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Original Article

Cost- Benefit Analysis of Collaborative Forest Management: A Case Study of Tororo Central Forest Reserve, Eastern Uganda

Silas Anguti[1*], *Buyinza Mukadasi*[2] & *Edward Andama*[3]

[1] Forest Department, P. O. Box 1, Tororo Uganda.
[2] Makerere University, P. O. Box 7062, Kampala, Uganda
[3] Busitema University, P. O. Box 236, Tororo Uganda
[*] Author for Correspondence ORCID: https://orcid.org/0000-0002-5437-4134; email: andamaedward@gmail.com.

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ABSTRACT

Forests provide multitude of benefits to humanity in terms of local socio-economic, development, and environmental protection which are often not valued at national level because of lack of a valuation system for the ecosystem services. This study undertook a cost-benefit analysis of Collaborative Forest Management (CFM) implementation at Tororo Central Forest Reserve (TCFR) between Nyangole community and National Forestry Authority (NFA) using Contingent Valuation Method (CVM). The result showed that Nyangole community incurred total discounted costs of USD 74,440.0 on tree planting, forest resource management and protection, tree nursery activities and agriculture. Meanwhile they received total discounted economic benefits of USD 396,720.0 from sale of poles, tree seedlings, training opportunities, fire wood, mango fruits, and food stuffs. Other benefits that accrued to the community were opportunity of receiving visitors at the project, training allowances and other ecosystem services provided by the forest. The benefit-cost ratio of CFM to Nyangole community was 5:1 with positive Net Present Value (NPV). We concluded that the CFM partnership between government and Nyangole yielded benefits to the both parties and recommend that this approach be rolled to other sites within the country.

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INTRODUCTION

Forests are very important to humans because they contribute to socio-economic development and environmental protection. They provide ecological stability to agricultural production and supply most energy needs in rural and urban homes and industries. The Forest Sector Review of 2001 (MWLE, 2003) indicated that the Ugandan ecosystems and wild species have enormous economic values to human kind through providing environmental goods and services. Mc Neely (1989) said that environmental goods and services had direct use values (Consumption use and Productive use values) or indirect use values (Non consumptive use, Option, and Existence values) and that direct values were those concerned with enjoyment, satisfaction, or basic sustenance received directly by consumers of biological resources. The rural and poor urban populations depend on forest resources for part of their shelter, energy, and subsistence needs. In the Eastern and Southern Africa regions, about 70 – 90% of the populations rely on wood energy and in the case of Uganda, forest resources provide six times more energy than electricity and petroleum products put together (MWLE, 2003). Forests are also known to stabilize and enrich soils, provide cover and fodder for grazing especially in drought prone areas. According to FAO (1997), Uganda's forests contributed to about 23% to its Gross Domestic Products (GDP) which was one of the highest in the world. Unfortunately, in 1970s and 80s the practice of forest management for biodiversity conservation and ecological functions became social issue since it ignored community interests of participating in forest resource management.

Mc Neely (1989) observed that forest conservation activities were increasingly becoming more of a social challenge than biological one. As human populations increase, disparity for wealth grows and unauthorized harvesting of forest resources within protected forest areas increases thus making forests to be protected by Forest Guards. This places economic burden on forests with social burden on local community population growth, leading to land and resource use conflicts. Collaborative Forest Management (CFM) practices which were introduced in late 90s have become an important tool for promoting forest conservation and reforestation in ways that sustainably support and improve community livelihoods, achieving both climate change mitigation and adaptation simultaneously (Kazoora et al., 2020). CFM was defined as mutually beneficial arrangement in which a local community or forest user group and a responsible Government body shared roles, responsibilities, and benefits in a forest reserve or part of it (MWLE, 2003). Today, CFM is being championed as a viable tool and policy instrument for sustainable management of most protected areas controlled by National Forest Authority (NFA), District Forest Services (DFS), and Uganda Wildlife Authority (UWA).

The previous Forest Policy of 1988 and Forest Act of 1964 respectively barred neighbouring forest communities from managing forests (GoU, 1964;

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1988). The communities who lived near Government forests had typically a history of open-access use of these forest resources (GoU, 2001). These provisions made it difficult for the Government to police and regulate the open-access use without communal responsibility. The community involvement in forest management was made possible when government of Uganda changed forest policies in 1929, 1988, and 2001. At the same time, the Forest Act of 1964 was amended and named the National Forestry and Tree Planting Act (NFTPA) in 2003 (GoU, 2001; 2003). These new policies and legislations recognized the very roles played by local communities, NGOs, and private sectors in managing Uganda's forest estates. This resulted in development of CFM to enable organized communities to play key roles in forest management and conservation activities in government forests while improving their livelihoods. Before CFM came into play, thousands of Ugandans had taken up arms with either the forest or national park authorities over illegal occupation of protected areas (Egunyu 2015). The main cause of conflicts was over access rights and resource use (MWLE, 2003).

Other causes of conflicts were due to insensitive management styles employed by the state agencies, failure to deal with vermin and problem animals, and lack of opportunities for local communities to voice their concerns. Hence the CFM initiative was perceived by policy makers to be attractive and inclusive approach for involving communities in forest resources management (GoU, 2001). To date CFM has become an innovative approach promoted by government of Uganda to allow communities participate in forest management on both government and private forest lands to address the disincentives associated with the previous protectionist approach to forest management, and the destructive practices associated with open access to forest resources (GoU 2001). The CFM approach has well defined rights, roles and responsibilities of partners and the basis for sharing benefits for improved forest management with main focus of stakeholder participation, collective responsibility, equity, and improvement of livelihoods of forest dependent communities. John (1990) described CFM approach as more viable to create proprietary interests and rights to limited use of forests by communities and individuals. Hence the CFM approach was perceived by many policy makers as the better strategy to engage the local community in the management and benefit sharing from the forestry sector.

Cost-Benefit Analysis (CBA) is the most used decision-making tool developed by economists and has extensively been applied to environmental management problems by academics and policy makers too. Cost-Benefit Analysis compares outcomes on basis of what gives the greatest benefits to the greatest number of people, where by benefits here mean utility. One early suggestion on whether CBA could determine if a project/policy improved social welfare was proposed by an Italian economist Pareto as reported by Nick et al. (2001). A "Pareto Improvement" is where at least one person is made better off by a change and no one is made worse off. In such a situation, Pareto argued that most people would agree the society was better off. However, in practice, it is hard to find a resource allocation that does not impose costs on any one. The general principle in monetary valuation in CBA is to value all impacts in terms of their marginal social costs or marginal social benefits where social means evaluation with regard to the economy as a whole. Cost-benefit analysis has turned up to be one of the most useful economic tools as it addresses an important social concern where a wide variety of impacts can be included and compared in the same measurement unit, it poses an advantage over referendum as it takes both the direction and intensity of preferences, and also allows comparison of the economic value of an environmental protection as well as opportunity costs of protecting the environment.

