SOCIO-ECONOMIC ASSESSMENT OF THE FACTORS INFLUENCING BUILDING POLES CONSUMPTION, CONSERVATION AND MANAGEMENT OF THE AMANI NATURE FOREST RESERVE, IN EAST USAMBARA, TANGA, TANZANIA

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ABSTRACT

This study was conducted in 1998 at Amani Forest Nature Reserve (AFNR) in the East Usambara Mountains, Tanga, Tanzania. The main objective was to assess the impact of building poles consumption on biodiversity conservation of Amani Nature Reserve. Data were collected through questionnaire, focused discussions, interviews and literature survey. Analysis of data was through statistical methods and cost-benefit analysis. Results showed that the main compelling force towards high rates of building poles consumption around AFNR is unfavorable economic condition of the surrounding communities which have rendered building poles from the forest reserve, the only cheap building material available next door to rural communities. About 90% of surveyed households use poles and withers as the main building material. Selective extraction of preferred species has caused an obvious shift in the availability of such species and large diameter specimens as well as change in biodiversity composition. About 1405m^3 per annum of wood are required for building poles and withers. Most of these are extracted from the Nature Reserve. Regression analysis results showed that factors which have significantly influenced building pole consumption are family size, occupation and the type of building materials used. Success of conservation activities depends on improvement of people's economy. Also people should be motivated to plant non-fruit trees to create a building poles source outside the forest reserve. Presently only 30 percent of trees grown in the area are non-fruit trees. Introduction of cheap treated poles could also promote biodiversity conservation by increasing the service life of building poles hence reducing pole extraction pressure from AFNR.

INTRODUCTION

Amani Nature Forest Reserve (ANFR) is the first and currently the only nature reserve established in Tanzania**. (Def: NR is a forest reserve legally declared for nature conservation of genetic resources and for scientific studies).** It was on the 9th May 1997 that the government of Tanzania legally gazetted ANFR due to its national and international importance. Its objectives are more of biodiversity conservation, ecotourism, education and less utilization.

Amani forests are found in Tanga, in the Southern Block of the East Usambara mountains. They are found within the Eastern arc mountains, the most important centre for biological diversity with more than 93% of Tanzania endemic species (Monela, 1995; Hipkiss, 1997). They have been designated as one of the biodiversity hot spot and centre of plant diversity of the world (Katigula & Johansson, 1997; Kessy, 1998).

ANFR is well known for its natural beauty and presence of an important and old botanic garden, one of the largest in Africa (Illari, 1993; Antony *et al*., 1997). It is an important catchment area for the region as a source of Sigi river an important source of water supply for more than 300,000 people in Tanga Municipality and the surrounding rural areas (Illari, 1993). It is also an important source of diverse forest products for the local communities. Therefore it is important for the country's future heritage, support to local livelihood as well as generation of foreign exchange through ecotourism.

However, ANFR is surrounded by dense human population of about 132 people/km^2 cf. Tanga average 76 people/km^2 and National average of 29 people/km^2. The communities surrounding ANFR are characterized by low household income and high dependence on the next door resources for their livelihood. One of the important products which the local people extract from the forest is poles which is the major building material for their houses. This constitute potential obstacle for the sustainability of the ANFR resources.
Hence this paper aims at presenting the contradiction existing between conservation goals and the needs of the local communities pertaining to ANFR resources.

Study objectives
The objective of this study was to conduct socio-economic assessment of the impact of building poles consumption on biodiversity conservation and management for the Amani Nature Forest Reserve.

The specific objectives were:

(i) To assess the quantity and quality of different tree species used as building poles.

(i) To assess the demand, supply and the market for building poles in the area, and the factors influencing consumption.

(i) To identify problems of conservation and management in the area as a consequence of building poles consumption, in order to suggest appropriate strategies to improve conservation and management of the reserve.

(i) To assess the role of building poles on the local economy focusing on the household and village level.

METHODOLOGY

Location, methods of data collection and data types

ANFR is located in the east Usambara Mountains, in Tanga region, The East Usambara Mountains are in Muheza district and they cause an area of about 1300km2 located between 4°48" and 5°13" and 38°32" and 38°48"E. The Eastern edge is about 40 km from the Indian Ocean.

