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Abstract

Purpose*:* To Quantify the contribution of forest resources to household income and level of dependence by different income groups (quintiles

Methodology: The study drew experiences from past studies and literature review. The study area that the sample was drawn from was the Kibiko Holding Ground with a population of 1,025 and 199 households. The study population was 199 households as households were the study unit. A sample size of 55 households was identified through systematic random sampling.

Results: Results indicated that the forest resources that are mostly extracted by the households are firewood, followed by honey, poles, vegetables and finally medicinal herbs. Study results also revealed that only the count of livestock and the quintile income mattered in the extraction of forest resources.

Unique contribution to theory, practice and policy: There needs to be a policy on livestock use of forests as an increase in livestock resources leads to an increase in forest use extraction. Consideration needs to be given to those households with livestock since an eviction would mean their livestock will be highly affected and of course in a negative way.

***Key words**: Forest Income, Quintiles, Forest Resources, Household Income*

1.0 INTRODUCTION

1.1 Background of the Study

Natural resources provide rural people with food, medicines, meat, honey, gums and resins, condiments and other goods that are exchanged or used for secondary processing, and contribute greatly to rural subsistence economies (Kaimowitz, 2003). In sub-Saharan Africa, forests provide rural people with timber, wood, pulp and foodstuffs, which are further processed into manufactured goods such as lumber, paper and pharmaceuticals. The provision of foodstuffs shows that forests are vital for the welfare of the rural African communities. For example, in

rural areas of the Congo Basin, five to six million tonnes of bush meat are harvested each year and account for up to 80 percent of the fats and proteins consumed by local communities (CIFOR, 2013). The traditional swidden agricultural systems depend on the forests for nutrients. Forests are also source of fodder for livestock (Campbell & Luckert 2002, Kowero et al. 2003). It is estimated that more than 15 million people in sub-Saharan Africa earn their cash income from forest-related enterprises such as fuel wood and charcoal sales, small-scale saw-milling, commercial hunting and handicraft. In addition, between 200,000 and 300,000 people are directly employed in the commercial timber industry (Oksanen & Mersmann, 2003) and in some countries, the forestry sector is an important foreign exchange earner.

The general observation in the use of forests is that communities living around forests do not use forest resources in a coordinated manner and this depletes the resources faster. The received wisdom is that the poor rural peasants are the agents of this process (Cavendish, 1999). However, reliable data on forest depletion do not exist. Published data on forest resource change are simply estimates (Cavendish, 2000).

The problem of lack of data on forest and other natural resources is more acute in Africa than in other regions (Cavendish 2000, Fisher 2002). In spite of the wealth of literature on the contribution of forests to poverty alleviation and food security (Peters et al. 1989, Hegde et al. 1996, Godoy et al. 2000a, Hegde & Enters 2000, Pattanayak & Sills 2001) the value of forests in household welfare is hardly integrated into national planning processes.

Quantitative analysis of household use of forest resources is limited. The use value of the full range of forest resources is also vague and scant. Given that a forest ecosystem provides a basket of highly differentiated goods and services, more empirical evidence examining household dependence on these commodities in a robust analytical framework is necessary.

One of the reasons for the low profile of forests is the lack of quantitative micro-level research on forests contribution to household welfare (Cavendish, 2000). Micro level analyses of the uses to which households put forests resources provides insights on the importance of the resources. These analyses help to devise policy interventions for sustainable use of forests. From this perspective, it is important to quantify forest contributions to household welfare so that these contributions can be entered into policy debates with a view to enhance forest conservation without compromising household welfare. Micro-level quantitative analysis of household's use of forest resources is important from policy, economic and ecological perspectives.

The goods and services that are derived from Ngong forest by the households that live around the forest are not clearly understood. There is a lack of appreciation of the economic potential of this forest to poor households' welfare, and as a result, Ngong Forest is being lost to make way for other development activities. This study looks at households' use of this forest's resources and attempts to put values to these resources in order to shed light on their impact to household consumption, income and general welfare.

1.2 Statement of the Research Problem

Rural households depend on freely-provided forest goods and services for their welfare. Forests provide both productive inputs and consumption goods. Since this forest resource uses are classically omitted from standard household budget surveys there is a substantial gap in our quantitative understanding of rural household incomes (Dasgupta 1993; Vedeld et al., 2004).