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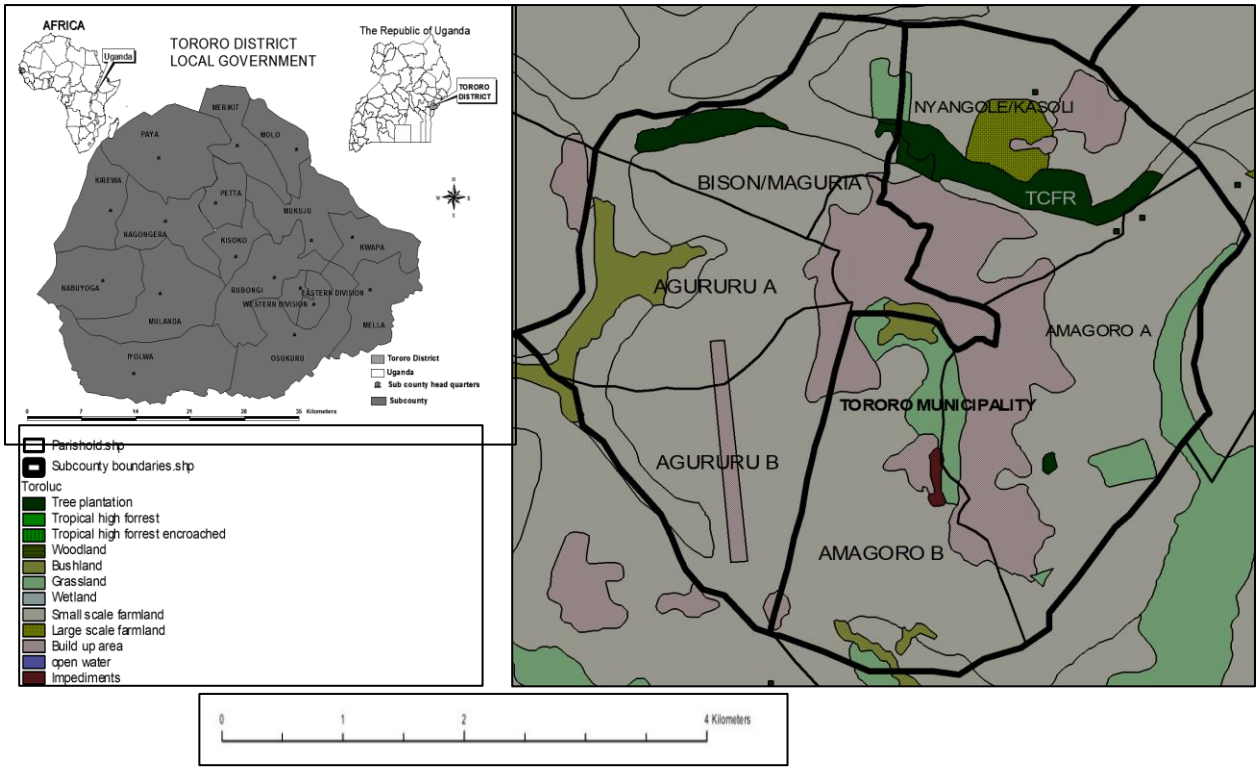
Since implementation of the CFM initiatives in Uganda, very few studies, for example by Buyinza (2010), have been undertaken on the cost-benefit analysis of CFM approach. Plan (1999) proposed that because of the benefits of biological diversity and the lack of information about these benefits, there was an urgent need for economic valuation to be carried out. O'Neill (1997) noted that a gap existed between the actual practice of management and the ideal practice offered by economics, hence the development of methods for placing monetary values on biodiversity and other environmental goods. By providing empirical data, economists would then understand the need to conserve forest resources so that benefits are appropriately captured and reflected in the national economic valuation system of the country. The overall objective of this study was to assess the economic costs and benefits of CFM policy implementation to Nyangole community of Tororo Central Forest Reserve (TCFR) in Tororo district – Eastern Uganda. The specific objectives were (i) to determine the economic costs incurred by Nyangole community on CFM activities. (ii) to determine the economic benefits of CFM activities to Nyangole community and (iii) to determine the profitability of CFM approach to Nyangole community.

METHODS

Study Area

The study was undertaken in Tororo Central Forest Reserve (TCFR) which is a peri-urban Eucalyptus plantation forest located in Tororo district in Eastern Uganda. It is located at 00 degrees 1' North and 33 degrees 34' East (*Figure 1*). TCFR is located within Tororo municipality in the Eastern Division and Nyangole village (*Figure 1*).

Figure 1: Location of Tororo Central Forest Reserve (TCFR).



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Soils in Tororo district consists of tertiary Pre-Elgon volcanic rocks of Tororo rocks and Osukuru hills with laterised clay, loam, and sand of which 60% are of low agricultural productivity. The area experiences sub-humid climate with two main peaks of rainfall ranging from 1,130 mm to 1,720 mm received during the months of May and October respectively. Temperatures in the area range from a minimum of 16.2 ^{0}C to a maximum of 28.7 ^{0}C with relative humidity of 84% - 91% respectively. Tororo forest reserves were gazetted in 1930s and first managed by Forest Department (FD) and later National Forest Authority (NFA) and District Forestry Services (DFS) respectively. During 1970s and 1980s TCFR was heavily encroached by the neighbouring communities and government agencies. Under the CFM initiative, 230 members of Nyangole community were allocated 17 hectares out of the 369 hectares of the total area of TCFR for planting trees for 49 years. This was through a lease agreement signed between FD and the Nyangole community in the year 2000. The community formed a CFM group and elected committees to manage the forest in accordance with its Management Plan (FD, 2000). Under the CFM agreement, Nyangole community paid USD 1.3 to FD as forest fee. This amount was charged per person per hectare per year to utilize the forest reserve and its resources. The CFM community benefited from NGO support through training of its members, which motivated them to participate voluntarily.

Research Design

A total of 150 (Sample size) respondents constituting 65% the total CFM group population were sampled to represent the overall population (230) of plot holders (Sample frame). Primary data was collected by use of questionnaire consisting of both open and closed ended questions and focus group discussions. Focus group discussions consisted of 6 - 10 members who were formed and moderated by Research Assistants to enable them give their opinions as was done by Babili and Wiersum (2010). Permission was sought from Makerere University, NFA management, local community leaders and the final questionnaire was approval before conducting interviews with the community members. The study was conducted in total adherence with relevant research ethical principles including the three main ones i.e., the principles of respect of persons, beneficence, and justice.

