formal or regular household income (exclusive of forest income) is the aggregate of total farm and off-farm incomes or the income from portfolio of activities that are formal in the sense of national income accounting. Forest income is income from non-timber forest resources and is calculated separately from off-farm incomes. Information on income from the major farm activities, that is agricultural production and animal husbandry, was collected.

Measuring Index of Diversification

In this study, a diversity variable, for diversification levels of income, was constructed from households' main income sources, namely; off-farm income, farm income, and non-timber forest product income. An inverse Simpson index of diversity was used (Hill, 1973) as applied by Valdivia, Duhn, & Jette, (1996), Illukpitiya *et al.* (2010) and Heubach *et al.* (2011):

$$\text{Index of Diversity} = \frac{1}{\sum_{i=1}^N P_i^2}, \text{ where}$$

$$\sum_{i=1}^N P_i^2 = \left(\frac{Y_1}{Y_T}\right)^2 + \left(\frac{Y_2}{Y_T}\right)^2 + \left(\frac{Y_3}{Y_T}\right)^2 \tag{ii}$$

N represents the number of household income sources; P_i is the proportion of household income from activity (i); the income source (Y_1) is off-farm income, Y_2 represents on-farm income, Y_3 is income from non-timber forest products and Y_T is the aggregate household income from all the sources. The diversification index is affected both by the income sources and the distribution of income between the different sources (Valdivia *et al.*, 1996). The inverse index help to understand the effective income sources used in diversification in which the squared term allows for non-linearity. A diversity index of 1 means there is no diversification at all. A diversity index close to the number of income sources (3) indicates a more uniformly distributed income from each of the sources.

Gini Coefficient of Income Inequality

Gini coefficients, which measure income inequality distributions, for household income were calculated to examine the equalizing effects of non-timber forest income among the households in Nandi. A Gini coefficient was first computed for the total household income as defined directly by Deaton (1997), instead of deriving from the Lorenz curve, as applied by Heubach *et al.* (2011). The forest income was deducted and a new Gini coefficient was calculated (Mamo, Sjaastad, & Vedeld 2007). The two coefficients were compared to determine the NTFP equalizing effect on income distribution across the households. In this analysis, the Gini coefficient was defined following Deaton (1997) as;

$$Y = \frac{N + 1}{N - 1} - \frac{2}{N(N - 1)\mu} \left(\sum_{i=1}^n P_i X_i\right) \tag{iii}$$

Where Y = a measure of Gini coefficient; μ = population average income; and P_i = income rank p of person i with income X.

In order to satisfy the transfer principle, which effectively gives higher weight to households with lower income in the income distribution, the measured inequality should decrease when income is shifted from the higher to lower income. The households were given the original order of income ranks, a weighted ranking was done where the highest income household was ranked as 1 and the lowest income (or the poorest) household ranked N (Heubach *et al.*, 2011). It was expected that forest income would reduce income inequalities between the rural households as in, Vedeld’s *et al.*, 2007, Kamanga’s *et al.*, 2009, Das’, 2010 and Heubach’s *et al.* (2011).

Techniques of Data Analysis

All the completed questionnaires were collated before being subjected to analysis. Responses to questions were coded and entered into the Statistical Package for Social Scientists (SPSS) spreadsheet 17.0 to facilitate creation of statistics. Descriptive statistics were computed in order to explain the mean, median, standard deviation, ranges of the data and frequency distributions. The analyzed data was presented in form of tables, graphs, equations and figures. Some selected variables were used in the multivariate analysis. In this, the relationship between the dependent variable, willingness to pay, and the explanatory variables were examined where an Ordinary Least Squares (OLS) regression was used for estimating the parameters in the multiple regression model.

Results and Discussion

Socio-Economic Characteristics of the Respondents

After eliminating, missing or inconsistent answers to economic valuation questions 276 (98%) responses were considered valid representative sample for Nandi households' population. Table 1 reports the descriptive statistics with the key socio-economic characteristics of the households. Results of the study show that the gender distribution of the samples was 65% females and 35% males. About 78% of the

respondents had primary education (eight or less years in school) and below while only 9% of the respondents had tertiary education. The age ranged between 25 years to 56 years and above. The average number of years the household heads have lived on their farms is 30 years, showing that the respondents could make relatively middle to long-term investments like livestock grazing in forest and beekeeping. The Table 1 below summarizes the descriptive characteristics of the households.