In total value terms, forest resources account for a significant portion of income of households that neighbor the forests. Household budget surveys do not incorporate forest income and as a result their impact to household income, consumption and general welfare is misunderstood. A clear analysis of their importance is needed to bridge this gap.

1.3 Objectives of the study

To quantify the contribution of forest resources to household income and level of dependence by different income groups (quintiles).

2.0 LITERATURE REVIEW

2.1 Theoretical Literature Review

Forests provide a wide range of benefits for poor households. They prevent poverty by supplementing income and may also help to improve the standard of households that are able to enter into the high-return forest occupations. There are three distinct roles of forests: safety nets, support of current consumption (coping strategy) and a pathway out of poverty through household income sustainability. The safety net role refers to the role that forests can play during periods of hardship (such as to cushion against unexpected income shortfalls due to say family illness, natural disasters etc.) and depends on household vulnerability. The second role sees forests not only as a gap-filler (complementing other incomes especially when there are seasonal food shortfalls) but also as a source of regular subsistence use (Cavendish, 2003, Vedeld et al., 2004; Angelsen & Wunder 2003; Fisher, 2004). The poverty reduction role is through diversification and specialized forest strategies adopted by households, but also provision of important environmental services which benefit local, regional, national and even global stakeholders (Vedeld et al. 2004; Angelsen & Wunder 2003).

Forest dependence and thus environmental income is relatively more important for the poor and therefore forest degradation and overuse will hurt the poor more than the non-poor. Most of the households that live next to the forests are poor households and they rely more on the forests for their survival as opposed to the rich households who are at the end of the value chain and benefit from the finished forest products and have other sources of income to rely on (Vedeld et al., 2004). The authors contribute to the literature that forests and other common pool resources contribute significantly to rural incomes and towards poverty reduction. In addition, the current study agrees with the concept that rich households extract more forest resources in absolute terms than poor households. However, the author failed to estimate the local prices of both marketable and non-marketable forest products and also failed to underscore the determinants of forest extraction by households. In particular, the author did not show the effect of shocks on the extraction of forest resources. The current study addressed this gap by employing rigorous and systematic methods of estimating local prices of both marketable and non-marketable forest products and also established the determinants of forest extraction by households.

2.2 Empirical Literature

In their case studies, Cavendish (1997) and Campbell et al (2002) drew out some experiences on rural households and their use of forest resources. They found that households that use forest resources have livelihoods characterized by formal and informal activities. These studies also found that forests offer rural households a wide range of resources whose uses are seasonal. They are also of small market value compared to other non-forest activities. Cavendish and

Campbell et al (2002) using household data from rural Zimbabwe found that woodland-based resources are important in mitigating poverty but not in lifting people out of poverty. The current study addressed this contextual gap by focusing on the Ngong Forest Area.

Using purpose-collected panel data from Zimbabwe, Cavendish (1999) finds that environmental resources make a significant contribution to average rural incomes. Poorer households depend heavily on these resources, which contribute 40 percent to their incomes. However, richer households use greater quantities of environmental resources in total. He also found considerable differentiation in the economic characteristics of environmental goods. Cavendish shows that the dependence of households on environmental income decrease as their average income rise. Although the poor tend to get more of their total income from the environment, the rich still make heavy use of natural products for income (Cavendish, 2000). The results demonstrate the economic significance of environmental resources to rural households. Surveys which ignore the contribution of environmental resources to rural households' incomes therefore miscalculate the incomes and welfare. The literature greatly contributes to the fact that the poor are more natural resource dependent than the rich, though the absolute benefits for the poor are lower. The results of the study will greatly contribute to the current study in terms of the effects of different income levels on forest resource extraction. The main difference to the current study is the observation that while Cavendish uses panel data, the current study is strictly cross sectional in nature as it addresses the contribution of forest resources to household income for residents living near Ngong Forest. The study by Cavendish (2000) also fails to establish the determinants of forest resource extraction, a gap that is addressed by this study.

To explore the role of forest in household welfare in Kenya, Kabubo-Mariara and Gachoki (2008) used primary household data collected from Nakuru district and supplemented by a community survey. Their results suggest that forests play an important role as safety nets that cushion households during periods of hardship. The results also suggest that forests play an important role as a gap-filler (complementing other incomes especially when there are seasonal food shortfalls), a source of regular subsistence and in poverty reduction. The results further suggest that both the poor and the less poor derive a substantive share of incomes from forest activities and that forests are not necessarily poverty traps for rural households. They concluded that forest policies need to take into account tradeoffs between forest extraction and forest degradation and also consider targeting of households in forest use and management depending on household heterogeneities in both current and permanent incomes.