In applying these principles, interviewers sought and achieved informed consent and explained risk/benefit involved in the study, how they were selected, and assured respondents of confidentiality and voluntary participation. A consent form was prepared and signed by all respondents before participating in the study. For interviews and discussions recorded, all recordings were deleted immediately after transcription. All data records were stored on password secured laptops/computers and only accessible to the researchers. In reporting the data, the identities of participants were made anonymous to protect them. A permissible environment was created during the focus groups that natured different perceptions and point of view, without pressing participants to vote, plan, or reach consensus. Careful and systematic analysis of the discussions provided clues and insights as to how a product, service, or opportunity was perceived. An inventory of the forest plantation was also undertaken to estimate the total physical stock and stock density.

Plan (1999) indicated that the most important method for economic valuation of biodiversity was through Contingent Valuation Method (CVM). This was largely because it directly reflected the non-use-orientated (Bequest and existence) values of biodiversity. He further added that in addition to retrieving and exchanging information during the interview process, verbatim minutes and tape recordings allowed the interviewer to analyse biodiversity related knowledge and understanding of the interviewee ("Think allowed analysis").

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Contingent Valuation Method (CVM) as pointed out by Plan (1999) was used during the study to determine what value the community was willing to place on a hypothetical change involving loss or gain in their utility or satisfaction, either in terms of their Willingness to Pay (WTP) for an improvement, or their Willingness to Accept (WTAC) compensation for loss of a benefit. The basic idea of using CVM was that, where markets did not exist, it was construed or imagined that people were capable of expressing their preferences in this hypothetical situation. Contingent Valuation (CV) was used to assess how people valued environmental costs and benefits which involved asking them. The information generated in the focus group discussions on opportunity costs were then captured and used as primary data. Focus groups comprising of 6 - 10 people were used as was done by Babili and Wiersum (2010). In these focus group discussions, respondents were asked to state their maximum WTP and minimum WTAC values from which average prices were inferred from the overall totals.

Information on leisure time of visitors who travelled to the CFM site in Tororo district was found from the visitors' books kept by the Chairperson of CFM group and/or from the office of the district forest officer of Tororo. These records were also cross checked with the respondents through questionnaire. The data was then used to calculate working time, transport costs, and meals. Adrian (1998) guided that travel cost method was used to determine a person's value of an environmental good from what they spend on traveling in terms of time, travel expenditures, and entry fees and that travel cost methods were particularly useful for assessing the non-commercial tourism, recreation, and leisure values of protected areas. The Chairpersons of CFM group and Local Council One (LC 1) guided the research team through the villages. The Researcher with his team used Kiswahili or English languages for communicating with the community members. Use of these languages was based on the understanding of the languages by respondents. Contingent Valuation Method (CVM) was used to determine values of willingness to pay or willingness to accept payment for the forest reserve through organized focus group discussions.

Data Management and Analysis

The data collected was coded, summarized and analysed using Spreadsheet/Microsoft Excel computer program, SPSS version 11 and Chi-square statistical methods. The value of costs and benefits generated from the data were discounted to determine the Net Present Value (NPV) using the formula shown: -

$$NPV = \sum_{t=0}^{t=n} \frac{(Rt - Ct)}{(1 + r)}$$

Where: Rt = discounted revenue, Ct = discounted costs, r = discount rate, t = the enterprise's season, the equation adopted from Terry Lucy (2002). The summation ran from t = 0 (The first year of project) to time t = T (The last year of the project). No costs or benefits before year zero are counted. The criterion for project acceptance was accept if and only if NPV >0. Based on the PPI criterion, any project passing the NPV test was described to be an improvement in social welfare. There are a number of alternatives to the NPV criteria of which the most commonly employed are the Internal Rate of Returns (IRR) and the Benefit-Cost Ratio (BCR). Odida and Odida & Margaret (2002) said that the value of outflows consisted of streams of resources that went into plantation development in terms of materials, labour, and services employed in the project for a long time. Since benefits and losses of conservation programs are long-term in nature, they are discounted to establish the present value of future losses and benefits. In the case of this study, time value of 8 years at interest rate of 8% was used as discount rates as was proposed by Buncle et al. (2016). Chi-square ($\chi 2$) values, as an important extension of hypothesis testing, which was also used

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to compare the actual and observed distributions with a hypothesized or expected distribution, often referred to as "goodness of fit" test. Values of Chi-square ($\chi 2$) were calculated using the formula: -

$$\text{Chi} - \text{square}\ (\chi\ 2) = \sum \frac{[O-E]^2}{E}$$

Here: O = the observed frequency of any value, E = the expected frequency of any value. (Equation adopted from Terry Lucy, 2002). Chi-square tests were additionally done to understand differences in particular variables such as differences by gender; cohort or year of admission to the program, among others. On a daily basis, data collected from different sources were reviewed for consistency and logic checks that allowed for a great extent, the self-cleaning teams to correct any errors, inconsistencies, or inaccuracies that would arise. Qualitative data were analysed using thematic and content analysis following objectives of the study. All audio recorded interviews and focus group discussions were transcribed and typed onto word documents. Completed transcripts were coded and analysed following patterns and analytic reflections relating to the objective questions. Critical responses made by study participants were extracted from the respective KII/FGD transcripts and used in the report to strengthen and provide meaning to the quantitative data and enrich context information.

Sensitivity Analysis

Sensitivity analysis was used to prove whether an alternative was sensitive to risks or not. Terry Lucy (2002) said that sensitivity analysis was a practical way of showing effects of uncertainty by varying values of key factors (For example sales volume, prices, rates of inflation, and cost per unit) to indicate the resulting effects on the project. Sensitivity analysis was used during this study to show which factors affected the project most. Nick et al., (2001) said that an essential stage of any CBA is to conduct sensitivity analysis which means calculating the NPV where the values of certain key parameters are changed such as: (i) Discount rate, physical quantities, and qualities of inputs, (ii) Shadow price of these inputs, (iii) Physical quantities and qualities of outputs, (iv) Shadow prices of these outputs, and (v) Project lifespan. One criterion is to discover to which parameters the NPV outcome is most sensitive. FAO (2005) recommended that favourable benefit-cost ratio was an indication that the benefits outweighed costs and a project with benefit-cost ratio of more than one was considered to be cost effective.