Table 1. Summary of Socio-Economic Characteristics of the Households

| Variable | | Percent |
|------------------------------------|---------------------|---------|
| Gender: | Female | 65 |
| | Male | 35 |
| Age: | 25 Years and below | 6 |
| | 26-40 | 32 |
| | 41-55 | 35 |
| | 56 and above | 28 |
| Occupation: | Formal employment | 6 |
| | Business man/woman | 21 |
| | Farmer | 100 |
| | Casual Work | 14 |
| Education: | No formal schooling | 18 |
| | Primary school | 60 |
| | Secondary school | 13 |
| | College and above | 9 |
| Land size distribution (in acres): | 0.1 – 2.4 | (46) |
| | 2.5 – 9 | (48) |
| | 10 and above | (6) |

The households in Nandi are small-scale farmers (100% of respondents) basically depending on small-scale rain-fed farming for subsistence. Other income generating activities were like business (21% of households), formal employment (6%) and casual work (14%). Farm and off-farm income sources are mostly contributed by tea (51% of farm income) and salaried employment (52% of off-farm income) respectively. Even though the dominant farming crops are maize and tea, these farmers also depend on forest for their livelihoods. Nandi, generally, receives a bimodal rainfall pattern which peaks between April to July and September to November.

Importance of Forest Incomes to Household Income

Non-timber forest products in Nandi contributed an average KSh. 68,261 per annum which translates to 26% of total household income, farm income *being* Sh. 139,147 (53%) and other sources of income *being* Sh. 55,134 (21%). This indicates that although farm income is the major income source, non-timber forest products contributes a significant amount to the residents adjacent to Nandi forest. This shows that forest products, although not appreciated in conventional national income statistics, contributes to domestic incomes and thus reducing poverty rates. These results are corroborated by the findings of Heubach *et al.* (2011) and Babulo *et al.*

(2009). Figure 1 illustrates the per capita income distribution.

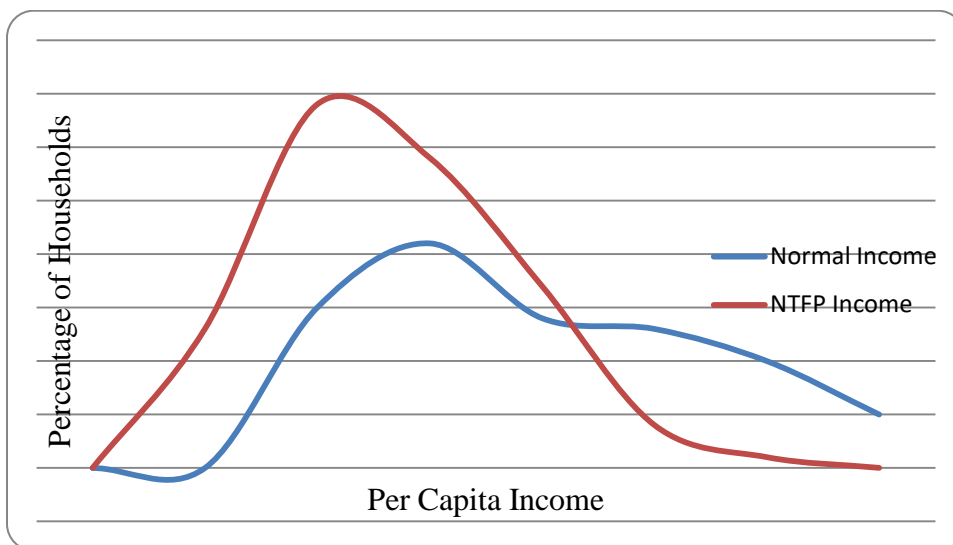


Figure 1. Per Capita Distribution of NTFP and Normal Incomes in South Nandi

From Figure 1, most of the households earn less than a dollar a day from the regular (normal) income and non-timber forest income. The average household formal income (both farm and off-farm) per annum was Sh. 234,658 translating into Sh. 93 a person per day. While this amount may look impressive for rural households but the distribution of this income shows that only 30% earned above average and most (70%) of the respondents earned below the average.