Data acquisition and sampling
Data were obtained from both primary and secondary sources
The primary data sources were sample villages and sample households, Forest reserves, public forests and people's farms. Four villages were sampled stratified based on ecological differences

(Lowland dry & wet, and upland) and the perceived scarcity of building poles. This makes a total of 108 households in the four villages. Secondary data sources comprised of literature survey, technical reports from EUCFP and government records.

Data types
The type of data collected includes forest products, Socio-economic including market survey for building poles, land use and demographic data.

Techniques of data collection
The main techniques used in collecting data includes; interview with heads of households and village government leaders, guided by structured questionnaire, focused discussions with individuals, village elders and traditional elders and field observation with a researcher's field note book.. The field survey in the forest was used to identify and quantify poles consumption and species preference. The main items observed includes; Pole dimensions, forest foot trails condition, poles extraction pressure, location and condition of farms and the market situation for poles.

Data Analysis
The analysis was both qualitative and quantitative. The data collected from questionnaire survey were summarised, coded and then fed into an SPSS computer programme for analysis. This gave a summary of distribution of responses, central tendency and dispersion so as to be able to classify summarise and explain using descriptive statistics.

Cost-Benefit analysis of building poles extraction at household level was also done.
The information obtained from the survey, was also used in inferential statistics to further describe the phenomenon of some socio-economic factors which were found likely to influence amount of poles consumed.
Regression equation to show the link operating between the dependent and independent variables is as shown below. The following general multiple regression model was used:

$$Y_i = B_o + B_1 X_1 + B_2 X_2 + ... + B_K X_K + E_i$$

Where:

Y_i = The i-th observed value of the dependent variable. X_1-X_k = Independent variables
B_o = population parameter for Yi intercept
B_1-B_k = Coefficients for the independent variables
E_i = Random disturbance error
i = 1,2...N

Y_i = Amount of building poles consumed against;
Age of the farmer, Level of education, Number of cattle/sheep/goats owned, Type of building materials used, Income of the farmer per year, Family size, Number of houses in the family, Number of times a house is repaired, Marital status, Occupation.

The hypotheses tested are;
HO: $Y_i \neq f\{ X_1....X_7\}$
$B_1...B_7 = 0$ Implying no correlation between dependent and independent variables.
HI: $Y_i = f\{X_1...X_7\}$
$B_1...B_7 \neq 0$ Implying that there is correlation between dependent and independent variables.

A two tailed t-test at 5% level of significance, was used to test the relationship between dependent and independent variables. H_o: was rejected where $p < 0.05$. Linearity was assumed in this case.

RESULT AND DISCUSSION

Based on the socio-economic survey conducted in the area, the following results were obtained.

Demographic aspect
Population size in the sampled villages was 6,412, average family size; 7, average dependants; 5 per household and population density; 132 people/km^2, cf. Tanga regional average; 76 people/km^2 and national average of 29 people/km^2.This indicates high dependence and demand for building poles.

Ethnic groups
The upland is dominated by the Shambaa by 60%, while the lowland is dominated by the Bondei by 46% . The type of houses they build use mainly poles from the forest.

Land use
Most of the land in villages is for agriculture, followed by residence and very little forest land.

Table1: The proportion of land use in the surveyed villages

	Agric %	Residence %	Forest %
Mlesa	85	15	-
Mbomole	75	20	15
Mashawa	65	25	10
Gereza	75	25	-

Source: Own survey data 1998

Land is acquired mainly through inheritance or borrowing. This implies that most of the land is held under customary laws and not easily accessible to other people eg. the immigrants. At the same time it was found that un-exploited land held under customary laws in the surveyed villages is still plenty, totaling 70.4Ha. This deprives other farmer access to land, and therefore increases the problem of land shortage which is a common cry especially in the upland villages. Average farm sizes per household for the villages surveyed ranged between 1 Ha - 3.2 Ha

Peasant economy
About 100% of the local people practice primitive agricultural methods, and the average income per year is around 240,000/= per household. About 85% are subsistence peasant farmers while about 7% are employed mostly in tea estates. Their income is very low about (Tsh 34400/= per capita) as a result of the type of agricultural methods so commonly used.