RESULTS

Socio-Economic Characteristic/Profile

Socio-economic characteristic/ profile of the respondents indicated that 51.3% (n = 77/150) were males and 48.7% (n = 73/150) females respectively. The male participants were slightly more than females in the CFM group. The Chi-square values indicated that there was no significant difference in gender-based engagements in forestry activities since Chi-square (χ^2) calculated value was less than the tabulated values (Calculated value = 0.10 and tabulated value = 3.84 for 3 degree of freedom). *Figure 2* shows that 46.7% (n = 70/150) of the respondents were in the age brackets of 41 – 60 years followed by those in the age range of 20 – 40 years which was represented by 44.7% (n = 67/150). The rest of the respondents were either less than 20 years or more than 60 years of age represented by 4.7% and 4.0% respectively. Significant differences therefore existed in the range of ages of respondents since chi-calculated value was greater than chi-tabulated values (Chi-square (χ^2) calculated value = 106.65 and tabulated value = 7.82 for 3 degree of freedom). Therefore, majority of the respondents were in the age bracket of 41 – 60 years. This result depicted that CFM farmers were adult household heads. Respondents with age range of less than 20 years consisted of mostly children who replaced their parents who either died or relocated to settle in another place.

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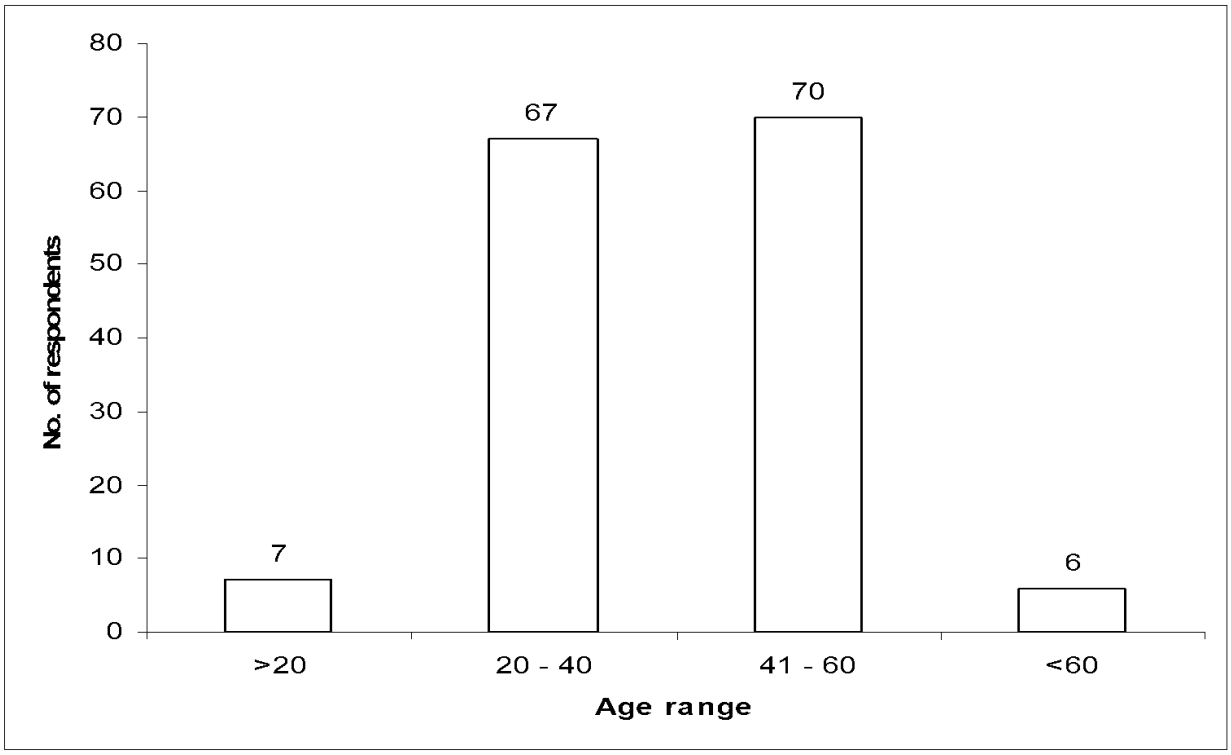
Figure 2: Age of respondents



The housing status of the respondents of Nyangole community showed that 51.3% (n = 77/150) of them lived in houses constructed with corrugated iron sheet roofs with wattle walls, while 31.3% (n = 47/150) lived in houses constructed with grass roofs and mud walls built with poles. Only 17.3% of the respondents lived in houses built with corrugated iron sheets and brick walls. The Chi-square values showed that there were overall significant differences in housing status of the respondents since the calculated Chi-square value was greater than the tabulated values [Chi-square (χ^2) calculated value = 26.28 and tabulated value = 5.99 for 2 degrees of freedom]. The result therefore indicated that the majority of Nyangole community lived in semi-permanent houses which were made of iron sheet roofs, wattles, and mud walls.

The educational level of the respondents revealed that 50% (n = 75/150) of the households attained primary level of education, 22.7% (n = 34/150) attained secondary level of education, at least 7.3% (n = 11/150) attained tertiary level of education, and 20% (n = 30/150) never attained any form of formal education. The Chi-square value [Chi-square (χ^2) calculated value = 35.06 and tabulated value = 7.82 for 3 degrees of freedom] showed that there were significant differences in levels of formal education attained by the community since the chi-calculated values were greater than the tabulated values. Generally, most of the respondents stopped at primary education level. The overall academic attainment picture therefore indicated that Nyangole community had low levels of education. In relation to size of land holdings among the respondents 59.3% (n = 89/150) owned less than one hectare, 37.3% owned about five hectares, 2% owned 6 – 10 hectares and 1.3% owned more than 10 hectares respectively. There was a significant difference in the size of land owned by respondents [Chi-square (χ^2) = 145.21).

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Economic costs of Collaborative Forest Management

The Nyangole community incurred economic costs during their participation in CFM activities in TCFR and these were incurred during land preparation, floods control/treatment of water, tree planting, and agriculture, hire of forest land, weeding, pruning, and forest protection from fire outbreaks as shown in table 1 for tree planting and management. Of the respondents 92.7% (n = 139/150) spent USD 440.0 – 800.0 per hectare per year on forest plantation establishment and management which totalled to USD 88,960.0 (Average of USD 640 per person multiplied by 139 respondents). Meanwhile 6.7% (n = 10/150) of the community spent USD 400.0 per hectare per year and in total USD 4,000.0 per hectare per year respectively (USD 400.0 multiplied by 10 respondents). Only one respondent represented by 0.7% (n = 1/150) spent between USD 640.0 - 1,200.0 per hectare per year and on average USD 1,040.0. Therefore, expenditure on tree planting and forest management was USD 94,000.0 per hectare per year (Expenditure of USD 10,480 in 17.0 hectares allocated for CFM) and an average of USD 6,000.0 per hectare per year per person.