The main forest activities are firewood collection, livestock pasture support, harvesting herbal medicinal plants, and vegetables picking. The average household income from livestock pasture was Sh. 40,811 per annum which is 58% of total forest income. A chi-square (χ^2) results show that only livestock pasture (6.45, $p < 0.01$) is independently extracted from the forest while the other NTFP activities are dependent on each other or other NTFPs to be extracted. This means that most residents are not grazing their livestock in the forest just as a result of engaging in other forest activities but as a way of diversifying

income. Most (58%) of the forest access trips were made for firewood collection, livestock pasture (27%), water (11%), medicinal plants (2.4%) and vegetables (1.5%). Even though respondents make more forest trips to extract firewood for domestic use than for livestock pasture, its' income is four times less. The reason for this is that firewood is mainly extracted for domestic use and not for commercial reasons. Demand for medicinal plants is revealed by its contribution to forest income (13%) with an average of Sh. 9,689 per annum in revenues to these households. Hence, with increased population growth rates of 2.9% per year (Republic of Kenya, 2010), demand for forest goods is likely to increase leading to unsustainable resources extraction.

Income Diversification

A diversification variable was constructed using the inverse Simpson index of diversity (Hill, 1973) in order to understand the effective income sources used in household diversification. Findings show that majority (81%) of the respondents diversified their income sources as a coping strategy in the

face of unpredictable consumer prices, weather variability and anticipated future domestic needs. The three main sources that were considered to determine household income diversification are: off-farm income, farm income and forest incomes. Off-farm income refers to incomes from private business, wages and other incomes outside farm and non-timber forest incomes. Farm income includes income that emanate from crop and livestock production. Forest income consists of incomes from non-timber forest products. Results (t-values in the parenthesis) of the effects of the three main household diversifications strategies are:

$$\text{DIVERSIFICATION} = 1.984 + 0.321 \text{ OFF-FARM} - 0.460 \text{ FARM} + 0.380 \text{ FOREST INCOME}$$

$$(49.314) \quad (3.740) \quad (-5.362) \quad (6.825)$$

$$F \text{ value} = 21.263, \text{ and } R^2 (\text{adj.}) = 0.587.$$

Results show that off-farm income had a positive and strong statistical effect on income of diversification. This means that off-farm income is not associated with reduced diversification of household income sources among residents of Nandi. The strong ($p < 0.05$, 3.470) effect of off-farm income on diversification can be interpreted to mean that it is due to the inconsistencies of the flow of off-farm income activities combined with lack of rural entrepreneurial skills which makes this income source as an instrument of diversification strategy and not a dependable income portfolio. It also indicates that households with off-farm income sources consider these sources unstable and unreliable economic activities to be depended on as the only domestic source of income.

Farm income, on the other hand, had an inverse effect on level of diversification. Thus, the statistical evidence indicates that more farm income reduces income diversification strategies among the households. With better agricultural productivity the farmers would rather invest in more crop and livestock farming. This may be due to uncertainty about

government policy on forest income extraction and the sustainability of this income source.

Forest income exhibited a positive and significant effect on diversification. This indicates that the higher the income from forest sources, the more likely the household is to diversify income. The influence may be due to rural low household income levels so that people use the forest resources as means of diversification to reduce consumption and income risks. That is, non-timber forest incomes are an important diversification strategy and therefore, revealing the importance of forest income to the households. Households using forest products had higher levels of diversification than those involved in off-farm income levels indicating that people prefer to diversify more their income in forest activities than diversifying off-farm enterprises. This means that returns from forest sources are likely to be greater.

Role of Forest Income on Income Inequality

Kenya's household total national Gini coefficient in the rural areas is about 0.55 (Chune, 2003 & Githinji, 2000). To explore the effects of forest income on the spread of income in Nandi, a Gini coefficient, which shows the level of income inequality, was first computed for total household income. Thereafter, a Gini was calculated for household inclusive of forest income. Before the inclusion of forest income, inequality was 0.52 but when forest product income is included in the total household income the Gini value dropped to 0.43, indicating considerable reduction in inequality between households. This means that forest incomes contributed to income equalizing effect among the rural households in Nandi. Hence, forest incomes can be an important instrument for gapping income inequalities among the rural communities of Nandi.

Determinants of Forest Income Dependency

In analyzing the determinants of forest income dependency relative forest income was used. Table 2 presents results for the analysis of forest incomes determinants.