Kabubo-Mariara and Gachoki (2008) and Hedge and Bull (2005) noted that environmental resource use may be positively and significantly influenced by gender. Particularly, female-headed households may collect significantly less environmental products than the male-headed households. More established households may also tend to extract more environmental resources than younger families. Older families may tend to have a greater knowledge and familiarity with the geography, seasonality, and quality and quantity of resource availability in their surroundings, and as a result will be in a better position to extract resources. Similarly, the probability of young families participating in the sale of environmental products may also be less. Size of household, number of household members below 16years and above 65 years, number of disabled adults, and migration may also positively affect the use and sale of

environmental resources. The shock variable for sickness, from a hypothetical point of view may be found to significantly increase environmental resource use.

3.0 RESEARCH METHODOLOGY

The study drew experiences from past studies and literature review. The study area that the sample was drawn from was the Kibiko Holding Ground with a population of 1,025 and 199 households. The study population was 199 households as households were the study unit. A sample size of 55 households was identified through systematic random sampling.

4.0 RESULTS

4.1 Income quintiles

Results in table 4.1 reveal the total household income which is KES. 1,573,052.00 (summation of forest and non-forest income) divided into 5 equal groupings (quintiles). Using SPSS software, KES. 1,573,052.00 is divided into 5 equal groups of 11 households each. Total income was subdivided into quintiles to show levels of poverty. The first quintile was for total income with a range of 0 to KES 6,496, 2nd quintile for income range of KES 6,497 to kes 10,616, 3rd quintile KES 10,617 to KES 23,869.33, 4th quintile of KES 23,870 to KES 43,112, and 5th quintile of income of above KES 43,112.

Table 5.1: Income quintiles

Percentiles	20%	6496.00
	40%	10616.00
	60%	23869.33
	80%	43112.00

Source: Survey Data; 2012

Table 4.2 shows the mean monthly forest resource extracted by a household was KES 5,308.65. The combined monthly forest income for the 55 households was KES 291,976. The highest monthly source of income was livestock income at KES 6,053.15 followed by forest income at KES 5,308.65, skilled income at KES 4,164.24, other non-forest income at KES 3,963.64, unskilled labour income at KES 1,527.58, crop income at KES 1,115.21 and remittances at KES 1,086.67.

Table 4.2 : Descriptive statistics of household income

	N	Mini	Max	Sum	Mean	Std.
Forest income	55	0	82,200.00	291,976.00	5,308.65	12,596.69
Crop Income	55	0	13,333.33	61,336.67	1,115.21	2,664.72

Live stock income	55	0	30,000.00	332,923.33	6,053.15	8,736.28
Unskilled labour income	55	0	15,000.00	84,016.67	1,527.58	3,080.62
Skilled income	55	0	30,000.00	229,033.33	4,164.24	7,571.79
Craft and small scale enterprise income	55	0	45,000.00	296,000.00	5,381.82	10,486.65
Remittances	55	0	20,000.00	59,766.67	1,086.67	3,651.03
Other non forest income	55	0	93,333.33	218,000.00	3,963.64	14,857.58
Total Non Forest Income	55	400	139,833.00	1,281,077.00	23,292.30	28,881.49
Total Income	55	400	141,403.00	1,573,052.00	28,600.95	32,290.66

Source: Survey Data; 2012

Results in table 4.3 indicate the contribution of absolute forest income to absolute total income. The presentation format was adapted from Cavendish (2000). The lowest 20% (the poorest of households) extracted a monthly forest income of KES 835.15 per household, followed by the households in the 20% to 40% quintile with a monthly extraction of KES 1,358.79 per household, 40% to 60% with a monthly extraction of KES 1,731.82, 60% to 80% with a monthly extraction of KES 4,501.14 per household. The top 20% household (the richest households) had a monthly extraction of KES 18,116.36 per household. Overall, all households extracted a mean monthly income of KES 5,308.65 per household.