Forest Resources utilisation
Although most of the people indicated high awareness on the conservation importance, the villagers generally depended on the next door cheap available resources as table 2 indicates.

Table 2: Dependence and awareness responses on AFNR Resources

Village	Awareness Response (%)	Dependence Response %
Mlesa	96	65
Mbomole	92	48
Mashewa	96	30
Gereza	88	68

Source: Own survey data 1998

The people in the study area have been utilizing the forest for many years to extract various forest products, these include fuelwood, poles ropes, withies, fruits, forest animals, mushrooms, vegetables, medicines etc, of which woodfuel and building poles extraction have shown to have greater impact to reserve. Table 3 indicates the type of materials mainly used as building poles. The combination and type of building materials used were mainly poles, withies, *Cocos nucifera* leaves/grass. Very few people used other materials as table 3 indicates.

Table 3: Building materials used

The combination of materials used	Frequency count (Villages)				
	Mlesa	**Mbomole**	**Mashewa**	**Gereza**	**%**
Poles, withes cocos leaves/grass	24	17	15	4	55.6
Poles, withes and iron sheets	5	12	17	12	42.6
Poles/Timber, bricks, stone and iron sheets	2	-	-	-	1.8
Total	**31**	**29**	**32**	**16**	**100**

Source: Own survey data 1998

This implies that the majority of the people use poles as the main building material, which come from the nearby forests. Most of the respondents indicated public forests and the AFNR to be the main sources of building poles as indicated in table 4.

Table 4: Percentage of use of poles by source in the surveyed villages

	Mlesa	Mbomole	Mashewa	Gereza
Public forest	47.0	66.0	28.4	47.5
AFNR	58.0	31.0	30.2	47.5
Forest project	5.0	-	32.4	-
Farms/Woodlots		3.0	9.0	5.0

Source: Own survey data 1998

This implies that there is still high dependence on AFNR as a source of building poles. Species which were found to have higher frequence of being used include: *Allanblackia stuhlmanii, Anisophyllea obtusifolia* (both indigenous),*Tectona grandis, Melia azaderach, Securinega virosa*. About 18 species were recorded as being used as poles but others were not

frequently used. The amount of wood used in building an average house of 8 * 5 m is given in table 5.

Table 5: The amount of wood used in the houses in surveyed villages with the mean in brackets

Average size:	Standing poles D=11cm, l=3m	Roof poles d=10cm, l=4m	Withies d=3cm, l=4m
Mlesa	3430(114)	1086(34)	22990(766)
Mbomole	3642(125)	1176(41)	29150(1005)
Mashewa	3435(111)	1325(46)	29649(956)
Gereza	1465(92)	810(50)	14850(928)
Overall average	(110.5)	(43)	(914)
Volume used	$4.20m^3$	$1.35\ m^3$	$0.646m^3$

Source: Own survey data 1998

The total amount about per house = $6.2m^3$

Key: d = diameter
l = length

The type of roofing materials used in the surveyed villages were mainly *Cocos nucifera leaves and* old corrugated iron sheets. The roofing materials were found to highly influence the life span of a house. The average life span ranged between 3 years for grass roofed houses and more than 30 years for corrugated iron sheets roofed houses, as table 6 indicates. This is attributed to the fact that roofs which leaks especially during rain seasons, expose the wooden parts to the agents of decay such as fungi, and eventually weakens the structure in a very short time.

Table 6: Frequency count and percent of houses with different roofing material and their average life span

Roof type	No	%	Life span average
Cocos leaves	47	43.0	<10 years
Sugar cane leaves and grass	23	21.0	years
Iron sheets			
Total	42	36.0	>30 years
	108	100	

Source: Own survey data 1998

This indicates high percent of houses with life span between 10 and 5 years. This implies that there is high demand of building poles now and in the near future. Other constructions include – kiosk, animal shade and bweni

The amount of wood used per year in different structures is given in table 7.