Table 2. NTFPs Dependency Regression Model

| Explanatory Variable | Coefficient | Standard Error | t-value | Significance |
|-----------------------------|--------------------|-----------------------|----------------|---------------------|
| Constant | - | 0.068 | 3.581 | 0.000 |
| Off-Farm | -0.490 | 0.000 | -4.190 | 0.000 |
| Education | -0.273 | 0.025 | -5.379 | 0.000 |
| Index of Income Diversity | 0.378 | 0.015 | 3.874 | 0.000 |
| Number of Cattle | 0.270 | 0.014 | 3.474 | 0.005 |
| Land-size | -0.227 | 0.010 | -3.241 | 0.001 |
| Proximity to forest | -0.292 | 0.004 | -3.45 | 0.000 |
| Years in Village | -0.130 | 0.011 | -1.683 | 0.078 |

Notes: N = 276; R² = 0.532; R² Adjusted = 0.581; F = 20.6, 3.23

Formal education level of household head had an expected negative and statistically significant effect on NTFPs dependency. This is because more education increases access to wider income opportunities. As expected, off-farm income had an inverse and significant effect on forest dependency, indicating that increased off-farm income among the households reduced forest dependency. The reason for this is that other sources of income enhances household wealth opportunity and increases opportunity costs of NTFPs extraction, leading to reduced extraction of forest products. The distance of the forest from the household homestead displayed a negative and significant relationship with forest resource dependency, meaning that the likelihood of household depending on NTFPs significantly reduces with increased distance from the forest edge.

Land size had an inverse and statistically significant effect on NTFPs dependency. The size of the household farmland directly influences agricultural production. With increased farm income people are likely to decrease extraction of non-timber forest products. This is confirmed by the negative effect of farm income on index of diversification (see section on Income Diversification). Index of income diversification had a positive and significant influence on NTFP dependency. The positive relationship indicated that

households with more diverse income sources were likely to depend on the NTFPs, hence, forest income represents an extra source of income. These findings are concomitant with that of Vedeld *et al.* (2007), although the findings of Coulibaly-Lingani Tigabu, Savadogo, Oden, and Ouadba . (2009), Illukpitiya *et al.* (2010) and Heubach *et al.* (2011) demonstrated an inverse relationship, meaning that greater diversity lessens forest dependency.

As expected the number of household cattle had a positively and significant effect on NTFPs dependency. The livestock pasture contributed the highest amount (58%) of forest income, which means that increased number of cattle was likely to cause greater dependency on the forest resources. Heubach *et al.* (2011) also reported a positive and significant relationship between the number of cattle and NTFP dependency.

Conclusions and Policy

Recommendations

Non-timber forest products provide a variety of economic benefits to forest-adjacent communities in developing economies. Forest products provide domestic subsistence and consumption requirements, natural insurance protection and direct monetary contribution to households in the rural economy. However, the value and significance of forest incomes to rural livelihoods have not been

appreciated, as shown in their exclusion from *the* national and county income accounting, resulting in incorrect forest management policies and development plans. Forest resources have also been directly used by rural households in Sub-Saharan Africa to construct diversification programs to generate income and meet other livelihood needs.

These findings show that forest incomes significantly contribute to improved household incomes and alleviate poverty in Nandi. This computation further demonstrates the essential gain of forest resource extraction to people whose income opportunities are limited and insecure. In analyzing the effects of forest income on distribution of wealth in the area, a Gini coefficient analysis indicated that forest income had a significant (Gini reduced by 0.9 points) equalization effect on rural household incomes. In other words, forest income reduced income disparities between households by an index of about 9%. This shows that forest income can be an economic instrument of bridging income disparities and alleviating poverty among surrounding communities. An implication of this is that public undertakings that intend to reduce income disparities in the study area should include the forest sector development.

The positive effect of off-farm and forest incomes on diversification index means that these income activities are important in household portfolio of diversification strategies. Since farm income had inverse effect on the level of diversification policies that target improved farm incomes, it is important to reduce income shocks that would otherwise increase overreliance on forest resources. Pro-poor approaches, like enhancement of entrepreneurial skills that focus on increased product values of forest resources, can be developed for better off-farm incomes. Improved rural incomes, and hence reduced poverty, hinges on how forest-based activities and off-farm businesses are maintained coevally with

efficient agricultural productivity interventions.

In the forest dependency model the explanatory variables, namely; off-farm income, formal education, index of income diversity, number of household cattle, farmland size and forest proximity all had statistically significant effects on NTFPs dependency. The negative influence of off-farm income on non-timber forest products dependency implies that contributions of this income portfolio to household income need to be encouraged to reduce the dependency while allowing the extreme poor and vulnerable to extract forest resources. Policy makers need to design policies that encourage creation of employment opportunities that increase opportunity costs of non-timber forest products extraction. Formal education had a negative effect on forest dependency, indicating that the less educated were more likely to be reliant on the local forest goods. Hence, there is need of improving rural education standards by encouraging more children to attend schools. Good education not only enhances income opportunities but also improve agricultural efficiency which ultimately will reduce dependency on forest products.

