



Appendix D
Forest Economic Assessment Report

Bujagali Hydro-Electric Power Project

Economic Assessment of Resource Values Affected by the 220 KV Powerline Wayleave Traversing Mabira, Kifu and Namyoya Central Forest Reserves

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REPORT

Acronyms and Abbreviations

AAC	Annual Allowable Cut
AR	Average Annual Net Benefit
CFM	Collaborative Forest Management
CFR	Central Forest Reserve
CVM	Contingent Valuation Method
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
FD	Forest Department
FGD	Focus Group Discussion
FORRI	Forestry Resources Research Institute
GFF	Greater Forest Functions
Ha	Hectare
MAFICO	Mabira Forest Integrated Community Organisation
MPA	Management Plan Area
MUIENR	Makerere University Institute of Environment and Natural Resources
MW	Mega Watt
NARS	National Agricultural Research Systems
NFA	National Forestry Authority
NPV	Net Present Value
NTFP	Non-Timber Forest Product
SNR	Strict Nature Reserve
TCM	Travel Cost Method
TEV	Total Economic Value
THF	Tropical High Forest
ToR	Terms of Reference
TPV	Total Present Value
USD	United States Dollar
USHS	Uganda Shillings
WTP	Willingness to Pay

Executive Summary

In order to evacuate electricity from the proposed power plant at Dumbbell Island on the River Nile and carry it to Kampala and other parts of Uganda, a 220 KV transmission line is to be installed. The proposed routing of the line passes through Mabira, Kifu and Namyoya CFRs. The powerline Wayleave traversing the three forests is 40 metres wide on the northern side of the existing 132 KV line.

Both the *National Environment Act* and the *National Forestry and Tree Planting Act* require that for certain major developments such as the installation of the powerline through the three forests, an environmental impact assessment (or environmental impact study) should be carried out. The same requirement holds in respect of the World Bank environmental and social safeguard policies. This report constitutes part of the environmental impact assessment process. In particular, the study is concerned with assessing the economic impact of the development in terms of resources lost and benefits foregone. The estimates were derived from both primary and secondary data and follow the principle of total economic value of forests.

The results of the study suggest a timber stock (50 cm + dbh) worth US\$ 307.6 million will be lost in Mabira CFR. The present value of timber benefit streams obtained from long-run sustainable yield in Mabira CFR and timber values foregone in the plantations of Kifu and Namyoya CFRs were estimated at US\$ 157.1 million. Furthermore, the present value of other annual benefit streams from forest products, biodiversity, domestic water, carbon storage and ecotourism was estimated at US\$ 37.2 million. The present value of annual ground rent payments was calculated to be US\$ 13.6 million. Other values which include immature tree plantings and incremental management costs had a present value of US\$ 18.4 million. Hence the total values lost or foregone was estimated at US\$ 533.9 million.

Of the total amount of values lost or foregone, the NFA can realise US\$ 307.6 million from the disposal of the standing crop in Mabira CFR through its auction process. The Developer on the other hand, should compensate the NFA for lost forest benefits and added management responsibilities to the tune of US\$ 226.3 million. The table below shows a summary of economic values lost or foregone.

Summary Impact Area Economic Values Lost or Foregone (UShs ‘000s)*

<i>Value Sources</i>	<i>Amount</i>
A. NATURAL FOREST GROWING STOCK	307,557
B. PRESENT VALUE OF BENEFITS STREAMS	
1. Timber	157,127
2. Poles + Firewood	4,788
3. Non-Timber Forest Products	5,399
4. Biodiversity	1,555
5. Domestic Water	4,334
6. Carbon Storage	18,243
7. Ecotourism	2,888
8. Landtake	<u>13,635</u>
SubTotal B	<u>207,969</u>
C. OTHERS	
1. Immature Tree Plantings	1,826
2. Management Costs	<u>16,552</u>
SubTotal C	<u>18,378</u>
D. TOTAL (B+C)	<u>226,347</u>
E. TOTAL (A+B+C)	<u>533,904</u>

* - corrected to nearest 1000

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1.0 Introduction

1.1 Background

Bujagali Energy Ltd. (BEL), a project-specific company owned by World Power Holdings, LLC of Luxembourg and IPS (Kenya) Limited proposes to build, own and operate a 250 MW hydro electric power plant at Dumbbell Island on the River Nile. To evacuate electricity from the generating station Uganda Electricity Transmission Company Limited (UETCL) proposes to construct a transmission line from the power generation house to Kampala. The aligned route passes through mostly private land. However, the line also passes through three central forest reserves (CFRs) – Mabira CFR, Kifu CFR and Namyoya CFR (*Figure 1*). The powerline Wayleave through the three forests is 40 metres (m) wide along the northern side of the existing 132 kV transmission line.

The National Environment Act Cap 153 and the National Forestry and Tree Planting Act require that for certain developments such as the installation of the powerline in forest areas, an environmental impact assessment (EIA) should be carried out. The same holds with respect to the World Bank’s environmental and social safeguard policies. Furthermore, these policy and legal instruments call for the fair compensation of any resources that will be lost as a result of the development. This, therefore, calls for an economic assessment of the value of forest resources which will be lost as a result of the 40m wide Wayleave. Economic valuation is a tool that can provide decisionmakers with useful information with which to decide between alternatives or in favour of preferred combinations of possible interventions. In this case, economic valuation was used to arrive at a fair and objective estimation of the value of resources which will be lost or foregone as a result of the Wayleave so as to guide negotiations on the appropriate level of compensation. The value of forests depends not only on the market prices of its direct uses but is also based on other indirect uses of the forest resources that cannot be traded on some kind of market.

1.2 Project description

The project will involve the clearance of a 40m wide area along the entire length traversing Mabira, Kifu and Namyoya CFRs, on the northern side of the existing 132 kV line.

Table 1 shows the Mabira CFR compartments through which the proposed line passes. The data excludes community enclaves. In Mabira CFR, the line passes through 8.26 km of production (Encroachment) zone¹, 3.72 km of production/low impact zone², and 5.63 km of recreation buffer zone.

¹ The production (encroachment) zone comprises compartments that had previously (in the 1970s) been encroached. The name does not mean encroachment is allowed in this zone.

² Although designated production/low impact management zone, the 0.7 km of the line passing through Compartment 234 is in a severely encroached area with no timber. However, the area contains a young crop of *Terminalia sp.* less than 1 year old.

Within Kifu CFR, the line passes through a 0.9 km stretch of forest plantation planted with *Araucaria cunninghamii* and owned by NFA. Similarly, the line passes through 1.9 km of *Eucalyptus grandis* plantations owned by private tree farmers licenced by the NFA in Namyoya CFR. Consequently, the total length of Wayleave through the CFRs (excluding community enclaves) is 20.5 km going through natural and plantation forests.

Table 2 shows the total area of impact in the three CFRs is about 81.8 ha made up of 70.4 ha in Mabira CFR, 3.7 ha in Kifu CFR and 7.7 ha in Namuyoya CFR.

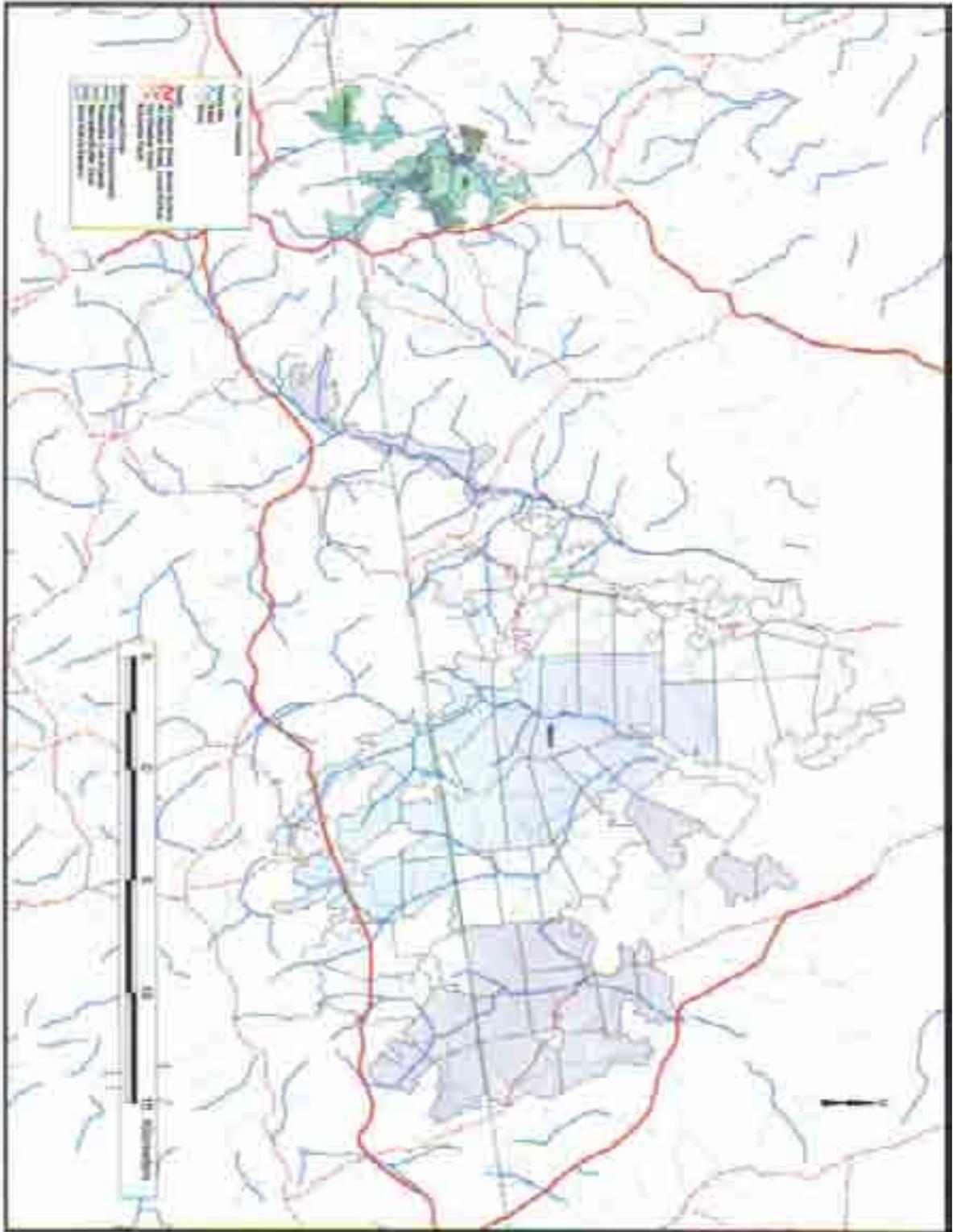
Table 1. Project Impact Area in Mabira CFR Alone