Disturbances and pressure in the forest

Disturbances and pressure in the forest was contributed by extraction of poles and withies from ANFR. Diameter classes used are those frequently found during household surveys. Both number of foot trails and distance from the boundary into the forest was taken to indicate activities in the forest. Table 8 indicated the extent of disturbance observed.

Table 7: Number of newly constructed houses per year, bwenis**, animal sheds and kiosks in each village**

Village	Family house	Bweni	Cattle shed	Kiosk
Mlesa	35	35	22	27
Mbomole	30	30	7	3
Mashewa	42	42	-	17
Gereza	15	15	-	8
Total	122	122	29	65
Volume used	926.8m^3	336.7m^3	36.8m^3	104.7m^3

Source: Own survey data 1998

Total amount of wood used per year =1405m^3 for the surveyed villages.

Table 8: Cut poles & withes by village with the volume in brackets

	Diameter classes			
	Count 12cm>dm^1>5cm	Count 3cm<dm^2<4cm	DB	NTr
Mlesa	142(5.9)	861(3.5)	1550m	8
Mbomole	84(3.5)	607(2.47)	750m	6
Mashewa	53(2.2)	123(0.50)	1920m	5
Gereza	76(3,16)	470(1.91)	1200m	8
Total volume	(14.76m^3)	(8.38m^3)		

Key: Average diameter dm^1 = 11.25
Average diameter dm^2 = 3.6cm
Average height = 40cm
DB = Distance from the boundary
NTr = Number of trails

This implies that disturbance in ANFR is significant, especially in areas where people are close to the boundary.
The amount of wood taken as removal from the forest is about 2.5% of the total volume calculated in table 5. Results of tallies for people entering ANFR in the surveyed area for 3 weeks was 252. Average 12 people per
day 84 people per week, species exploited were both endemic and non-endemic. More than 23 species recorded during both household and forest surveys. People move along trails 10-15m each side and to about 2000 m into the forest. Species which showed high resilience to over cutting in the forest were *Cephalosphylla usambarensis* while *Melia azaderach* indicated high resilience in peoples farms. This implies ANFR and peoples farms can offer more of these species in the near future.

Local communities livelihood strategies

Tree planting was done, however, most of the local people were found planting fruit trees more than non- fruit trees. There was no balance between fruit and non-fruit trees, as a result people's dependence on ANFR as a source of building poles will continues.

Retaining trees was also found to be a common strategy to most of the respondents trees trees were retained in the farms for different reasons such as shade, future fuelwood, windbreak and future poles. However, their contribution to the overall need of poles is very small. Most of the species
retained were indigenous. Table 9 indicates the percentage of people who retained trees.

Table 9: Percentage of respondents who retain trees in the our villages

Village	Percentage
Mlesa	78
Mbomole	69
Mashewa	58
Gereza	13

Source: Own Survey data, 1998

Market survey

There is a potential market for building poles in the area. More than 1405m^2 is required as building poles per year. Taking into account population increase every year, there is a good reason for people to establish woodlots for future building pole sale and lessen pressure in the ANFR. This can be an economic activity.

Inferential statistics (Multiple regression)

Table 10 indicates the efferential statistics results for the factors influncing building poles consumption.

Table 10: Regression analysis results of factors influencing building poles consumption.

Variable	B	SE B	Beta	T	P
1.AGE	12.584405	17.812748	0.662497	0.706	0.488Ns
2.FMLSIZE	1.857784	0.900002	0.342322	2.064	0.022S
3.NCATT	0.010428	2.231303	6.30222	0.005	0.996Ns
4.OCCUP	-19.755116	5.695826	-0.227643	3.468	0.013S
5.INCOME	15.310427	30.209704	0.065843	0.507	0.618Ns
6.EDUL	49.144061	61.971530	0.152186	0.793	0.438Ns
7.NOHSE	12.397247	74.900895	0.079477	0.166	0.870Ns
8.CONSTMA	0.140018	0.027653	1.127993	5.063	0.0001S
9.MARITO	-19.309977	50.347218	-0.185689	0.384	0.705Ns
10.NOREP	-14.688812	17.437712	-0.810879	0.842	0.410Ns
(Constant)	91.968294	100.248420		0.917	0.3711