Table 1: Cost of establishing and managing trees per hectare

Cost/Ha (in USD)	Total costs (in USD)	F	Percent
400.0	4,000.0	10	6.7
440.0 – 800.0	88,960.0	139	92.7
840.0 – 1,200.0	1,040.0	1	0.7
Total	94,000.0 (10,640,0 in 17 ha)	150	100.0

The cost of tree nursery management and agriculture is indicated in table 2. Where 60.7% (n = 91/150) of respondents spent USD 40.0 – 400.0 per hectare per year and a total of USD 20,040.0 respectively (USD 240.0 multiplied by 91 respondents) on tree nursery management and agricultural food crop management. Also 57.0% (n = 38/150) of the respondents spent USD 440.0 - 800.0 and USD 23,560.0 in total per annum respectively. Only one respondent spent USD 840.0 – 1,200.0 (Average of USD 1,040.0) and the other USD 1,240.0 - 1,600.0 (Average of USD 1,440.0) represented by 0.7%. Overall, the community spent USD 46,160.0 per hectare per year on tree nurseries and food crop production (USD 5,200.0 in the 17 hectares allocated for CFM).

Table 2: Cost of tree seedlings and crops

Cost/Ha (in USD)	Total cost (in USD)	f	%
40.0 – 400.0	20,040.0	91	60.7
440.0 – 800.0	23,560.0	57	38.0
840.0 – 1,200.0	1,040.0	1	0.7
1,240.0 – 1,600.0	46,080.0	1	0.7
Total	(USD 5,200.0 in 17 ha)	150	100.0

Nyangole community raised tree seedlings such as *Pinus caribaea, Eucalyptus grandis, E. camadulensis* and *Grivellea robusta* through their participation in CFM. The cost of flood mitigation, control, and treatment of water for domestic use is shown in table 3. Where 80.0% (n = 120/150) of the community spent USD 20.4 – 40.0 per year (Average of USD 30.2) and USD 3,640.0 in total to

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control floods or treat water for domestic use, 10.7% (n = 16/150) spent USD 10.0 – 20.0 (Average of USD 15.0) and USD 180.0 in total, while 9.3% (n = 14/150) spent USD 40.4 – 60.0 (Average of USD 50.0) and total of USD 702.5 per year respectively on floods thus making their total expenditure of USD 5,040.0 per year. Therefore, Nyangole community used their own resources and labour to control floods in TCFR under CFM programme.

Table 3: Cost of flood mitigation, control, and treatment of water

Cost of flood control	Cost in USD	f	%
10.0 – 20.0	180.0	16	10.7
20.4 – 40.0	3,640.0	20	80.0
40.4 – 60.0	720.0	14	9.3
Total	5,040.0	150	0.0

Being in a peri-urban dwelling, a total of 119 respondents bought at least 2 bags of charcoal per month from the market. Each bag weighting 50 Kg was bought at USD 8.0 and the two bags costed USD 16.0. Nyangole community bought charcoal from the market because they could not produce their own due to lack of suitable trees for charcoal production from the forest. Expenditure on charcoal (Table 4) was therefore considered as a cost. Meanwhile 79.3% (n = 119/150) of the respondents bought 1 - 2 bags of charcoal per month for cooking thus spending a total of USD 1,440.0 per year (1.5 bags times USD 8.0 times 119 respondents), 16.0% (n = 24/150) bought 3 – 4 bags totalling USD 680.0 and only 4% (n = 6/150) bought 4 - 5 bags of charcoal at USD 200.0 per year respectively. Finally, 0.7% (n = 1/150) bought 6 – 7 bags of charcoal at total cost of USD 40.0 per year. Overall, USD 2,360.0 was spent by the community on charcoal alone.

Table 4: Number of bags of charcoal bought by respondents per month

Number of bags of charcoal	Total value (in USD)	Frequency	Percent
1 – 2	2,360.0	119	79.3
3 – 4	680.0	24	16.0
4 – 5	200.0	6	4.0
6 – 7	40.0	1	0.7
Total	2,360.0	150	100.0

Economic Benefits of Collaborative Forest Management

The finding from the study revealed that Nyangole community benefited economically and socially from their participation in CFM as shown in the following sections. And the economic benefits from agriculture and tree seedlings are shown in table 5. Where 92.0% (n = 138/150) of the community earned USD 400.0 - 760.0 per year and USD 82,800.0 in total from sale of agricultural crops and tree seedlings (USD 600.0 on average multiplied by 138 respondents). Meanwhile 5.3% (n = 8/150) earned USD 800.0 – 1,160.0 per year and in total USD 800.0 (Average of USD 1,000.0 multiplied by eight respondents) respectively. Only one respondent represented by 0.7% (n = 1/150) earned USD 1,200.0 – 1,560.0 per year (USD 1,400.0 on average). Finally, 2% (n = 3/150) earned USD 1,600.0 – 1,960.0 per year and a total of USD 5,400.0 respectively (Average of USD 1,800.0 multiplied by three respondents). Overall, USD

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97,600.0 per year (USD 5,760.0 for the 17 hectares) was earned by the community.

Table 5: Income from agriculture and tree seedlings per year

Value of income (in USD)	Total income (in USD)	Frequency	Percent
400.0 – 760.0	82,800.0	138	92.0
800.0– 1,160.0	8,000.0	8	5.3
1,200.0 – 1,560.0	1,400.0	1	0.7
1,600.0 – 1,960.0	5,400.0	3	2.0
Total	89,600.0 (USD 5,760.0 in 17 ha)	150	100.0

Other benefits that accrued to the Nyangole community members included social interactions with the visitors coming from outside Tororo district. The visitors spent money on transport, meals, and leisure time. Secondary data obtained from the district forest office and Chairperson of CFM group and primary data collected through questionnaire showed that 708 visitors came to TCFR. These visitors were mainly from Kampala where CFM activities in Uganda were being coordinated. Visitors from other parts of the country and officers on duty had therefore first to report to the Forest Department Headquarters to get information on CFM and make travel arrangements. It was assumed that during each visit, four people travelled together in a double cabin pick up vehicle and spent USD 60.0 per trip on fuel (60 litres of diesel at USD 1.0 per litre). In a year they made 22 trips (176 trips in 8 years) and spent USD 1,320.0 (USD 60.0 per trip multiplied by 22 trips).