Compartment	Management Zone	Area (ha)
173	Production (Encroachment)	10.02
179	Production (Encroachment)	7.78
185	Production (Encroachment)	12.44
192	Production (Low Impact)	13.02
202	Recreation/Buffer Zone	6.27
203	Recreation/Buffer Zone	5.16
206	Recreation/Buffer Zone	1.68
207	Recreation/Buffer Zone	8.23
211	Recreation/Buffer Zone	1.16
229	Production (Low Impact)	1.87
234	Production (Encroachment)	2.81
Totals		70.44

Table 2. Combined Total Project Impact Areas in Mabira CFR, Kifu CFR and Namyoya CFR

CFR	Impact Area (ha)	Description
Mabira	33.05	Production (Encroachment)
	14.89	Production/Low Impact
	22.50	Recreation/Buffer Management Zone Includes crop of <i>Araucaria cunninghamii</i> less than 1 year old
Kifu	3.70	<i>Araucaria cunninghamii</i> owned by the NFA
Namyoya	7.70	Two <i>Eucalyptus grandis</i> plantations privately owned and grown under licence/permit from the NFA
TOTAL PROJECT IMPACT AREA	81.84	

Figure 1. New Power Line Through Mabira, Kifu and Namyoya CFRs



1.3 Scope of the assignment

The Terms of Reference (ToR) of the study required a comprehensive Economic Assessment of the environmental and natural resources impacts of the establishment of the 220 kV Electric Transmission Wayleave through the central forest reserves.

The conceptual, spatial and temporal scope of the study were as follows:

- the conceptual scope of the study involved the estimation of total economic value (TEV) of the forest areas affected. In this context, due to the small area of forestland withdrawn the bequest and existence values will not be significantly affected by the Wayleave. Hence, only direct use and indirect use and option values were considered. Direct use values are those deriving from timber, poles, firewood, non-timber forest products (NTFPs), water and ecotourism. The indirect use value considered consisted only of carbon sequestration values since the area affected will be too small to make any significant impact on watershed values of the three CFRs. The option value considered concerned the loss of biodiversity.
- the temporal aspect of the study related to considering annualised stream of net resource benefits capitalised at an appropriate discount rate to arrive at net present values (NPVs); and
- the spatial scope of the study was limited to a 40m width along the entire length of the sections of CFRs the line is proposed to traverse. The spatial scope was indexed to the appropriate forest zones, considered on compartment by compartment basis in Mabira CFR, and ownership of planted crops in Kifu and Namyoya CFRs.

1.4 Report structure

This economic assessment report of forest values is divided into five chapters including this introduction as Chapter 1.0. Characteristics of the three CFRs is presented in Chapter 2.0 and relate primarily to general area physical characteristics, climate, flora, fauna and forest enclaves for Mabira; and descriptions of the plantations in Kifu and Namyoya. Chapter 3.0 was devoted to impact analysis beginning with defining the systems boundaries and then to a closer examination of the three CFRs. Chapter 4.0 was dedicated to economic valuation covering the theory and practice of forest valuation, methodologies employed and estimates of economic values of significant impacts. Chapter 5.0 looked at several mitigation options, and is followed by References and Annexes.

2.0 Area Characteristics

While the proposed transmission line passes through both public and private lands, this report covers the former. In particular, the report is devoted to the three CFRs – Mabira, Kifu and Namyoya. Hence any enclaves of community areas such as those in Mabira were not covered since they are not within the boundaries of the CFR and valuation follows different legal approaches.

2.2 Mabira Central Forest Reserve³

Mabira Forest reserve was established in 1900 (under the Buganda Agreement). It lies in the counties of Buikwe and Nakifuma in the administrative district of Mukono. It occupies an area of 306 km² with an altitudinal range of 1070-1340 m above sea level and is situated between latitude 0⁰ 22' and 0⁰ 35' and between longitude 32⁰ 56' and 33⁰ 02'E. The Forest Reserve is, therefore, the largest natural high forest in the Lake Victoria crescent.

Mabira Forest Reserve is located in a heavily settled agricultural area close to large urban centres including Kampala, Lugazi, Mukono and Jinja. This makes it a very important refugium and eco-tourist destination. The location of the forest also makes it a very important source of forest products whose demand has increasingly grown in the towns mentioned earlier. The management of Mabira forest therefore, currently caters for production, conservation and recreational functions of the forest ecosystem.

Whereas the forest suffered considerable destruction through illegal removal of forest produce and agricultural encroachment which activities threatened the integrity of the forest, these have now been controlled and the forest has near regained its original integrity.

Vegetation

The vegetation in Mabira Forest is dominated by *Celtis-Chrysophyllum* medium altitude moist semi-deciduous Tropical High Forest communities of type D1 (95% equivalent to 292 km²). The remaining 5 % of the forest area is made up of medium altitude moist evergreen forest communities of *Piptadeniastrum-Albizia-Celtis* tree species (Langdale-Brown, 1964).

Mabira Forest is a dominantly sub-climax forest which is just recovering from a long period of exploitation and encroachment. The forest is, therefore, made up of young colonising mixed forest trees dominated by *Maesopsis eminii* (25%), young mixed *Celtis-Holoptelea spp.* (60%), and mixed wet valley bottom species dominated by *Baikiaea spp.* (15%).

The forest also suffered selective felling (creaming) of high value trees (ie. Class 1A and B) in the last twenty or so years and today, only retains a small percentage of such trees (including *Milicia excelsa*, *Holoptelea grandis* and *Olea welwitschii*) in the growing stock (0.06%). Most trees in the forest are Class III fee group tree species making up as much as

³ Description of Mabira CFR is adapted from Muramira (2000)

52.4% of all trees of all fee groups. The remaining 47.5% of the growing stock is comprised of Class II fee group tree species including *Celtis species*, *Albizia species*, *Alstonia boonei* and *Funtumia africana*. The forest is notably dominated by Paper Mulberry (*Broussonetia papyriferra*) particularly in the previously heavily encroached areas (25.1%). Whereas *Broussonetia papyriferra* is an exotic tree specie with clearly invasive characteristics, the specie is not considered a threat to natural regeneration. In fact, the tree species has been noticed to help the natural regeneration of indigenous tree species including *Antiaris africana*, *Prunus africana*, *Lovoa trichilioides* and *Celtis species*, which require shade and forest cover for their successful regeneration. *Broussonetia papyriferra* has also quickly taken up areas which would otherwise be invaded by pioneer grasses like *Imperata cylindricum* which discourage regeneration and growth of indigenous forest cover. The species is also a very important source of firewood (Davenport *et al*, 1996).

Birds

The birds of Mabira Forest have been subjected to a considerable amount of survey work including regular surveys, summarized by Carswell (1986). Birds are arguably therefore, the best known faunal group in Mabira forest.

The bird species list for Mabira Forest now stands at 287 species of which 109 were recorded during the 1992-1994 Forest Department Biodiversity Inventory (Davenport *et al*, 1996). These include three species listed as threatened by the Red Data Books (Collar *et al*, 1994) i.e. the blue swallow (*Hirundo atrocaerulea*), the papyrus Gonolek (*Laniarius mufumbiri*) and Nahan's Francolin (*Francolini nahani*).

Mammals

A number of recordings of the mammalian diversity of the Mabira Forest Reserve have been done in the last thirty years. The most comprehensive published study of the mammals of the forest however, is that by the Forest Department of 1996 (Davenport *et al* 1996). The Davenport report documented 17 new species of small mammals found in the forest. Other recordings include those by the Tropical Forest Diversity Project (1987-88 on woody vegetation, birds and mammals); Kingdon (1971) on mangabeys and red tailed monkeys; and Delany (1975) for rodents.

The Davenport report indicates a high incidence of small forest dependent mammal species including *Deomys ferrugineus* and *Scutisorex somereni*. The two mammals are closed forest-dependent specialists and are often regarded as the most sensitive indicators of forest disturbance. The Uganda endemic shrew *Crocidura selina*, only previously recorded in Mabira Forest and reported in 1990 is again recorded in the Davenport report (Davenport *et al*. 1996).

Butterflies and Moths

Mabira Forest Reserve is considered rich in terms of the diversity of its butterfly fauna (Davenport *et al*. 1996). The forest supports a variety of forest dependent butterflies, as well

as a number of uncommon and restricted-range species. Despite a recent history of intensive human disturbance, the butterfly fauna of Mabira Forest has shown marked resilience.