The findings imply that the extraction of absolute forest resources (actual cash flows) is highest in the top 20% (richest households). The findings agree with those in Cavendish (2000). The poorest households had the least absolute mean extraction of forest resources. . The justification of these is that they may have fewer capacities to extract forest income such as having less livestock for grazing (however, the results do not necessarily hold when we refer to percentage contribution of forest income to total household).

Table 4.3: Extraction of forest income and non-forest income across quintiles

Income Sources	Lowest 20%	20% to 40%	40% to 60%	60% to 80%	Top 20%	All households	Anova-f stat
Forest income	**835.15**	**1,358.79**	**1,731.82**	**4,501.14**	**18,116.36**	**5,308.65**	**4.707(0.03)**
Total Non Forest Income	**2,115.15**	**6,712.12**	**15,129.09**	**27,595.45**	**64,909.70**	**23,292.30**	**20.431(0.00)**
Crop Income	142.42	227.27	774.55	1,404.55	3,027.27	1,115.21	2.388 (0.063)
Livestock income	112.12	1,969.70	4,554.55	8,140.91	15,488.48	6,053.15	8.125(0.000)
Unskilled labor	569.70	1,024.24	1,663.64	2,246.97	2,133.33	1,527.58	0.582(0.677)

income							
skilled income	636.36	1,412.12	4,681.82	6,000.00	8,090.91	4,164.24	2.105(0.107)
Craft and small scale enterprise income	439.39	1,978.79	1,227.27	6,045.45	17,218.18	5,381.82	7.001(0.000)
Remittances	215.15	100.00	530.30	2,242.42	2,345.45	1,086.67	1.026(0.403)
Other non forest income	-	-	1,696.97	1,515.15	16,606.06	3,963.64	2.871(0.032)
Total Income	**2,950.30**	**8,070.91**	**16,860.91**	**32,096.59**	**83,026.06**	**28,600.95**	**56.517(0.000)**

Source: Survey Data; 2012

Results in table 4.4 indicate that forest income contributes 18.6% to the total household income. The highest contributor to total household income was livestock resource at 21.2%. The lowest contributor to total household income was remittances at 3.8%. However, forest income contributes 28.3% to the lowest 20% (the poorest households), 16.8% to the 20% to 40% household group, 10.3% to the 40% to 60% group, 14.0 % to the 60% to 80% group and 21.8% to the top 20% group. The findings imply that the share of forest resources to total household income is highest in the lowest 20% (poorest households). The findings agree with those in Kabubo-Mariara (2008) that the poorest groups derive a much larger share of income from forests compared to other groups while it does not agree with those in Cavendish (2000) which found that the share of forest income to total household income is highest in the top 20% households (the richest households).