As mentioned earlier, the rural poor of Nandi depend on forest products for their livelihoods and hence the contribution of forest products to household income, domestic sustenance and diversification strategies cannot be underestimated. Any policy changes that affect access to the forest products will have a significant impact in household incomes. Therefore inordinate restrictions of the rural poor to access forest goods would impact negatively the peoples' welfare, especially income inequalities and poverty exacerbation. The study recommended that forest management programs that enhance supply of forest economic benefits to *the* adjacent communities be an integral component of conservation efforts.

References

- Arnold, J. E., & Pérez, M. R. (2001). Can non-timber forest products match tropical forest conservation and development objectives? *Ecological Economics* 39, 437-447.
- Babulo, B., Muys, B., Nega, F., Tollens, E., Nyssen, J., Deckers, J., & Mathijs, E. (2009). The economic contribution of forest use to rural livelihoods in Tigray, Northern Ethiopia. *Forest Policy and Economics* 11, 109-117.
- Cavendish, W. (2000). Empirical irregularities in the poverty- environment relationship of rural households: evidence from Zimbabwe. *World Development* 28, 1979-2003.
- Chune, N. C. (2003). Highlights of current labour market conditions in Kenya. Global Policy Network. Downloaded from <http://www.globalpolicynetwork.org>, on 30th July, 2011.
- CIFOR. (2011). Forests and non-timber forest products. CIFOR fact sheets. <http://www.cifor.cgiar.org/publications/corporate/factsheet/NTFP.htm2011>. Accessed in July, 2011.
- Coulibaly-Lingani, P., Tigabu, M., Savadogo, P., Oden, P. C., & Ouadba, J. M. (2009). Determinants of access to forest products in southern Burkina Faso. *Forest Policy and Economics* 11, 516-524.
- Croitoru, L. (2007). Valuing the non-timber forest products in the Mediterranean region. *Ecological Economics* 63, 768-775.
- Das, N. (2010). Incidence of forest income on reduction of inequality: evidence from dependent household in milieu of joint forest management. *Ecological Economics* 69, 1617-1625.
- Deaton, A. (1997). The analysis of household surveys: a micro-econometric approach to development policy/Angus Deaton. Published for the World Bank [by] Johns Hopkins University Press, Baltimore, MD.
- Delang, C. O. (2006). Not just minor forest products: The economic rationale for the consumption of wild food plants by subsistence farmers. *Ecological Economics* 59, 64-73.
- Dolisca, F., McDaniel, J. M., & Teeter, L. D. (2007). Farmers' perceptions towards forests: A case study from Haiti. *Forest Policy and Economics* 9, 704-712.
- Ellis, F. (1998). Household strategies and rural livelihood diversification, *Journal of Development Studies* 35, 1-38.
- Emerton, L. (1997). Valuing household use of non-timber forest products. In Crafter, S.A., Awimbo, J., & Broekhoven, A. J. (ed.) 1997: Non-Timber Forest Products. Value, use and management issues in Africa, including example from Latin America. *International Union for Conservation of Nature and Natural Resources*.
- Emerton, L., & Tessema, Y. (2001). Economic constraints to the management of marine protected areas: the case of Kisite Marine National Park and Mpunguti Marine Reserve, Kenya. IUCN Eastern Africa, Nairobi, Kenya.
- Falco, S. D., Bezabih, M., & Yesuf, M. (2010). Seeds for livelihood: Crop biodiversity and food production in Ethiopia. *Ecological Economics* 69, 1695-1702.
- Fisher, M., & Shively, G. (2005). Can income programs reduce tropical forest pressure? Income shocks and forest use in Malawi. *World Development*, 33(7), 1115-1128.
- Githinji, M. (2000). Income distribution and dualism: The Case of Kenya. *Review of Development Economics*, 4(3), 326-339.
- Heubach, K., Wittig, R., Nuppenau, E. A., & Hahn, K. (2011). The economic importance of non-timber products (NTFPs) for livelihood maintenance of rural West African Communities: A case study from Northern Benin. *Ecological Economics* 70, 1991-2001.
- Hill, M., (1973). Diversity and evenness: a unifying notation and its consequences. *Ecology* 54, 427-432.
- Illukpitiya, P., & Yanagida, J. F. (2010). Farming Vs Forests: Trade-off between agriculture and the extraction of non-timber forest products. *Ecological Economics* 69, 1952-1963.
- Kamanga, P., Vedeld, P., & Sjaastad, E. (2009). Forest incomes and rural livelihoods in Chiradzulu District, Malawi. *Ecological Economics* 69, 613 – 624.
- Mamo, G., Sjaastad, E., & Vedeld, P. (2007). Economic dependence on forest resources: A case from Dendi District, Ethiopia. *Forest Policy and Economics* 9, 916-927.
- Mutenje, M. J., Ortmann, G. F., & Ferrer, S. R. D. (2011). Management of non-timber