The time on leisure was obtained through interviews with some of the visitors and it showed that each visitor spent an average of 10 hours. Nick et al., (2001) said that leisure time was equivalent to 33% of the daily allowances of an individual. By the time of the study the government of Uganda was paying an average of USD 28.0 per night as allowances for civil servants (MPS, 2008). Based on the rate of 33%, expenditure on leisure time was calculated to be USD 9.2.0 per visitor per trip (33% multiplied by USD 28.0) and USD 800.0 per visitor per year (22 trips multiplied by four visitors and USD 9.2.0) respectively. Given an average of USD 6.0 was spent per person per day on meals, USD 520.0 (22 trips multiplied by four visitors and USD 6.0) was spent by all the visitors on meals per month and USD 2,640.0 per year (USD 1,320.0 for fuel added to USD 800.0 for leisure time and USD 520.0 for meals respectively). The expenditure from visitors (Table 6) was treated as benefits to Nyangole community during this study because they had to forego other activities and come to spend time at TCFR. These visitors facilitated social interactions leading to building of linkages and social networks.

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Table 6: Income from visitors

Year of travel	Frequency	Percent
2000	192	27.1
2001	144	20.3
2002	120	16.9
2003	56	7.9
2004	40	5.7
2005	96	13.6
2006	32	4.5
2007	28	4.0
Total	708	100.0

Water for Domestic Use, Tree Nursery and Agricultural Irrigation

Hydrological functions of TCFR showed that there was water for Nyangole community which they used for watering tree seedlings and vegetables during dry seasons. However, during the study, only water collected for domestic use, for animals to drink, and nursery work were valued as was done by Lim et al., (1997). The rationale was that the role of saline intrusion and flood prevention were assumed to have been encompassed and covered by water retained in the forest during rainy seasons. Water from this source was potentially availed for the agricultural production needs and domestic water supplies of the dry seasons.

In general 51.3% (n = 77/150) of the community used 2 - 5 jerry cans of water daily for irrigation and domestic use (Daily average of 3.5 jerry cans) and a total of 98,367.5 jerry cans annually (Daily average of 3.5 jerry cans multiplied by 77 respondents and 365 days of the year) respectively, 34.0% (n = 51/150) used 6 - 9 jerry cans of water per day and a total of 139,612.5 jerry cans in a year and only 6.7% (n = 10/150) used one jerry can per day and 3,650 in total per year respectively while 8.0% (n = 12/150) used 10 - 13 jerry cans per day (Daily average of 11.5) and a total of 50,370 jerry cans per year. Overall, 292,000 jerry cans of water were used per year by the community which was equivalent to 5,840 cubic meters (20 litre jerry can equal to 0.02 cubic meters). Therefore, the community spent USD 1,760.0 annually on water (5,840 multiplied by USD 0.3 per cubic meter of water).

Firewood Consumption

The respondents used 1 – 2 head loads of fire wood per week and 127.5 head loads per month (Average of 1.5 head loads multiplied 85 respondents). Total of 56.7% (n = 85/150) of the number of respondents represented by 17.3% (n = 26/150) used one head load and 3 - 4 head loads of fire wood per week. This was equivalent to a total of 117 head loads used per month. Meanwhile 8.7% (n = 13/150) of the respondents used 5 – 6 head loads of fire wood per week and 71.5 per month respectively. According to TDPU (2008) one head load of fire wood weighing 20 Kg was valued at USD 8.0. Hence 315.5 head loads of firewood (6,310 Kg) were consumed by the community per month and 3,786 (75,720 Kg or 75.7 tons) per annum. The community therefore incurred USD 600.0 (75.7 tons of fire wood multiplied by USD 8.0 per ton) annually on firewood.

Eucalyptus Poles Harvested by Nyangole Community

Table 7 shows number of poles of Eucalyptus harvested per month. 86.0% (n = 129/150) of the respondents harvested 1 – 10 poles of Eucalyptus monthly and 8,514 poles annually (Average of 5.5 poles multiplied by 129 respondents and 12 months), 8.7% (n = 13/150) harvested 2,418 poles,

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2% (n = 3/150) harvested 3,048 poles and 3.3% (n = 5/150) harvested 3,048 poles per year respectively. Overall, 17,028 poles were harvested by Nyangole community annually. Langoya et al., (2007) reported that one Eucalyptus tree which was cut was equivalent to two poles. Therefore, one hectare of class II poles on average supported 2,000 trees (About 180 – 250 m^3 and 215 m^3 on average). Since the price of class II pole was USD 0.6 (at the time of study), the value of 17,028 poles harvested by Nyangole community was equivalent to USD 9,520.0 per year.

Table 7: Number of Eucalyptus trees harvested per month

Monthly harvests of poles	Total No. harvested	USD	f	%
1 – 10	8,514	9,520.0	129	86.0
11 – 20	2,418	2,720.0	13	8.7
21 – 30	3,048	3,400.0	3	2.0
31 – 40	3,048	3,400.0	5	3.3
Total	17,028	19,040.0 (USD 9,520.0 in 17 ha)	150	100.0

Other benefits that accrued to the respondents included training. Total of 8% (n = 12/150) of the community received training benefits and 92% (n = 138/150) did not. Of those who benefited, 2% (n = 3/150) received USD 60.0 and 0.7% (n = 1/150) received USD 40.0 respectively. Others received USD 160.0 represented by 1.3% (n = 2/150) and USD 1,200.0 represented by 4% (n = 6/150) respectively. Total benefits amounted to USD 1,480.0 (Average of USD 9.7 per respondent per year). The result showed that Nyangole community received cash benefits from FD or NFA through participating in workshops. After training the respondents received farm inputs. 92.0% (n = 138/150) of the respondents received watering cans and polythene tubes worth USD 1,120.0 (USD 4.0 per kilogram of polythene tubes and USD 4.0 per watering can respectively). While 6.6% (n = 10/150) of the respondents received gumboots worth USD 60.0. Two respondents each represented by 0.7% received hoes and wheel barrows worth USD 41.6 ((USD 1.6 per hoe and USD 40.0 per wheelbarrow respectively). The overall value of inputs received by the community per year was USD 1,240.0 (Average of USD 92.0 per person per year).

Value of Environmental Goods and Services

The value of environmental goods and services (Table 8) were generated from choices made by respondents. Bid values of hypothetical markets were provided to the respondents as shown in table 8 from which they selected their maximum and minimum. The result showed that 50% of the respondents provided a number of values including zero. The zero-value indicated protest value for WTAC of the community which meant that the community never valued the goods and services of the forest. All such protest values were removed from the results as was done by the National Oceanic and Atmospheric Administration (NOAA) as cited by Nick et al., (2001) that average values of WTP/WTAC should be calculated after reducing the total values by 50%. Thus, total value of WTP/WTAC for the forest was USD 46,440.0 which was an indication of the community acceptance to pay for the goods and services of TCFR.