Source: Own Survey data, 1998

R = 0.86 R^2= 0.74

Source: Own survey data 1998

Key: S = Significant at 5% level of significance
Ns = Not significant at 5% level of significance
R = Correlation coefficient
R2 = Coefficient of determination

Implication of regression analysis

From the survey results, it is evident that some socio-economic factors had some influence on the amount of building poles consumption. From table 10, the results from significance test

show that Family size, Occupation and type of building materials used were statistically significant at 5% level of significance. Other factors were not significant.

The family size was found to significant influence the amount of poles consumed at 5% level. In the study area there is a custom of building more houses around the main homestead as the family grow large, this automatically increased the amount of poles consumed. This factor also showed positive correlation, implying that the amount of poles consumed increased with the increase in family size.

Occupation of the respondent was found significant at 5% and negatively correlated to the amount of poles consumed in that as the occupation level increased the amount of poles consumed decreased. People who were found employed in government institutions, private companies and Tea estates were ranked in higher levels, followed by casual labour in tea factories, petty trading and peasantry farming. Those of the higher classes used less building poles as compared to farmers, or those peaking tea in tea estates probably because of education and income differences.

The type of building materials used was also significant at 5% level of significance. Those who prefer modern houses to pole built houses, used cement bricks and iron sheets with less poles, hence use less amount of poles compared to those using poles, mud and *Cocos nucifera* leaves or grass, which consume larger amount of building poles. The type of building material was also positively correlate to the amount of poles consumed. The primitive materials (eg. mud, grass, *Cocos nucifera* leaves) were ranked high followed by modern materials such as cement, bricks , iron sheets etc. Therefore more primitive materials used, implies more building poles consumed.

Other variables, Age, level of education, income, number of cattle owned, marital status, number of repairs and number of houses in the family were statistically not significant at 5% level of significance. However, Age was positively correlated to the amount of poles. This can be attributed to the fact that most young people, have smaller families, smaller houses which consume less poles as compared to old people. The tradition of Tanzania and particularly in the study area allows the old people to have children and grandchildren and sometime grand grand children living together in the same house hold, this requires either big enough or more houses, hence the amount of poles consumed increases with age.

The number of cattle owned showed a positive correlation in that as the number of cattle increased the amount of poles consumed also increased. This also implies that keeping more animals means more poles are required in construction of animal shades.

The income level was found positively correlated to the amount of poles consumed. This can be attributed to the fact that the poor in the society normally build relatively smaller houses as compared to those with better income levels. This implies that those with less income build smaller houses which use relatively less poles compared to those with more income.

The level of education was positively correlated to the amount of poles used and it is difficult to explain why it is positive but the reason can be a masking effect since it could also be an income effect through education because 78% of the respondent had either primary education or no formal education.

The number of repairs was negatively correlated to the amount of poles consumed, implying that the consumption of building poles decreases with increasing number of repairs. This is logically true since repairing increases the life service of a house, hence the amount of poles decreases with repairs.

Marital status showed negative correlation with the amount of poles consumed. The effect of marital status can possibly be masked due to the fact that 87.5% of the household surveyed were of married status.

About 74% of the variation in the amount of building poles consumption in the study area were explained by the regression equation (R^2=73.74%).

The cost benefit analysis of building poles extraction

The cost benefit analysis aims at analyzing financial costs and benefits of building poles extraction in the study area. The analysis covers the costs and benefit involved from felling, chopping and hauling to the building site. This is done by dealers with the aim of making profit.

With the experience of pitsawing in Tanzania, which has been studied more than poles, shows that the work is usually done without regards to sustainability or other social benefits (Monela, 1995). When the utilization principle is applied, social benefits or profit is left out (Perce and Moran 1994). The felling processing and selling of poles is done under personal agreements between dealers and buyers.