Mabira forest reserve is a home to two sub-species which are endemic to Uganda including *Tanuetheira timon orientius* (for which Ugandan forests are the eastern limit of the species' range) and *Acraea lycoentebbia* (Davenport *et al.* 1996).

The moth fauna is typical of large forests situated on the lake crescent. Mabira Forest Reserve supports a few rainforest species from West and Central Africa. A total of 52 hawk moth and 45 silk moth species characteristic of closed canopy forests and forest edges live in the forest. Several lowland species have also been recorded. Compared with other major forests in Southern and Western Uganda, Mabira Forest is a high-ranking site for silk moths, but less so for hawk moths. This is because the Eastern range of most West African hawk moth species does not extend to this region.

Objectives of Management

The location, unique species richness and productivity of Mabira Forest Reserve, impart to it special qualities demanding a multiple objective management approach. The objectives of management of the forest therefore, are:

- to conserve and enhance forest biodiversity and ecological conditions;
- to produce timber and non-timber products on a sustainable yield basis using the most efficient methods (i.e. without compromising the capability of the forest to provide environmental services);
- to integrate the communities within the forest enclaves and parishes surrounding the forest reserve into the management of the forest;
- to provide recreational facilities for the people of Ugandan citizen, visitors and tourists; and
- to carry out research aimed at obtaining information on various aspects of forest ecosystem dynamics for the improvement of the management of Mabira Forest in particular, and other forests in general.

To achieve the above management objectives, Mabira forest reserve is divided into five working circles namely:

- the conservation working circle consisting of 13 compartments including compartments 198-202, 207-210 and 213-216 as the Strict Nature Reserve;
- the production working circle consisting of 45 compartments which include compartments 171-188, 192-197, 217-237 and 71 ha of Kalagala Falls forest reserve;

- the community participation working circle to pilot Collaborative Forest Management (CFM) within selected forest enclaves and parishes surrounding the forest reserve;
- the recreation working circle consisting of 9 compartments which include compartments 189-191, 203-206, 211-212 and 33 ha of Kalagala Falls forest reserve totaling 4,097 ha; and
- the research working circle.

2.3 Kifu Central Forest Reserve⁴

Kifu CFR covers an area of 1419 ha (Statutory Instrument No. 63, 1998). It was gazetted in 1932. The CFR is located in close proximity to Mukono Town Council; just off the Mukono-Kayunga Highway (32 km from Kampala City and about 6 km from Mukono Town).

Originally Kifu CFR was a well-stocked Natural High Forest. It held Greater Forest Functions (GFF) in addition to water catchment. The CFR is drained by several rivers and streams (Kifu, Kasota, Lwajali and Ssezibwa) which flow into Lake Victoria. The population around Kifu CFR, rapidly urbanising, exerted pressure on the reserve as a result of ever greater demand for fuelwood and other livelihood activities. This pressure led to the degradation of the reserve and reduced the flow of most of the forest use values. Currently, the NFA is implementing the following management objectives:

- to restore the forest through planting of mixed broad leaved species;
- to demonstrate fast growing tree species with high yield;
- to promote *ex situ* conservation by way of maintaining superior seed tree species; and
- to implement technologies and forest management practices for poverty reduction and reduce pressure on the forest reserve.

The foregoing objectives are being met through the creation of three land use categories as follows.

- Research – 425 ha has been licensed to the Forestry Resources Research Institute (FORRI) under the National Agricultural Research Systems (NARS) programme
- Private plantation establishment (694 ha)
- NFA management practices (300 ha), of which about 79 ha has been planted (*Table 3*).

Wayleave construction in Kifu CFR passes through the land use category of NFA Management Practices, and covers 3.713 ha. Of this area only 2.4 ha has been planted. The crop of *Araucaria cunninghamii* is now 5 years old. The remainder is severely degraded natural forest area. *A. cunninghamii* is grown on 25-year economic rotation in Uganda.

⁴ The description which follows was obtained from NFA records.

Table 3. Demonstration, Restoration and Seed Species by NFA in Kifu CFR

Tree species	Area planted (ha)	Planting date	Age (yrs)	Remarks
<i>Araucaria cunninghamii</i>	26.5	May 2001 Oct 2002 April 2003	5 4 3	Fast growing timber species with high Yield
<i>Araucaria haustenii</i>	2	Oct 2002	4	
<i>Araucaria agathis</i>	2	Oct 2002	4	
<i>Araucaria cunninghamii</i> and <i>Araucaria haustenii</i>	6	1974	32yrs	Superior seed tree species /Seed/Mother stand for seedling production
	3	1971-72	34yrs	
<i>Araucaria cunninghamii</i> and <i>Araucaria haustenii</i>	10	1974	32yrs	Under trial
	4	1971-72	34yrs	
<i>Maesopsis emnii</i>	15	May 2001	5	Natural forest restoration / Broad leaved
<i>Cedrella odorata</i>	1	May 2002	4	Quality Timber species, High demand
<i>Eucalyptus Citrodora</i>	3.7	May 2004	2	Technology for poverty reduction (Essential oils / Medicinal)
<i>Eucalyptus paniculata</i>	1	May 2004	2	Charcoal production trials
	2	May 2005	1	
<i>Eucalyptus cleosiana</i>	1	May 2005	1	Poles and Charcoal production trials
<i>Eucalyptus grandis</i>	2	Dec 2004	2	Pole production
Grafted Pine	0.25	Nov 2002	4	Hybrid seed production

Total area planted = 79.45 ha

Source: NFA Records

2.4 Namyoya Central Forest Reserve

Similar to Kifu, the Namyoya CFR was originally a natural forest but now entirely converted to plantation forestry. The entire CFR is allocated to private tree farmers initially on 5-year lease permits by the Forest Department (FD). These permits are now being converted to 25-year licences which allows a private tree farmer to harvest at least three crops of Eucalyptus suitable as electric poles (on 8-year economic rotation basis).

3.0 Impact Analysis

3.1 Systems boundaries

The systems boundaries have been defined in terms of valuation area, magnitude of development impacts, management costs, and other considerations.

Valuation area

The valuation area is only 40 m wide on the northern side of the existing 132 kV line along sections of the forest through which the transmission line passes. Defined thus, the valuation area consists of both natural and plantation forests, the first assessed according to the different zones specified in the Forest Management Plan 1997-2007 for Mabira CFR; and the latter based on age and species of plantings for Kifu CFR and Namyoya CFR. For Mabira CFR recognition was given to the fact that not all compartments are homogenous and benefit streams were therefore estimated on compartment by compartment basis. Detailed maps of the three CFRs showing the areas to be impacted by the Wayleave construction are presented in *Annex 1*.

Magnitudes of development impacts

Only significant impacts were considered in the impact analysis. What this meant was that by and large, the hydrological functions of the forests will be largely left unaffected since much smaller areas relative to the total area of the reserve will be impacted. Similarly, the construction and subsequent maintenance of the Wayleave will have virtually no noticeable impact on options, bequest and existence values except for considerations of loss of biodiversity (under option values).

Management costs

Monitoring of mitigation measures will entail additional management effort by the NFA. Furthermore, the NFA is about to begin preparing a new Forest Management Plan (FMP) for Mabira CFR and, as such, the impacts of the proposed transmission line will also have to be addressed during the process.

Plantations

Only established plantation tree crops were considered for estimates of future values foregone based on the length of the license issued to the tree farmer. For the Kifu CFR plantation crop, the NFA is equated to a private tree farmer and applicable licence periods used as a basis for calculating benefits foregone. For eucalyptus planting, a crop of more than 1 year is considered established. For other species, a crop of 5 years is considered established. For plantings less than the age of establishment, investments lost in ground clearing, planting, beating up and weeding were considered.

Other considerations

Some 5.1 ha of land in community enclaves in Mabira CFR, owned by individuals, will be affected. These areas need to be compensated for to allow the Developer to enjoy unencumbered access. However, the compensation was excluded from the economic assessment in Mabira CFR, since a different methodology would be required and the areas are not part of the reserve as further explained below.

3.2 Triangulation and ground truthing

A significant amount of the information used in the analytical part of this report was obtained from secondary sources. However, a conscious effort was made to triangulate and ‘ground truth’ the information with on the ground work. This was achieved using key informant interviews, focus group discussions, participant observations, and a semi-structured household survey using questionnaires.

In general, it was clear that Mabira CFR, the main area of concern because of its natural forest cover, provides a number of livelihood opportunities for the communities in the enclaves and the surrounding areas. From key informant interviews and participant observation, the restoration of the degraded parts of Mabira and maintaining the ecotourism attributes of the CFR features prominently as stakeholder interests. During the Focus Group Discussions (FGDs) hunting, firewood and the harvesting of medicinal plants for home consumption and limited intra-community sales were highlighted as significant non-timber uses. Households also emphasized the important role Mabira CFR plays in ensuring clean supplies of water.

On the other hand, communities were either ambivalent or welcomed the development. Those in favour of the development requested that suitable young and energetic members be considered for employment in project work. With respect to compensatory investments, the communities would like the Developer to commit resources towards putting up classroom blocks and providing classroom furniture. The communities also requested that the Developer should ensure community roads used during the construction of the Wayleave be left in a sound condition. Finally, the communities requested that electricity be made available in their enclaves and surrounding areas.

Details of Key Informant Interviews are presented in *Annex 2*; Focus Group Discussions in *Annex 3*; and Household Survey in *Annex 4*.

4.0 Economic Valuation

4.1 Theory

Forests in general are complex ecosystems and generate a range of goods and services. For purposes of determining the magnitudes of net benefits lost due to conversion of a forest to other development options, the total economic value (TEV) approach was chosen as the most comprehensive. The TEV is made up of use and non-use values. The use values in turn consist of direct and indirect use values; while the non-use values consist of options, bequest and existence values. This classification was characterised by Monasinghe (1992). *Figure 2*, shows adaptation of the classification by Lette & de Boo (2002).