- forestry products extraction: local institutions, ecological knowledge and market structure in South Eastern Zimbabwe. *Ecological Economics* 70, 454-461.
- Paumgarten, F., & Shackleton, C. M. (2009). Wealth differentiation in household use and trade in non-timber products in South Africa. *Ecological Economics* 68, 2950-2959.
- Perman, R., Ma, Y., McGilvray, J., & Common, M – 3rd ed. (2003). *Natural Resource and Environmental Economics*. Pearson Education Limited. Harlow, England.
- Republic of Kenya (2009). Nandi South District Development Plan 2008-2012.
- Republic of Kenya (2010). Basic report on well-being in Kenya. Based on Kenya Integrated Household Budget Survey- 2008/2009. Kenya National Bureau of Statistics.
- Republic of Kenya (2011). Basic Report on Well-Being in Kenya. Based on Kenya Integrated Household Budget Survey-2009/2011. Kenya National Bureau of Statistics.
- Shackleton, C. M., Shackleton, S. E., Buiten, E., & Bird, N. (2007). The importance of dry woodlands and forests in rural livelihoods and poverty alleviation in South Africa. *Forest Policy and Economics* 9, 558-577.
- Shackleton, C. M., & Shackleton, S. E. (2006). Household wealth status and natural resources in the Kat River Valley, South Africa. *Ecological Economics* 57, 306-317.
- Shackleton, C., & Shackleton, S. (2004). The importance of non-timber forest products in rural livelihood security and as safety nets: A review of evidence from South Africa. *South African Journal of Science* 100, 658-664.
- Sumukwo, J., Adano, W. R., Kiptui, M., Cheserek, G. J., & Kipkoech, A. K. (2013). Valuation of natural insurance demand for non-timber forest products in South Nandi, Kenya. *Journal of Emerging Issues in Economics and Management Sciences*. 4 (1), 89-97.
- Sumukwo, J. (2013). A comparative analysis of random utility model and contingent valuation estimates of non-timber forest products' income in South Nandi, Kenya. University of Eldoret, Eldoret, Kenya. PhD Thesis. Unpublished.
- Sumukwo, J., Kiptui, M., & Cheserek, G. J. (2012). Economic valuation of improved solid waste management in Eldoret Municipality. *Journal of Emerging Issues in Economics and Management Sciences* 3(6), 962-970.
- Tesfaye, Y., Roos, A., Campbell, B. M., & Bohlin, F. (2011). Livelihood strategies and the role of forest income in participatory-managed forests of Dodola area in the Bale Highlands, Southern Ethiopia. *Forest Policy and Economics* 13, 258 – 265.
- Tisdell, A. C. (2005). *Economics of Environmental Conservation*. Edward Elgar. Cheltenham. United Kingdom.
- Turpie, J. K., Heydenrych, B. J., & Lamberth, S. J. (2003). Economic value of terrestrial and marine biodiversity in the Cape Floristic Region: Implications for defining effective and socially optimal strategies. *Biological Conservation* 112, 233-251.
- Valdivia, C., Duhn, E., & Jette, C. (1996). Diversification as a risk management strategy in an Andean Agro Pastoral Community. *American Journal of Agricultural Economics* 78, 1329-1334.
- Vedeld, P., Angelsen, A., Bojo, J., Sjaastad, E., & Berg, G. K. (2007). Forest environmental incomes and the rural poor. *Forest Policy and Economics* 9, 869-879.
- World Bank (2008). *Forests Sourcebook. Practical Guidance for Sustainable Forests in Developing Cooperation*. Washington, D.C: The World Bank.