The dealers may get the poles either legally from the public forest or illegally from the reserve. The tree to be cut into poles is really bought, normally they are obtained inkind from the public forest or illegally from reserve, therefore the cost of buying a tree by the dealer is ignored.

The Cost factors included were
- Labour costs (cutting, chopping)
- Cost of tools (investment and depreciation)
- Cost of other inputs.

Factors affecting the cost of poles to individual buyers include;
i. Species of pole
ii. Durability of poles
iii Distance and terrain transport from extraction site to building site.
iv. Risk of being caught for illegal harvesting.

Benefits were derived from sales of timber hence based on pole prices. The cost of production of poles and price of poles at the building site, labour cost, average transport cost, was based on the survey of pole dealers in the four villages surveyed.

- The total labour cost was Tshs 1200/ m^3
- Average transport cost was Ths 1500/ m^3
- The Cost of tools was calculated as depreciation costs based on average productivity of 10m3/year. Table 11 below presents the costs of cutting tools.

Table 11: Cost of tools

Tool	Purchase Price	Life Span	Depreciation/ year Tshs/year	Depreciation Tshs/ m^3
Axe	4 350	5	870	87
Bush knife	2 000	2	1 000	100
File	1 200	2	600	60
Chisel	3 000	5	600	60
Tape measure	2 500	5	500	50

Source: Own Survey data, 1998

The risk involved by harvesting in the reserve amount to Tshs 300,000/= if we take 50% probability of being caught we can take the risk premium to be Tshs. 150,000/=
Based on this C-B analysis and without considering risk, the results are as follows;

Price of pole Tsh/ m^3	4 500
Production cost Tsh/ m^3	3 057
Profit Tsh/ m^3	1 443
Economic productivity price/costs	1.5

Based on C-B analysis and when risk is taken into consideration, where by the probability of being caught is estimated to be 0.001, the resuls are as follows;

Price of pole Tsh/ m^3	4 500
Production cost Tsh/ m^3	3 057
Risk on illegal harvesting Tsh	300
Profit Tsh/ m^3	**1 143**
Economic productivity price/cost	1.3

Under the current situation building poles extraction is still considered to be one of the important economic activity to dealers. This will continue as long as no other employment opportunities in the area. This implies that ANFR sustainability will remain problematic unless people secure better employment opportunity in the area.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

- The current low household economy is one of the important driving force toward exploitation of the ANFR as a source of building poles.
- The main sources of building poles are the public forests, ANFR and to a small extent peoples farms and forest project plantation.
- Biodiversity disturbances is mostly attributed to selective cutting of preferred species for poles; observed by the disappearance of large specimens of some species such as *Allanblackia stuhlmanii* and *Anisophyllea obtusifolia*.
- The total volume of building poles required per year for the surveyed villages is about 1405m^3 of which a substantial amount come from ANFR.
- Factors which significantly influence building poles consumption include family size, occupation and type of building materials used. All of them converge on the same point "poor household economy"

- Most families plant fruit trees more than non fruit trees. There is no balance between the two, hence dependence on the ANFR will continue.
- There is a potential market for building poles, people can establish their own woodlots to meet the future building poles need.

Recommendations

- Plans and strategies should be initiated by the management of ANFR to improve peoples' economy to reduce poverty and dependence on ANFR
- To reduce selective pressure on certain species due to qualitative preference by local communities, people should be encouraged and educated to utilize abundant species which has shown high resilience in the forest and in farms eg *Melia azaderach, Cephalosphaera usambarensis* together with the invasive *Maesopsis eminii*.
- One of the ways to improve the people's economy and reduce pressure to the forest is to encourage people to exploit the local building poles market, by stating wood lots with the aim of selling poles in the future.
- People should be encouraged to plant more non-fruits to balance the population of fruits and non-fruit trees to reduce dependence on the forest for poles requirements.
- People should be encouraged to continue with retaining trees in their farms so as to meet some of their daily requirements of wood.
- In order to improve service life of poles and reduce the demand for building poles from the reserve, where possible people should be helped to use treated poles.

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