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Table 8: Value of willingness to pay/willingness to accept payment for environmental goods and services

Environmental goods	No.	Bid price WTP (US$)	Bid price WTAC (US$)	Average of WTP/ WTAC values (US$)	%
Felling of forest	4	200,000.0	0.0	0.0	8
Protection for sand mining	2	400.0	80.0	480.0	4
Protecting whole forest	6	8,000.0	800.0	26,400.0	12
Protection for bee keeping	8	2,000.0	400.0	9,600.0	16
Conservation for Aesthetics	4	4,000.0	800.0	9,600.0	8
Value for grazing	7	10,000.0	0.0	0.0	14
Value for fish farming	4	4,000.0	800.0	9,600.0	8
Environmental protection	4	8,000.0	1,600.0	19,200.0	8
Wind break	4	2,000.0	800.0	5,200.0	8
Seed collection value	2	0.0	1,600.0	0.0	4
Clean air	3	8,000.0	800.0	13,200.0	6
Collection of herbs	2	200.0	0.0	0.0	4
Total	50				100.0

Harvest of Mangoes

The Nyangole community harvested mangoes for consumption or to sale for money. Of the respondents 35.3% (n = 53/150) harvested 300 to 349 mangos per year (325 mangoes on average), 33.3% (n = 50/150) harvested 350 to 399 mangoes (375 mangoes on average) and 30.7% (n = 46/150) harvested 250 to 299 mangoes per year (average of 275) respectively. The highest number of mangoes harvested ranged from 400 to 499 (average of 450 mangoes) which was represented by 0.7% (n = 1/150). Overall, 47,450 mangoes were harvested by the community annually, some of which were traded in markets at USD 0.02 (TDPU, 2008). The 47,450 mangoes were valued at USD 960.0 (47,450 mangoes multiplied by USD 0.02). GoU (2001) reported that different methods of valuing non-market goods existed with some showing higher values for non-market benefits than others.

Stumpage Value of the Community Forests

In this study, the stumpage value of the forest plantation established by the community under CFM in TCFR was determined based on Lim et al., (1997). Stumpage meant trees standing in the forest un-severed from their stumps whose value was the difference between the price of logs/poles plus total cost of harvests and transport to the point of sale. The stock inventory of the forest showed that there were 1,992 of class II poles of Eucalyptus trees per hectare and 33,864 poles in the 17 hectares allocated to the community for CFM. The inventory result was similar to 2,000 poles per hectare reported by Langoya, et al. (2007). The value of 33,864 poles was equivalent to USD 18,960.0 (Rate per pole of USD 560.0). Given that a seven-ton lorry loaded 15 m^3 of poles per trip valued at USD 60.0, 243 trip loads from the total harvests was valued at USD 14,600 (3,640 m^3 divided by 15 m^3 per trip). Hence the net annul stumpage value of the forest was USD 33,560.0.

Summary of Economic Cost-Benefit Analysis

The total value of cash flows of the environmental costs and benefits of CFM to Nyangole community was discounted to obtain the Net Present Values (NPV). Since time value of money or resource

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changes over time, costs and benefits associated with CFM were discounted during this study. An interest rate of 8% for period of 8 years was used as was done by Lakshmikanthamma and Ninan, (2001). As indicated in Table 9, the total economic cost of CFM to Nyangole community was USD 23,280.0 while total economic benefits were USD 113,480.0 respectively.

Table 9: Summary of costs and benefits from CFM activities by Nyangole community

Costs			**Benefits**		
Item	**USD.**	**%**	**Item**	**USD**	**%**
Community woodlots			**Community woodlots**		
Tree planting	10,640.0	45.7	Stumpage value of Eucalyptus	33,560.0	29.6
Seedlings and crops	5,200.0	22.3	**Non-timber**		
Public Investments			Eucalyptus poles	19,040.0	16.8
Floods & water treatment	5,040.0	21.6	Seedlings and crops	5,760.0	5.0
Land rent	40.0	0.2	Fuel wood	600.0	0.5
Charcoal from markets	2,360.0	10.1	Fruits	960.0	0.8
-	-	-	**Other benefits**		
-	-	-	Visitors	2,640.0	2.3
-	-	-	Domestic water	1,760.0	1.5
-	-	-	Training	1,480.0	1.3
-	-	-	Inputs	1,240.0	1.1
-	-	-	**Contingent value**		
-	-	-	WTP/WTAC	46,440.0	40.9
Total costs	**23,280.0**	**100**	**Total benefits**	**113,480.0**	**100**

The study result shows that total costs of CFM incurred by Nyangole community amounted to USD 23,280.0, the bulk of which was spent on tree planting (Land preparation, silviculture, and management) consisting of 45.7% of the total costs. This was followed by establishment of tree nurseries and growing of crops (Agro forestry) which accounted for 13.0% of the total costs. Soil and water conservation measures by way of flood control and treatment of water for domestic use was about 12.6% of the total costs. Charcoal consumption from the market in absence of charcoal produced from the forest amounted to 5.9% of total costs. Lastly, payment for forest land rent or hire of the forest reserve from FD was 0.1 % of the total costs. Total benefits received by Nyangole community were USD 113,480.0 of which 40.9% went to contingent values and 29.6% to stumpage values. Benefits from harvested poles were 16.8% of the total benefits, 5.0% from sale of seedlings and crops and 1.5% from domestic water. Other benefits were from visitors 2.3%, training 1.3%, inputs 1.1%, fruits 0.5%, and firewood 0.5% respectively of the total benefits. Total value of discounted economic costs was USD 74,440.0 while total discounted economic benefits USD 396,720.0 (Discount rate of 8% for 8 years) respectively. The findings indicated that total economic benefits of CFM to Nyangole community were more than total economic costs by USD 322,280.0 (Benefit - cost ratio of 5:1). Economic profitability of Collaborative Forest Management: Table 10 shows that full benefits of CFM to Nyangole community ranged from USD 120,000.0 to 388,000.0 with benefit-cost ratio of 5.3 to 0.9 respectively. The findings revealed that when interest rates were high, benefits tended to reduce. A 25% across the board reduction was allowed as part of sensitivity analysis for the expected benefits from the CFM program

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which was done to test the vigorousness of the estimates under alternative scenarios.

Table 10: Net present values and benefit-cost ratios

Item	Discount rates			Discount rates		
	Net Present Values in USD			Benefit-cost ratio in USD		
	8%	10%	12%	8%	10%	12%
Full benefits less of costs	316.0	240.0	220.0	2,120.0	1,720	1,400.0
Benefits reduced by 25%	216.0	160.0	120.0	1,600.0	400.0	360.0

Based on the interest rate guideline provided by Buncle et al. (2016) the result indicated positive benefit - cost ratio of 5:1 for the CFM program (USD 396,720.0 divided by USD 74,440.0). Terry Lucy, (2002) reported that a project whose NPV was positive with CBA greater than one was profitable. Hence, the CFM program in Tororo district was therefore considered profitable since the NPV value was also positive.