Table 4.4: Extraction of forest income and non forest income across quintiles

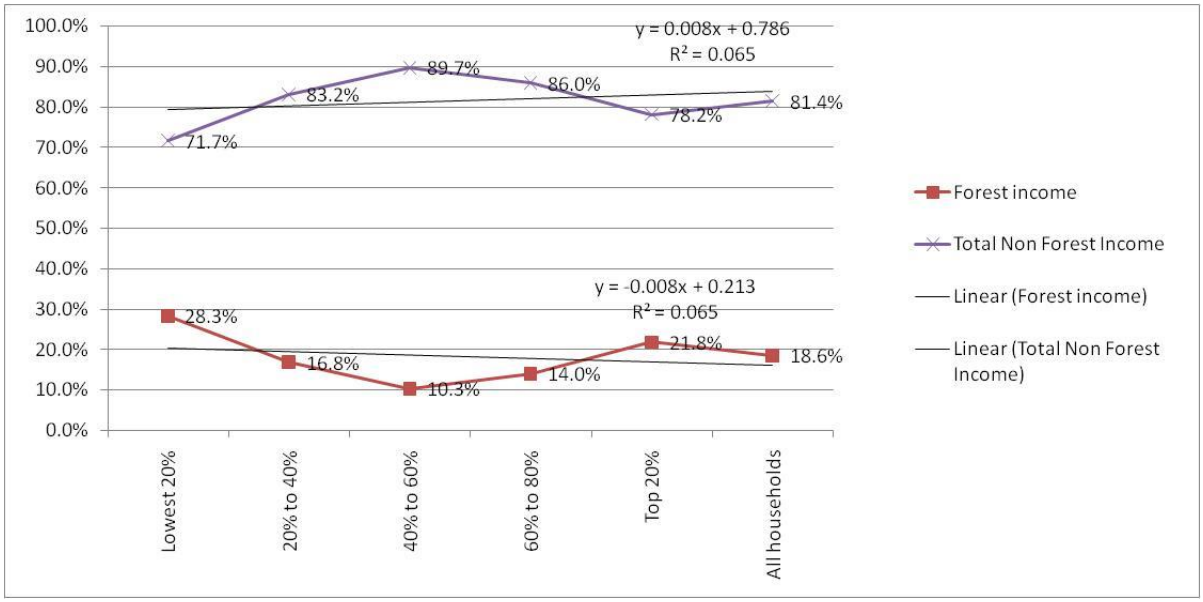
Income Sources	Lowest 20%	20% to 40%	40% to 60%	60% to 80%	Top 20%	All households
Forest income	**28.3%**	**16.8%**	**10.3%**	**14.0%**	**21.8%**	**18.6%**
Total Non Forest Income	**71.7%**	**83.2%**	**89.7%**	**86.0%**	**78.2%**	**81.4%**
Crop Income	4.8%	2.8%	4.6%	4.4%	3.6%	3.9%
Livestock income	3.8%	24.4%	27.0%	25.4%	18.7%	21.2%
Unskilled labor income	19.3%	12.7%	9.9%	7.0%	2.6%	5.3%
Skilled income	21.6%	17.5%	27.8%	18.7%	9.7%	14.6%
Craft and small scale enterprise income	14.9%	24.5%	7.3%	18.8%	20.7%	18.8%
Remittances	7.3%	1.2%	3.1%	7.0%	2.8%	3.8%

Other non forest income	0.0%	0.0%	10.1%	4.7%	20.0%	13.9%
Total Income	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Source: Survey Data; 2012

A graphical display indicated in graph 4.1 of forest income and non forest income across the 5 quintiles indicates that total non forest income is an increasing function of the household quintile. Results also indicate that forest income is a decreasing function of the household quintile.

Graph 4. 1: Forest Income and Non Forest Income across Quintiles



Source: Survey Data; 2012

4.2 Correlation Analysis

Correlation analysis is important in identifying multicollinearity issues. The study first conducted a Pearson bivariate correlation analysis (See Annex 2) so as to see which social economic characteristics were significantly correlated to each other. Age of household head was negatively but significantly correlated with absolute forest income (r=-0.306, p value =0.023). The correlation between count of number of livestock and absolute forest income is positive and significant (r=0.878, p value =0.000). The high correlation between count of livestock and forest income is an indicator of endogeneity.

Variables that had a correlation coefficient of above 0.5 were identified to suffer from multicollinearity. The literacy of head of household and head of household years of education were collinear as indicated by correlation coefficient of 0.752. Family members less than 16yrs and family size were highly correlated and therefore were collinear. This was supported by a

correlation coefficient of 0.701. Family members over 65 yrs and age of head of household were collinear as indicated by a correlation of 0.515. The implication of multicollinearity is that it distorts the significance of individual variables. It also implies that having two collinear variable in one equation does not improve the r squared (model goodness of fit) as we all as the F value (overall model significance).). It is therefore best to estimate regression equations after omitting one of the collinear variables.

4.3 Regression Analysis

Linear regression method was used to investigate the determinants of household forest income.

It was noted that the model could be suffering from endogeneity. A suitable instrument for the endogenous variables was however, not readily available. In this regard, the results of the OLS method used should be interpreted with caution. This is because OLS can produce biased and inconsistent parameter estimates.

The best way to deal with endogeneity concerns is through instrumental variables (IV) techniques. The most common IV estimator is Two Stage Least Squares (TSLS). It works by finding a variable that is correlated with the explanatory variables but not correlated with the error term. The variable is the instrument. The more highly correlated the instrument is with the explanatory variables while uncorrelated with the error term, the greater the efficiency of the instrument.