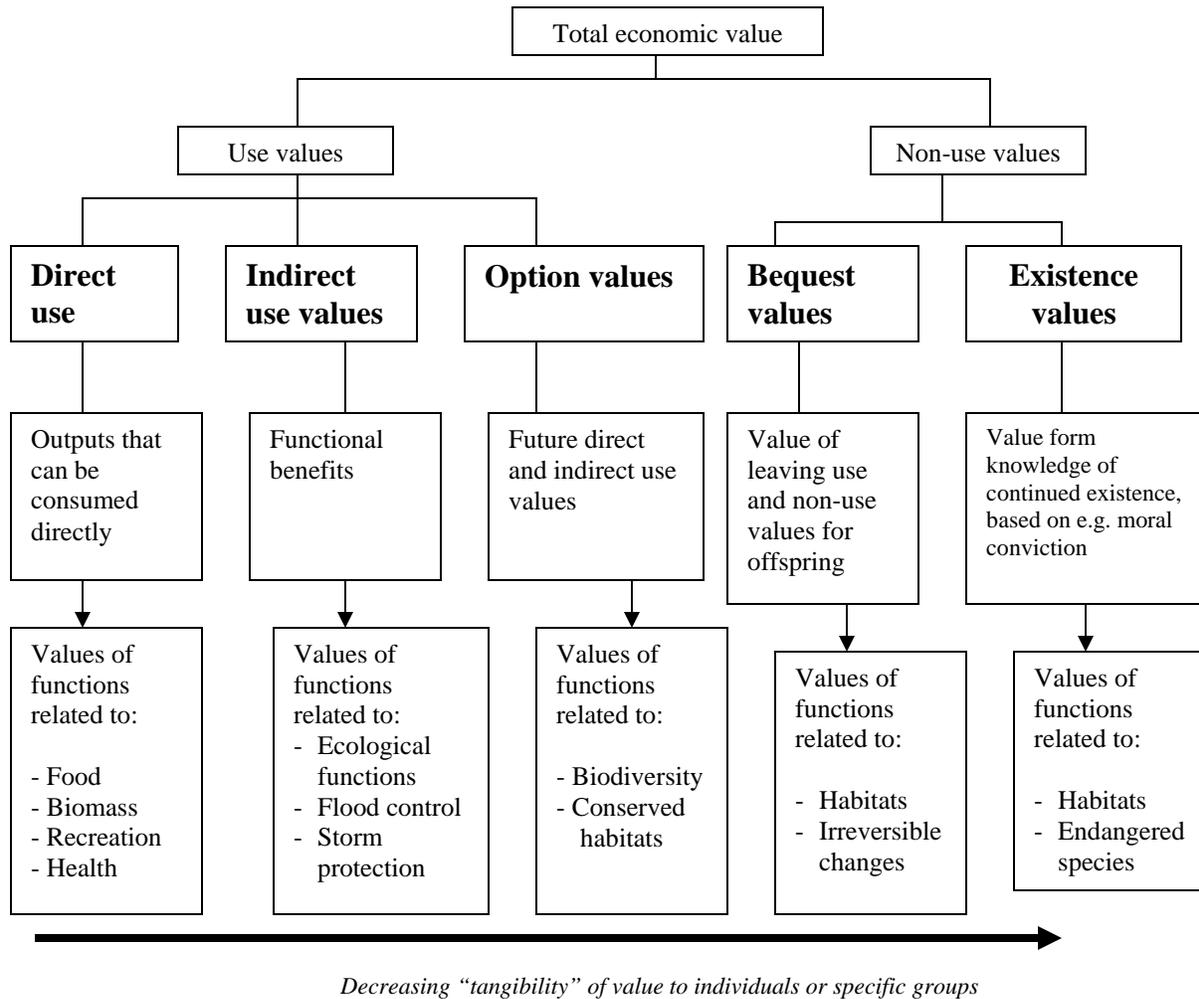
Economic valuation is a tool for decisionmaking intended to compare the advantages and disadvantages of alternative development options or alternatives. The value of forests depends not only on the market prices of its direct uses but is also based on other indirect uses of the forest resources that cannot be traded on some kind of market (Lette & de Boo 2002). Valuation of the goods and services provided by forests is needed because these areas are under great pressure and are in fact disappearing. Extensive areas of Mabira CFR were severely encroached not too long ago (Karani *et al* 1997). The natural forest cover of Kifu CFR and Namyoya CFR have been completely destroyed and the areas have now reverted to plantation forests. The lack of knowledge and awareness of the total value of the goods and services provided by the forest resources will obscure the ecological and social impact of the conversion of forests into other uses. Proper valuation of all goods and services provided by a forest can help us understand the extent to which those who benefit from the forest or its conversion also bear the associated management costs or opportunities foregone (Lette & de Boo 2002). As part of an expanding response to declining global biodiversity (Daily & Walker 2000), interdisciplinary research teams of economists and ecologists have conducted valuation exercises designed to estimate the costs (Ando *et al* 1998; Montgomery *et al* 1999; Balmford *et al* 2003) and benefits (Pimentel *et al* 1997; Costanza *et al* 1997; Balmford *et al* 2002) of forest use alterations.

Despite the importance of the valuation of forests and nature, under-valuation was and still is the order of the day, as a result of market and policy failures (Lette & de Boo 2002). Market failure has been identified as one of the major causes of under-valuation (Lette & de Boo 2002). For example, when determining the economic value of a forest, decisionmakers usually only take into account the easily quantifiable – financial – costs and benefits related to goods and services traded on the market, whereas there are numerous functions of forests for which markets malfunction, are distorted or simply do not exist (Lette & de Boo 2002). Markets only exist for some of the production functions of forests, such as timber, fuelwood, and non-timber products. However, even if markets exist, market prices for these goods may not reflect their real value, since markets can be distorted, for example by subsidies which represent policy failures (Lette & de Boo 2002). The authors suggest that the market price of a particular good may not reflect all the costs involved in producing that good because there may be benefits or costs enjoyed or borne by others not directly involved in the production of the good, what economists call externalities (Lette & de Boo 2002).

With respect to the valuation of a forest using the total economic value approach, the following terms are defined as follows.

- *direct use values* – benefits that accrue directly to the users of forests, whether extractive (e.g. timber and NTFPs) or non-extractive (e.g. ecotourism);
- *indirect use values* – benefits that accrue indirectly to users of forests, primarily ecological or environmental services;
- *option value* – the amount that individuals would be willing to pay to conserve a forest for future use (e.g. biodiversity values);
- *bequest value* – the value attached to the knowledge that others might benefit from a forest area in the future; and
- *existence value* – the value placed by non-users on the knowledge that something exists, i.e. its intrinsic value.

Figure 2. The Total Economic Value of Forests



Source: Lette & de Boo (2002); Munasinghe (1992)

Various valuation tools have been developed to estimate the monetary value of non-marketed goods and services (Lette & de Boo 2002). Munasinghe’s classification of major value categories has proved to be a useful analytical tool to link value categories and their underlying environmental goods and services with specific valuation tools (Munasinghe 1992; Lette & de Boo 2002) as shown in *Table 4*.

While the direct use value of goods and services traded on the market can be easily translated into monetary terms by taking their market prices, there are a lot of other goods and services often conceived as having direct use values. These functions can be better valued by means of other valuation tools (e.g. Related Goods Approach, Hedonic Pricing or Travel Cost Method). The regulation functions of forests from which indirect use value is perceived can also be valued by various valuation tools (e.g. Replacement Cost Technique, Production Function Approach). To capture option, bequest and existence values, Contingent Valuation

Method (CVM) is used to estimate the monetary value of environmental amenities. Lette & de Boo (2002) have cautioned on the use of valuation tools as follows:

“It must be emphasised that none of these valuation tools provides comprehensive answers. All of them value only part of the goods and services provided by forests and nature. They all have limitations and should be chosen and used with care. Using several valuation tools for a single object case, could contribute to a more complete valuation”

Table 4. Example of links between value category, functions and valuation tools

USE	USE VALUES		NON-USE VALUES		
	1. Direct use value	2. Indirect use value	3. Option value	4. Bequest value	5. Existence value
FUNCTIONS	Wood products (timber, fuel)	Watershed protection	Possible future uses of the goods and services mentioned in 1&2 (Use Values) by actual stakeholders	Possible future uses of the goods and services mentioned in 1&2 (use Values) by the offspring of actual stakeholders	Biodiversity Culture, heritage Benefits to stakeholders of only knowing of the existence of goods or services without using them
	Non-wood products (food, medicine, genetic material)	Nutrient cycling			
	Educational, recreational and cultural uses	Air pollution reduction			
	Human habitat	Micro-climatic regulation			
	Carbon storage				
	Tool to be used:	Tool to be used:	Tool to be used:	Tool to be used:	Tool to be used:
VALUATION TOOLS	Market Analysis	Restoration Cost	Contingent Valuation Method	Contingent Valuation Method	Contingent Valuation Method
	Related Goods Approaches	Preventive Expenditure			
	Travel Cost Method	Production Function Approach			
	Contingent Valuation Method	Replacement Costs			
	Hedonic Pricing				

Source: Lette & de Boo (2002)

The foregoing tools have been successfully applied in the valuation of several tropical high forests and other ecosystems. Naidoo & Adamowicz (2005) quantified the costs and benefits of avian biodiversity in Mabira CFR through a combination of economic surveys of tourists, spatial land-use analyses, and species-area relationship. The results showed that revising entrance fees and redistributing ecotourism revenues would protect 114 of the 143 forest bird

species under current market conditions. This total would increase if entrance fees were optimised to capture the tourists' willingness to pay for forest visits and the chance of seeing increased numbers of bird species.