DISCUSSION

There was an equality in gender representation within the Nyangole community involved in the implementation of CFM program in TCFR which was in line with GoU (2001) program policy of promoting gender mainstreaming in the forest sector. The trends therefore indicate that there was growing (but still small) interest and participation of women in forestry activities such as saw-milling, pit-sawing, and charcoal trading which were previously dominated by men (FAO, 2009). Most of the beneficiaries of CFM had lower income levels as shown by the state of the houses owned/rented by the community. The majority of the members had stopped at low levels of education as complimented by UBOS (2000). Omona (1998) however said that through education, societies were able to attack the evil of poverty and diseases at its sources and that education was critical factor (Pre-condition) in development since it provided basic skills such as literacy and innumeracy; as most specialized technical knowledge that modern methods of production and management demanded. The low level of education attainment by Nyangole community in this study could have constrained their efforts to move to higher levels of income. The land holding was equally small, leading to shortage of land for production and this may be a constraint to their development. IFAD (2002) reported that in countries like Tanzania and Zimbabwe, shortage of land for poor communities was a big problem which obstructed livelihood project interventions. The Nyangole community demonstrated high level of awareness about the government policies, legislations, and guidelines on CFM. This could have been due to the training they received from CFM supporting NGOs and Government departments.

The Nyangole community incurred economic costs while implementing the CFM partnership with FD in TCFR. These varied from costs on agricultural inputs, control of floods, land rent, tree planting and protection of the forest resources as a result of CFM. Odida and Margaret (2002) found out that it costed USD 480.0 per hectare per year to establish Coniferous Plantation in Budongo forest in Masindi district. Meanwhile results from this study indicated that the community incurred average annual expenditure of USD 600.0 per hectare on plantation establishment and management. The difference in the two results may be due to the site and time variations for the two studies. For example, TCFR is in a peri-urban setting while Budongo forest was in a rural setting.

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Economic benefits of CFM received by the Nyangole community were mainly from sale of poles, access to forest resources, visitors, and water. Other benefits were from allowances received during training, inputs, optional values, hydrological functions, and harvest of mangoes. Of importance was the benefits received from fuel wood consumption and sale which the community obtained from the forest reserve. Moreover, greater proportion (86%) of households in Tororo district used firewood for cooking (TDPU, 2008) which thus provided the market for their products. Apart from the benefits from the community planted forests (17 hectares allocated) of Eucalyptus trees and food crops, the community got involved in bee keeping and savings credit schemes to keep their earnings from sale of forest resources and food crops. In addition, the community expanded its commercial tree nurseries management activities along the roadsides for ease of accessibility to the public. The community also harvested non-forest products such as honey, water, tree seeds, herbs, mushroom, and fruits from TCFR. The only non-forest products valued in this study were mangoes and water collected by the community members due to their prominence.

Although the full value of these opportunity costs was not estimated in this study, there is a potential to develop the tourism sector, considering that TCFR is located close to the urban centre of Tororo municipality and other urban centres. Manyindo (2003) said that in the Buhoma valley in Western Uganda, just outside Bwindi Impenetrable national park, many local businesses were established to offer goods and services to visitors. He further said that in case of Ssese islands in Lake Victoria in Uganda such economic benefits of ecotourism were derived from entry fees, licenses, concessions, and tourism expenditures on lodging, transportation, food, guides, and souvenirs as well as employment which improved house hold incomes. GoU (2001) documented the annual gross revenues earned by FD from ecotourism in Budongo and Mabira forests as USD 10,800.0 which was from the visitors who travelled from Europe and other parts of the world to Uganda to see natural areas. The findings on WTP/WTAC of Nyangole community revealed that they willingly accepted to pay for the goods and services of TCFR. According to O'Neil (1997), the total wellbeing produced by a policy option was ascertained by measuring the strength of preferences of affected parties for or against its realization by the willingness to pay measures, and aggregating the results in standard cost-benefit analysis. Adrian (1998) said that people revealed their values for the benefits derived from a protected area through WTP for those benefits or WTAC compensation for forgoing the benefits.

Based on this study, the profitability of CFM as measured by benefit-cost ratio value was 5:1. A positive NPV value with CBA of greater than one was also obtained. According to Terry Lucy (2002), such a scenario meant that the program was profitable thus the profitability of the CFM program implemented by Nyangole community in TCFR. It was also reported by GoU (2003) that from the pilot sites where CFM was implemented in Uganda, it led to improvement of forest revenues and revenue sharing with communities which created sense of ownership and responsibility of the community. This study has shown that there was improvement in inter personal relationships with responsible bodies such as NFA, UWA, and the former FD staff which led to improvement in the resolution of conflicts and promotion of forest regeneration. The GoU (2003) report further indicated that CFM program in the TCFR greatly reduced poverty, improved quality of life for the women, and equity in access to forest resources, empowered communities to share authority, and make decisions, increased employment and led to acquisition of new skills. Similar findings have been reported for Watershed Development Programs (WDP) initiated in India (Lakshmikanthamma & Ninan 2001).

Results reported by GoU (2001) on cash out flows estimated annual economic contribution of the

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forest sector to the Gross Domestic Product (GDP) of Uganda was estimated to be 6%. Howard (1995) said that significant benefits were received by households living adjacent to protected areas such as wildlife reserves in spite of costs incurred from wild life which damaged their property. Buyinza (2010) similarly reported that a cost-benefit analysis conducted to examine the level of net economic benefits received from forest produce in Mt. Elgon national park had positive effect on poverty reduction and imparted significant improvement in livelihoods as well as forest conservation status. To date, CFM has continued to be practiced by Nyangole community in partnership with NFA after FD was restructured (GoU, 2003). Scott (1998; 1999) further reported that CFM activities in Uganda improved people's livelihoods and sustainable management of forests under community holdings. Economic improvements such as a greater degree of forest job security reduced unemployment, revitalized local economy, and recreational attractions which provided additional sources of revenue from the forests. These findings are thus in favour of promotion of the CFM policy as a tool for both improvement of the livelihoods of the local community and to promote sustainable use of forestry sector. Therefore, lessons learnt from the current study could serve as model for promoting community forestry.

CONCLUSION AND RECOMMANDATION

The government policy change on forestry management through CFM was beneficial to Nyangole community which improved inter-personal relationships and sustainable management of TCFR. We recommend that TCFR should continue to be managed under CFM partnership between government and Nyangole community since benefits of this partnership were greater than costs incurred by them. In addition, future studies should be undertaken to factor in the aspects such as hydrological and carbon sequencing benefits of CFM.

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