The first stage "cleanses" the endogeneity from the variables we are worried about. By using predicted values based on genuinely exogenous variables only, we obtain the exogenous part of their variation. The second stage uses a variable that is now exogenous thanks to the first stage, and so the bias disappears. Interpretation of parameters and hypothesis testing can all take place as usual, following the same procedures as OLS

The selection of all variables to be included in the study was informed by the conceptual framework. However, variables that were multicollinear were not included in the regression analysis. Quintile income as a variable was selected to take into account the effect of the various income levels on forest income

Table 4.5: Regression Coefficients (P values are in parenthesis)

Variables [1]	Coefficients of Regression
Male Headed Household	538.27 (0.76)
Age of Head of Household	-9.91 (0.85)

Variables [1]	Coefficients of Regression
Family Members over 65years	
Literacy of Head of Household	432.55 (0.81)
Years of Education (Household head)	
Family Size	-234.38 (0.33)
Family Members Less than 16yrs	
Count of Family Members with Disability	-313.71 (0.93)
Number of Family Members Out migrated	993.82 (0.46)
Count of Number of Times Sick	158.53 (0.56)
Count of livestock	69.18 (0.00)
Quintile income	1731.95 (0.02)
(Constant)	-2509.36 (0.54)
R-squared	0.810
F statistic	21.268 (0.000)

Source: Survey Data, 2012

The regression equation eliminated multicollinearity by excluding Family Members less than 16 years as it was highly correlated with family size. The equation also excluded family members with over 65 years as it was highly correlated to Age of Head of Household. Furthermore, Household Head Years of Education was also excluded as it was highly correlated to Literacy of Head of Household.

The results in the regression analysis indicated in Table 6.2 had the coefficient of determination (r squared) of 0.810 indicating that 81% of the variations in forest income were explained by the independent variables. An F-statistic of 21.268 and a p-value of 0.000 were indicated. Quintile income and count of livestock were the only variables to have a positive and significant relationship with forest income. A rise in total household income from one quintile to another leads to an increase in forest income extraction by 1731.95 units, this implies that the extraction ability improves with the level of income. An increase in livestock by one unit leads to an increase in forest extraction by 69.18 units. This implies that a rise in household wealth has a positive effect on the extraction of forest resources. This implies that the extraction ability improves with the level of income.

The results confirm that count of livestock and quintile income mattered in the extraction of forest resources. The rest of the socio-economic factors such as gender, literacy, years of

education, family size, family composition, sickness either display insignificant or the unexpected signs. Results by Kabubo-Mariara and Gachoki (2008) are consistent with the results.

The results of the above regression analysis show which social economic group need to be targeted. In this case, households with more livestock extract significantly more forest resources. Poverty levels as shown by quintiles also need targeting in case of any compensation once the households are relocated.

5.0 CONCLUSIONS AND RECOMENDATIONS

5.1 Conclusions

From the study the forest resources that are mostly extracted by the households are firewood, followed by honey, poles, vegetables and finally medicinal herbs. The average local selling prices of fruits was KES 46, vegetables KES 61, bamboos KES 3000 per feet, poles KES 136 per feet and firewood KES 186 per head load.

The study concluded that only the count of livestock mattered in the extraction of forest resources. The rest of the socioeconomic factors (gender, literacy, years of education, age, family size, family composition, sickness shocks) displayed insignificance or the unexpected signs hence age and sex of the household head do not seem to matter for resource extraction.

The extraction of absolute forest resources is highest in the top 20% (richest households) and the poorest households had the least absolute mean extraction of forest resources. The share of forest resources to total household income is highest in the lowest 20% (poorest households). This therefore indicates that non forest income is an increasing function of the household quintile and forest income is a decreasing function of the household quintile.

5.2 Recommendations and Policy Implication

The communities living around the forest should be enabled to benefit from the financial resources/ forest proceeds to enable them realize the value the forest thus change their perceptions towards these resources. For instance, the forestry and natural resources departments should emphasize and strictly enforce a community association policy for extraction of forest resources. This would avoid the problem of over extraction and the challenges brought about the tragedy of commons.

In addition, there needs to be a policy on livestock use of forests as an increase in livestock resources leads to an increase in forest use extraction. Consideration needs to be given to those households with livestock since an eviction would mean their livestock will be highly affected and of course in a negative way. Policy concerns should be to introduce zero grazing among the households. As it was noted, the average livestock holding was very high, and this implies that the animal husbandry practice could be a threat to Ngong Forest ecosystem.

Poorer households rely more on the forest and should therefore by aided by the Government to diversify their income generating activities in order to avoid their reliance on Ngong Forest thereby preserving the ecosystem.

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