Beukering & Cesar (2001) calculated the total economic value of the Leuser ecosystem in the Philippines under conservation and deforestation scenarios using extended Cost-Benefit Analysis and found that the conservation scenario far outweighed the deforestation scenario and they concluded that the ecosystem would be in the interests of the local population, local and national governments, and the international community. Hadker *et al* (1997) used the Contingent Valuation Method to estimate willingness-to-pay on the part of residents of Bombay (Mumbai) for the maintenance of Borivli National Park, located within the City's limits. The study arrived at a willingness-to-pay of 7.5 rupees per month per household, which amounted to a total present value of 1033 million rupees (or USD 31.6 million). The authors suggested that this figure could be used to influence policy decisions, given that the Protected Area at the time ran on a budget of 17 million rupees (USD 520 000).

Menkhaus & Lober (1995) used the Travel Cost Method (TCM) to determine the value that tourists from the US placed on Costa Rican rainforests as ecotourism destinations using the Monteverde Cloud Reserve as a sampling site. Consumer surplus was estimated to be approximately USD 1150, representing the average annual per person valuation of the ecotourism value of PAs in Costa Rica. The ecotourist value of the Monteverde Cloud Forest Reserve was obtained by multiplying the total number of visitors by the average consumer surplus. This resulted in a total annual US ecotourism value of USD 4.5 million for the Monteverde Reserve.

Janssen & Padilla (1999) used a combination of Cost-Benefit Analysis and Multi-Criteria Analysis to assess the opportunity cost of preservation and analyse tradeoffs to be made in deciding whether to preserve or convert a mangrove forest in the Philippines. The result showed that the aquaculture alternatives performed better than the forestry alternatives and preservation in terms of economic efficiency.

Kramer *et al* (1995) used a combination of valuation tools (Contingent Valuation combined with Opportunity Cost Analysis and Recreation Demand Analysis) to investigate changes in environmental values resulting from the creation of Mantadia National Park in Madagascar. Kramer *et al* (1993) used Contingent Valuation Method to determine the value of tropical rainforest protection as a global environmental good. Using two approaches the authors determined the average willingness-to-pay of US citizens at USD 24 to 31 and extending to all US households, total willingness-to-pay was estimated at USD 2180 to 2820 million per year.

Sikoyo (1995), used the Contingent Valuation Method to determine community direct use benefits from Bwindi Impenetrable Forest National Park in Uganda; while Moyini & Uwimbabazi (2001) used the Travel Cost Method and the Contingent Valuation Method to determine the Mountain gorilla tourism value of Bwindi Impenetrable Forest National Park. The results showed a consumer surplus of USD 100.

Muramira (2000) estimated the value of the overall impact of Wayleave construction through Mabira at USD 340,202 and suggested that this money be set aside to address the environmental impacts of the development. The author used inventory and market analysis, secondary information on resource usage and willingness-to-pay studies in comparable areas and project data.

4.2 Analytical framework

The analytical approach adopted in this report consists of the following.

1. Resource values were estimated from the perspective of net benefit streams, annualised, and then their present values obtained by capitalising the average annual benefits stream using the Government of Uganda's social opportunity cost of capital of 12%.

That is, the present value of product or service (i) equals average annual net benefits (economic rent) capitalised by the social opportunity cost of capital, or:

$$PV_i = AR_i/r$$

where

PV_i - present value of product i

AR_i – average annual net benefit from product i

r – social opportunity cost of capital (discount rate)

Subsequently, the total present value of the Wayleave impact area is given by the equation $TPV = \sum_{i=1}^n (AR_i/r)$

where

TPV-stands for total present value.

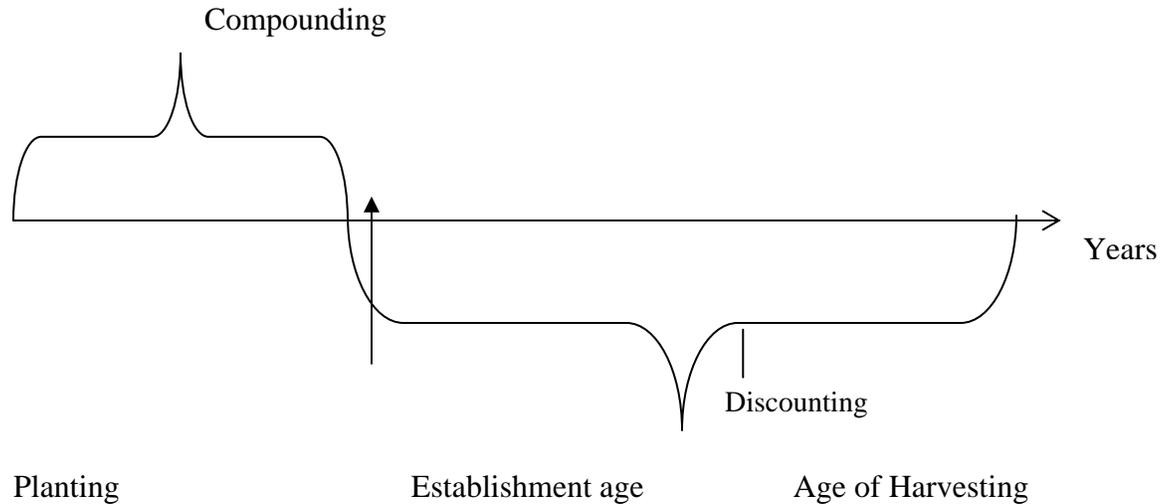
n – number of products

The approach is a good measure of the opportunity cost (or forest benefits foregone) as a result of the Wayleave construction in Mabira CFR.

2. For Mabira CFR, the volume of the standing timber is the capital stock from which benefits are derived, and not the stream of benefits themselves. The Developer compensates the NFA for forest benefits foregone. Therefore, the capital stock remains the property of the NFA and represents an encumbrance to the construction of the Wayleave. One option is for the NFA to issue a salvage operation licence for a third party to remove this encumbrance, preferably at a net benefit to the Authority.
3. In calculating the streams of benefits arising from timber, poles and firewood, stumpage values and not market prices were used.
4. The powerline from Bujagali while passing through Mabira CFR also traverses Kifu CFR and Namyoya CFR, areas which are now under plantation, rather than natural,

forests compared to Mabira CFR. The plantations are production-oriented, supplying timber, poles and firewood. Where the tree crop is below the age which is considered established, the present value of costs incurred was the eligible item for compensation. On the other hand, benefits streams were calculated for tree crops above establishment stage using the appropriate stumpage values.

For the forest plantations of Kifu and Namyoya CFRs, the capitalisation of annual benefits would not be appropriate. For one, the yield of benefits are not annual. Rather, they are periodic. For purposes of this valuation 25 years for *Eucalyptus sp* and 50 years for *Araucaria sp* were used since the permits granted though renewable do not immediately satisfy long-run continuity conditions and the areas planted have not been compartmentalised to yield even annual returns. Hence, plantation expenses incurred up to establishment age should be compounded while those to be incurred from the present to full rotation age discounted as shown below. The same applies to benefits.



In other words, the present value of net benefits accruing between now and subsequent harvests is given by the following formulae:

$$PVc = C / 1/(1+r)^t \text{ for costs; and}$$

$$PVb = B / 1/(1+r)^t \text{ for benefits}$$

$$\text{or } PVnb = (B-C) / 1/(1+r)^t$$

where:

PVc – present value of cost

PVb – present value of benefit

C – cost

B – benefit

PVnb – present value of net benefits (benefits less costs)

r – social opportunity cost of capital

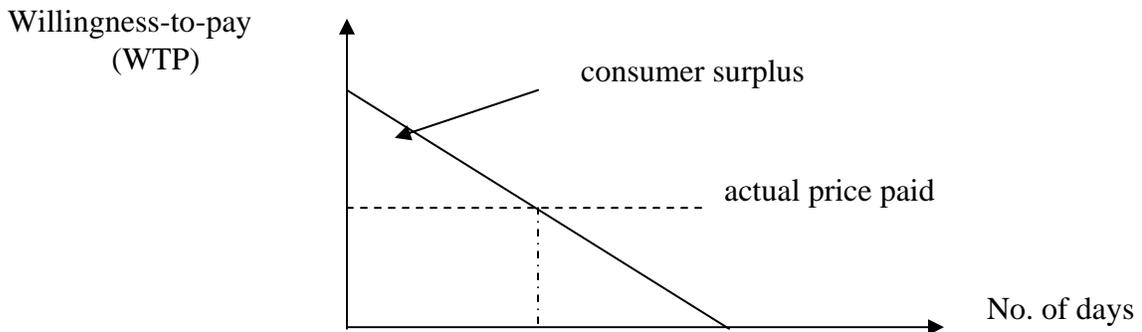
t – time

On the other hand, for expenses incurred earlier – such as planting, beating up and weeding before a crop is considered established – the value of those investments were amortised as follows:

$$PVc = C (1+r)^t$$

5. The basis for calculating the value of forests for ecotourism is the consumer surplus, representing the price tourists are willing-to-pay, up and above what they actually pay for the ecotourism experience (*Figure 3*). Ecotourism is an important activity in Mabira CFR but not Kifu and Namyoya central forest reserves.

Figure 3. Graphic Illustration of Willingness to Pay



6. *Non-timber forest products* are harvested in Mabira CFR and not the other two reserves. This study used the extensive research of Bush *et al* (2004) on community livelihoods in representative forests in Uganda. The results of their research was used in this study, augmented by the Consultants’ household survey and Focus Group Discussions (FGDs), among others.
7. *Carbon sequestration* values were derived from Bush *et al* (2004) where average values of tonnes of carbon per unit area per year have been estimated multiplied by the appropriate domestic market price prevailing then for carbon.
8. *Hydrological functions* were omitted from calculations for compensation for the reason that the area of forest removed for the Wayleave construction is too small to affect the hydrological functions of the forest. However, water conservation values, based on supply of water for forest communities were estimated as part of the livelihoods contribution.
9. *Bequest and Existence Values* were also removed from the calculations on the basis that the area required for the Wayleave construction is too small to significantly affect the bequest and existence values of Mabira CFR.

10. Biodiversity values were estimated using secondary data from research in comparable areas. Being forest plantation areas, Kifu CFR and Namyoya CFR were assumed to have minimal biodiversity richness and hence values were estimated only for Mabira CFR.
11. Small parts of Buwoola and Namusa community enclaves extend into Mabira CFR and will be impacted by the development. This *land is owned by individuals* who should be compensated so that the Developer has quiet enjoyment of its use rights in Mabira. However, the valuation of the lands is outside the scope of this study as explained earlier.
12. *Landtake*. The Developer is expected to obtain a use right for the Wayleave construction from the NFA. The use right is issued free of charge. However, an annual ground rent will be levied on forest land withdrawals for the Wayleave Construction. The NFA charges a ground rent of US\$ 20,000 per hectare per annum. The present value of this annual payment was estimated.

4.3 Data gathering methods

The study used six approaches to gathering data, as shown below.

Secondary data through review of literature, project documents and records of the NFA. Data on forest characteristics, value of the forest for community livelihoods, carbon sequestration and biodiversity values were derived.

Consultations and meetings were held with the management and field staff of the NFA, and with representatives of community organisations to obtain site-specific information.

Stock assessment. The Makerere University Institute of Environment and Natural Resources (MUIENR) carried out detailed biodiversity assessment in Mabira CFR as part of a biodiversity inventory survey. The data related to timber stocking was to be used to calculate the volume of timber which would be removed as a result of the Wayleave construction. However, to the extent that the NFA is best suited to carry out timber inventory for its auction process and preparation of management plans, the accuracy of the volume of standing timber crop is less important compared to estimates of annual allowance cut (AAC). Hence timber inventory data from the Forest Management Plan were used. Plantation data for Kifu and Namyoya were obtained from the inventory work of the NFA.

Key informant interviews were conducted with individuals who were informed about the three CFRs. They were: Steven Khauka currently Manager of the Tree Seed Centre and formerly in charge of planning at the NFA; executive committee members of Mabira Forest Integrated Conservation Organisation (MAFICO); and the staff of the Mabira Ecotourism Centre. Their views are presented in *Annex 2*.

Focus Group Discussions (FGDs) were held with three communities within the enclaves and surrounding Mabira CFR. Meetings were held at Buwoola, Ssesse and Sanga. The purpose of these meetings was to elicit the views of the communities with respect to the importance they attach to, and the livelihoods values they derive from, Mabira CFR (see *Annex 3* for details).

Household survey was conducted using a structured questionnaire based on the format of the Bush *et al* (2004) study to determine community livelihoods derived from Mabira CFR. It was assumed the benefits to communities surrounding Kifu CFR and Namyoya CFR were negligible and therefore these were excluded from the calculations of total livelihoods. Results of the household survey are presented in *Annex 4*.

4.4 Mabira CFR

Timber

Table 5 shows that the impact area for the line passing through Mabira CFR holds a standing volume of 2,808.1 m³ for trees of 50 cm diameter at breast height (dbh) and above.

Table 6 shows the exploitable timber yield. The data indicate a long-run sustainable yield (LRSY) of 1m³/ha/year for the species desired for timber made up of 21% Class I, 31% of Class II timber and 48% of Class III timber.

The LRSY timber yield in the Wayleave impact area was, therefore, estimated at 67.6m³/year (*Table 7*).

To convert the sustainable volume removals into monetary terms, the stumpage values (or reserve prices the NFA uses for its timber auctioning business) were obtained from the Authority. The stumpage value for each timber utilisation class was simply the average for all the species in that class. *Table 8* shows stumpage values for different species in Mabira CFR. Average stumpage values (at 100% management costs, per cubic metre) for the different utilisation classes were estimated as: UShs 172,770 for Class I; UShs 102,511 for Class II and UShs 86,385 for Class III⁵.

⁵ Historically bidders have paid prices slightly above the reserve prices.

Table 5. Estimates of Standing Timber Crop in Area of Impact^a

Compartment No.	Impact Area (ha)	Volume/ha ^b (m ³ /ha)	Total Volume (m ³)	Management Zone
173	10.02	8.1	81.2	Production /Encroachment
179	7.78	30.2	235.0	Production /Encroachment
185	12.44	8.1	100.8	Production /Encroachment
192	13.02	60.3	785.1	Production /Low impact
202	6.27	59.3	371.8	Recreation / Buffer Zone
203	5.16	61.8	318.9	Recreation / Buffer Zone
206	1.68	56.4	94.8	Recreation / Buffer Zone
207	8.23	79.1	651.0	Recreation / Buffer Zone
211	1.16	60.7	70.4	Recreation / Buffer Zone
229	1.87	53.0	99.1	Production /Low Impact
Totals	67.63		2,808.1	

/a – Compartment 234 excluded because there were no large trees in the area of impact

/b – Appendix 7, Mabira CFR Forest Management Plan 1997 – 2007

Source: Karani *et al* (1997)

**Table 6. Mabira Forest Exploitable Timber Yield Trees above 50cm dbh
(based on 60 year felling cycle for whole forest - 30,305 ha)**

A. By Species	Utilisation Class	m ³ /ha	m ³ /yr	m ³ /ha/yr
Albizia	I	7.2	3,636	0.120
Alstonia	II	3.4	1,717	0.057
Antiaris	II	4.6	2,323	0.077
Celtis	II	18.3	9,243	0.305
Chrysophyllum	II	2.4	1,212	0.040
Trilepsium	III	1.9	959	0.031
Cola gigantea	III	1.2	606	0.020
Ficus	III	2.7	1,363	0.045
Other species	III	13	6,866	0.217
		60.0	30,305	1.000
B. By Utilisation Class				
		12.5	6,312	0.208
Class I		28.7	14,495	0.479
Class II		18.8	9,794	0.313
Class III		60	30,601	1.000

Source: Karani *et al* (1997), Table 9.

Table 7. Exploitable Natural Forest Timber Yield in the Impact Area

Compartment	Impact Area (ha)	Annual timber yield (m ³ /year)			Total Volume/Year (m ³)
		Class I	Class II	Class III	
173	10.02	2.1	3.1	4.8	10.0
179	7.78	1.6	2.4	3.7	7.7
185	12.44	2.6	3.9	6.0	12.5
192	13.02	2.7	4.1	6.2	13.0
202	6.27	1.3	2.0	3.0	6.3
203	5.16	1.1	1.6	2.5	5.2
206	1.68	0.3	0.5	0.8	1.6
207	8.23	1.7	2.6	3.9	8.2
211	1.16	0.2	0.4	0.6	1.2
229	1.87	0.4	0.6	0.9	1.9
Totals		14.0	21.2	32.4	67.6

/a - based on the following: 0.208m³/ha/year for Class I, 0.313 m³/ha/year for Class II and 0.479 m³/ha/year for Class III. Derived from Karani *et al* (1997)

To convert the sustainable volume removals into monetary terms, the stumpage values (reserve prices the NFA uses for its timber auctioning business) were obtained from the Authority. The stumpage value for each timber utilisation class was arrived at by obtaining the average for all species in that class. *Table 8* shows stumpage values for different species in Mabira CFR. Average stumpage values per cubic metre (at 100% management costs) for the different utilisation classes where subsequently estimated at: Ushs 172,770 for Class I; Ushs 102,511 for Class II; and Ushs 86,386 for Class III⁶.

Using the foregoing stumpage values multiplied by the volumes in each class presented in *Table 8*, one arrives at an annual stream of timber values of:

Class	Amount (Ushs)/year
I	2,418,780
II	2,173,233
III	2,798,906
Total	7,390,919

Capitalising this annual timber benefits flow by 12% per year (social opportunity cost of capital) gives a present value of Ushs 61,590,992, representing the timber (sawlogs/peer logs) production opportunity cost.

⁶ Historically, purchases of standing timber have paid in excess of the NFA's reserve prices. Hence, these values should be considered conservative.

The value of the standing crop was estimated using data presented in *Table 5* and assuming the total volume represents 21% Class I, 31% Class II, and 48% Class III. That is:

$$V_{sc} = P_1 (2808.1 * S_{pi}) + P_2 (2808.1 * S_{pii}) + P_3 (2808.1 * S_{piii})$$

where

V_{sc} – volume of standing crop in the impact area

S_{pi} , S_{pii} and S_{piii} represent stumpage values for Class I, Class II and Class III, respectively

P_1 , P_2 , and P_3 represent the proportion of the different utilisation classes, where $P_1 = 0.21$, $P_2 = 0.48$, and $P_3 = 0.31$.

Therefore:

$$\begin{aligned} V_{sc} &= 0.21 (2808.1 * 172,770) + 0.31 (2808.1 * 102,511) + 0.48 (2808.1 * 86,385) \\ &= 101,882,642 + 89,236,953 + 116,437,305 \\ &= 307,556,900 \end{aligned}$$

Hence the value of the standing timber crop in Mabira CFR area of impact was established to be Ushs 307,556,900 for trees having dbh of 50 cm and above.

Table 8. Stumpage Values for Mabira

Species	Stumpage Values (Ushs /m ³)		
	Base	75%*	100%*
Muvule	126,667	151,553	201,565
Nkoba	90,476	108,252	143,975
Aningeria / chysophyllum	104,953	125,572	167,011
Albizia	72,381	86,602	115,181
Maesopsis	65,143	77,942	103,663
Nkuzanyana	54,289	64,951	86,385
Antiaris	25,333	30,311	40,314

* refers to management cost levels

Source: NFA databank

Poles and Firewood

The Management Plan for Mabira CFR 1997-2007 did not encourage the harvesting of poles from the forest. The Plan had this to say in Prescription No. 30.

“ Though a limited quantity of poles is permitted for domestic use, there are attempts to collect and sell poles due to socioeconomic pressures. There is absolute need to watch out for any large quantities collected by people neighbouring the reserves, as a small business. The FD (now the

NFA) staff will investigate any suspected cases and take appropriate steps to stamp out the practice”.

Karani, *et al* (1997).

Similarly, for fuelwood or woodfuel (representing firewood and charcoal), the Management Plan 1997-2007 Prescription 31 said thus.

“ Fuelwood cutting (sic) and charcoal production are destructive to a standing crop, as licence holders are indiscriminate i.e. cutting young trees of marketable species. *Fuelwood cutting (sic) and charcoal production shall not be allowed in the MPA (Management Plan Area)*”. Karani *et al* (1997).

From the foregoing, harvesting of both poles and firewood in commercial quantities is prohibited. However, harvesting the products in limited quantities for own use is permissible. Hence the approach to estimating the combined stream of values from firewood and poles was the one Bush *et al* (2004) used based on household livelihoods.

Bush *et al* (2004) estimated the total livelihood value of timber (largely poles and firewood) and non-timber products from a typical protected tropical high forest in Uganda at US\$ 18,074 per ha per year, of which 47% was timber and 53% non-timber forest products. Hence the combined annual stream of poles and firewood values was estimated at US\$ 8,495/ha. Since the impact area in Mabira CFR is estimated at 67.63 ha, this gives a benefit stream of US\$ 574,517/year. Capitalising this annual benefit stream by 12% gives a net present value for poles and firewood of US\$ 4,693,492. Bush *et al* (2004) cautioned as follows.

“ It is important to note at this point that the values calculated *do not* imply that the level of economic value derived is sustainable. (They estimated economic value based on the current levels of use). However, it is reasonable to assume that protected THF [Tropical High Forest] values are closer to sustainable harvest rates considering the management efforts of the NFA”.

In summary, the values of poles and firewood were arrived at as follows.

Poles + Firewood livelihood value	US\$ 8,495/ha/year
Size of Impact Area	67.63 ha
Total annual benefit stream	US\$ 574,517/year
Present Value of Poles + Firewood benefits	US\$ 4,787,642

Non-timber forest products

Prescription 32 of the Mabira Forest Management Plan 1997-2007 had this to say about handicrafts materials.

“Demand for handicraft products, including easy chairs, stools, mats and baskets is rising. Although limited quantities, for domestic use, are permitted free of charge under the FORESTS ACT, a system shall be devised to monitor, record and control harvesting. Any collection/harvesting for commercial purposes shall be fully charged at appropriate rates of such forest product”. Karani et al (1997).

For other non-timber forest products, Prescription 33 of the Mabira Forest Management Plan 1997-2007 stated as follows:

“Domestic collection of medicinal herbs, edible plants and other food materials does not pose any immediate danger to the resource or the standing forest crop. Such collection may promote protection and conservation of the respective forest resource in the MPA by neighbouring communities. However, levels of harvesting shall be controlled and in case of commercial interests, corresponding fees shall be charged. In case of any destruction to standing forest crop, e.g. debarking and uprooting, the FD (now NFA) officers shall take steps to immediately stop such actions”. Karani et al (1997).

To estimate the benefits stream from non-timber forest products, the Bush *et al* (2004) study was used. The results of the research showed that typical tropical high forest protected areas (PAs) on average generate US\$ 9,579/ha/year, an amount much lower than Afromontane forest PAs, private THFs and savanna woodland/bushland. Nonetheless, the value for tropical high forest PA is thought to be the closest to the Mabira situation. Using the approach similar to the one for poles and firewood, the present value of the benefits stream from non-timber forest products was estimated at US\$ 5,292,398 as shown below.

NTFPs livelihood value	US\$ 9,579/ha/year
Size of impact area	67.63 ha
Annual benefit stream	US\$ 647,828/year
Present Value of NTFPs	US\$ 5,398,565

Biodiversity

Mabira CFR is rich in biodiversity. Although the area of impact of the Wayleave construction is small and, therefore, unlikely to affect overall biodiversity richness, it is possible even in a small area some may be lost.

Biodiversity richness of a forest represents an option value; and it is perhaps one of the least tangible benefits of Uganda’s forests (Bush *et al* 2004). The value of biodiversity lies partly in the development of plant-based pharmaceuticals (Bush *et al* 2004; Emerton & Muramira 1999; Mendelsohn & Balik 1997; Howard 1995; Pearce & Moran 1994; Ruitenbeek 1989). In addition to undiscovered plant-based pharmaceuticals, Howard (1995) reported that there is potential in wild coffee genetic material. According to Bush *et al* (2004), Uganda’s farmed

coffee is being hit by a *Fusarium* wilt against which no known cultural or chemical practices appear to succeed and wild coffee is known to be resistant to it (Bush *et al* 2004).

Various estimates have been made of the value of forest biodiversity. Ruitenbeek (1989) estimated the biodiversity of Korup Park in Cameroon at £0.1/ha/annum. Pearce & Moran (1994) provided a range of values for tropical forest, ranging from US\$0.1/ha to US \$ 21/ha.

Mendelsohn & Balik (1997) produced a value for undiscovered plant-based drugs in tropical forest with average plant endemism of US\$3/ha. Howard (1995) suggested that Uganda's forests are not as species rich as Korup Park and the country would be less competitive in say supply of *Prunus africana*. Bush *et al* (2004), suggest an average value for biodiversity at US\$1.50/ha/year. Using this estimate the biodiversity opportunities foregone in the impact area would be US\$ 186,659/year (using an exchange rate of 1 US\$ = US\$ 1840). This annual benefit stream translates into a present value of US\$ 1,555,490.

Domestic water conservation

During Focus Group Discussions with communities surrounding Mabira CFR and living in the forest enclaves (*Annex 3*), they revealed that to them the most important use of the forest was for water collection. All the surrounding communities and those living in the forest enclaves, said they get their water from the forest. This view tallies with the observation of Bush *et al* (2004), where the forests surveyed across Uganda represented important sources of water for local communities.

Bush *et al* (2004) estimated the mean value of water provision for both humans and livestock per household at US\$ 18,415 per annum, and ranges from US\$ 12,078 per annum for Budongo CFR to US\$ 30,928 per annum for Ruwenzori Mountains National Park. In this report, the value for Budongo CFR which is relatively similar to Mabira CFR was used in estimating community water benefits.

Muramira (2000) estimated the number of households in the enclaves and within the proximity of Mabira at 15,631. Assuming population growth rate of 3.4% per annum (UBOS 2002), by 2006, this population would have increased to about 19,103 households. Therefore multiplying the mean value of water provision of US\$ 12,078 per annum by the number of households gives a total value of US\$ 230,726,034 per annum. However, the impact area is 67.63 ha out of the total size of about 30,000 ha. Therefore, the value of water provision in impact area which will be lost is equivalent to US\$ 520,133 per annum. Holding this value constant over the project period, the net present value of domestic water provision translates into a conservative estimate of US\$ 4,334,445⁷.

⁷ The estimate is conservative because the population in the enclaves and the surrounding areas will increase over the years. However, it is possible with increased development, alternative water sources are likely to be developed.

Carbon storage

The removal of tree cover as a result of the Wayleave construction will result in loss of some of the carbon storage capacity of Mabira CFR. According to Bush *et al* (2004), at the global level, the forestry sub-sector is an important carbon sink, helping to reduce accumulation of greenhouse gases and hence global warming which will lead to adverse changes in climate. Emerton & Muramira (1999) and Bush *et al* (2004) give the following carbon storage values for different vegetation types: primary closed forest US\$ 54,660/ha/year; degraded forest US\$ 32,538/ha/year; and woodland, bushland and grassland US\$ 2,603/ha/year. The Wayleave construction is expected to leave the cleared impact area under grassland instead of bare ground. Furthermore, the Production (Encroachment) and the Recreation/Buffer Zone would have carbon sink values equivalent to a degraded forest. The Production (Low Impact) zone on the other hand should have carbon sink values somewhere between the primary and degraded forests. Subsequently, the value of carbon sink/ha/year for the Production/Encroachment and Recreation/Buffer Zone was estimated at US\$ 32,358/ha/year less grassland value of US\$ 2,603/ha/year giving a net value of US\$ 29,935/ha/year. Using a similar approach, the carbon sink value for the Production/Low Impact Zone would be US\$ 40,996/ha/year, using the average value for a primary closed forest and a degraded forest and deducting grassland values.

Multiplying the carbon sink values by the size of the applicable impact area, *Table 9* shows the annual values lost. The Wayleave construction is expected to result in a loss of carbon sink values equivalent to US\$ 2,189,202/year. Capitalised at the social opportunity cost of capital, the annual stream gives a present value of US\$ 18,243,350.

Table 9. Carbon Sink Values

Management Zone in Mabira	Impact Area (ha)	Value of Carbon sequestered/ha/yr*	Total Value/year (U Shs)
Production (Encroachment)	30.24	29,935	905,234
Production (Low Impact)	14.89	40,996	610,430
Recreation / Buffer Zone	22.5	29,935	673,538
	67.63		2,189,202

*adapted from Bush *et al* (2004) and Emerton & Muramira (1999)

Landtake

The total impact area in Mabira CFR was estimated at 70.44 ha (including Compartment 234). An annual ground rent of US\$ 20,000/ha/year is charged by the NFA. Therefore the annual benefit stream from landtake was estimated at US\$ 1,408,800; and the present value of this annualised series was US\$ 11,740,000.

Ecotourism

According to Muramira (2000), Uganda’s tropical high forests have some of the richest biodiversity of plant and animal life in the world. The biodiversity inventory for Mabira CFR revealed that the forest has average biodiversity attributes (Davenport *et al* 1996). However, the ecotourism value of Mabira lies in the fact that it is the only THF protected area within the Lake Victoria shore crescent. Furthermore, Mabira CFR is close to the urban centres of Kampala (50km) and Jinja (21km). There is increasing interest in ecotourism in Mabira CFR as shown in *Table 10*. Finally, in addition to the Ecotourism Centre operated by the NFA, new developments are either nearing completion (for example the facility of Ecolodges) or are in the early stages of development (for example the plans of MAFICO).

Table 10. Visitor statistics

Year	Foreigners/ Foreign Residents	Locals	Total
2005/06	1,989	2,854	4,843
1999	1,312	2,880	4,172
1998	1,450	1,125	2,575
1997	1,304	1,094	2,398
1996	1,097	515	1,612

*Source : data for 2005/06 fiscal year from the NFA
: data for remaining years, Muramira (2000)*

The basis to estimating the annual value of ecotourism is the consumer surplus, the difference between the price tourists are willing to pay and the price they actually paid. Naidoo & Adamowicz (2005) found that an entrance of US\$47 would maximise tourism value i.e. the amount foreign and foreign residents of Uganda are currently charged US\$5 to visit Mabira CFR (Naidoo & Adamowicz 2005). This dramatic under-valuation of the willingness to pay of tourist visitors is consistent with results from other tropical areas and suggests much room for improvement in entrance fee policy (Naidoo & Adamowicz 2005).

From the above, the consumer surplus for foreigners and foreign residents is US\$42 per tourist. In the absence of data on the local tourists’ willingness-to-pay and considering their low income levels, this study assumes a zero consumer surplus pertaining to local tourists. For foreigners and foreign residents US\$ 42 or US\$ 77,280 (at exchange rate of US\$ 1840 to the US\$) – was used. Furthermore, using the 2005/06 data for foreigners and foreign residents of 1,989 tourists, the annual value of ecotourism for the whole Mabira CFR was estimated at US\$ 153,709,920/year. Mabira CFR is about 30,000 ha in size and it would be incorrect to allocate all the annual value lost due to the impact area of 67.63 ha. Hence, the proportionate share of ecotourism benefits lost was estimated as a fraction of the value for Mabira as a whole (that is, US\$ 153,709,920/year x 67.63/30,000) giving a value of US\$ 346,513.

Subsequently, the present value of the ecotourism benefits foregone as a result of the Wayleave construction translates into US\$ 2,887,612.

Recently planted crop

In Compartment 234, there was a crop of *Terminalia sp* less than 1 year old and hence below the age of establishment. Nonetheless, the private tree farmer ought to be compensated for expenses incurred assuming that the money will be realised in the third year. Total expenses were estimated at US\$ 1,300,000 (based on NFA experience). When this amount was compounded by 3 years, the present value equaled to US\$ 1,826,370.

4.5 Kifu CFR

Timber

On a plot of 10m x 20m or 0.02 ha, 15 standing trees of average dbh of 6.5 cm-12.4 cm and height of 2-3 m were counted in Kifu CFR. This gives a stocking rate of 750 trees/ha. The latest yield recording for *Araucaria sp.* was 1,400 m³/ha. The stumpage value was US\$ 86,000/m³. The area impacted by the Wayleave construction in the part of Kifu forest was 3.713 ha. However only about 600 m by 40 m is planted, indicating an area of 2.4 ha. A crop of *Araucaria* matures in 25 years (economic rotation age). Licence for growing *Araucaria* is 50 years, renewable, meaning 2 rotations are realisable. Therefore, the total Present Value for the *Araucaria* crop is given by US\$ 288,960,000 each received in the 25th and 50th years based on present stumpage values. When the two receipts were discounted at the appropriate social opportunity cost of capital, the present value of future benefits foregone was equal to US\$ 17,990,650, or put in another way US\$ 7,496,104/ha.

Landtake

In addition to this foregone benefit payable to the crop owner, the Developer is also required to pay US\$ 20,000 /ha/year of ground rent to the NFA. Therefore, payment of ground rent for the impact area of 3.713 ha was estimated at US\$ 74,260/year, giving a present value of US\$ 618,833.

4.6 Namyoya CFR

Timber

On a plot of 10m x 20m or 0.02 ha, 16 standing trees of *Eucalyptus grandis* of average dbh of 3.8 to 10.6 cm were counted in Namyoya CFR. This gives a stocking rate of 800 trees/ha. It is assumed that all 800 trees would be suitable for electric poles. The stumpage value for electric poles is US\$ 20,000/tree. The area impacted by the Wayleave construction in Namyoya CFR was 7.658 ha. Production of electricity poles from *E. grandis* takes 8 years and the tree growers now have 25-year licences, renewable which gives them an opportunity

to raise three crops during the licence period. Therefore, the total Present Value for the Eucalyptus crops is given by US\$ 122,528,000 each received in the 8th, 16th and 24th years based on present stumpage values. When the three harvest payments were discounted at the appropriate social opportunity cost of capital, the total present value of future benefits foregone was equal to US\$ 77,545,521 or put in another way, US\$ 10,126,080/ha of area impacted.

Landtake

In addition to this foregone benefit payable to the crop owner, the Developer is also required to pay US\$ 20000/ha/year of ground rent to the NFA. Therefore, payment of ground rent for the impact area of 7.658 ha was estimated at US\$ 153,160/year, giving a present value of US\$ 1,276,333.

4.7 Management costs

The NFA will need to commit staff and equipment to monitor the implementation of the mitigation measures proposed in the project EIS. Second, there is a need to revise the management plan for Mabira CFR but not Kifu and Namyoya reserves. Third, the NFA will need to allocate other lands for the private tree farmers whose land is to be affected by the construction of the Wayleave. The attendant costs will be one time expenditures and even if they cover a period of 18 months (e.g. monitoring), the cost figures were treated as present values.

Muramira (2000) estimated the cost of monitoring to be US\$ 6,526,080. This cost is probably on the lower side since the remuneration of the staff of the NFA has gone up and so has the cost of fuel. Therefore, a doubling of this cost at US\$ 13,052,160 would be more reasonable.

Revision of the management plan for Mabira CFR was estimated at US\$ 2,000,000. Finally the cost of demarcating new areas to be allocated to tree farmers in Kifu and Namyoya CFR is expected to cost a nominal amount of US\$ 1,500,000.

Subsequently, total management costs were estimated at US\$ 16,552,160 as follows.

Monitoring of EIS	US\$ 13,052,160
Revision of management plan	US\$ 2,000,000
Planting area allocation	<u>US\$ 1,500,000</u>
	<u>US\$ 16,552,160</u>

It is worth noting that the NFA will incur additional costs in removing the timber stock in the area of impact. However, it is expected that the Authority will meet this cost from proceeds it gets from issuing salvage felling licenses to third parties.

4.8 Summary of economic values

This section provides a summary of the economic value lost or foregone as a result of the construction of the Wayleave for the new 220 KV transmission line north of the existing 132 KV line. *Table 11* shows a summary of the overall economic impact.

The data show a growing stock (50 cm dbh +) in Mabira CFR worth US\$ 307,556,900 will have to be cleared to make way for the transmission line. Furthermore, the present value of use and non-use values foregone including land and compensation for recently planted crop of *Terminalia sp.* and a small compensation for private land, would amount to US\$ 112,364,466.

In Kifu CFR the value of timber benefits foregone and annual payments of ground rent would amount to a present value of US\$ 18,609,483. Similarly, in Namyoya CFR, foregone timber values and annual ground rent payments would give a present value of US\$ 78,821,854.

The NFA would incur incremental management costs arising from monitoring of the EIS; preparation of a new management plan for Mabira CFR; administering the allocation of new areas to the private tree farmers who are expected to lose their planting area as a result of the Wayleave construction. These added management costs were estimated at US\$ 16,552,160.

Finally, the present value of the growing stock for Mabira, the benefit streams foregone in all the three CFRs together with associated incremental management costs were estimated to total US\$ 533,903,863.

Table 11. Summary of Economic Values (Ushs)

Source of Economic Value	Mabira CFR	Kifu CFR	Namyoya CFR	TOTAL VALUE
A. GROWING STOCK	307,556,900	0	0	307,556,900
B. PRESENT VALUES OF BENEFITS STREAMS				
1. Timber	61,590,992	17,990,650	77,545,521	157,127,163
2. Poles + Firewood	4,787,642	0	0	4,787,642
3. Non-Timber Forest Products	5,398,565	0	0	5,398,565
4. Biodiversity	1,555,490	0	0	1,555,490
5. Domestic Water	4,334,445	0	0	4,334,445
6. Carbon Storage/Sequestration	18,243,350	0	0	18,243,350
7. Ecotourism	2,887,612	0	0	2,887,612
8. Landtake	11,740,000	618,833	1,276,333	13,635,166
9. Immature plantings	1,826,370	0	0	1,826,370
Sub Total B	112,364,466	18,609,483	78,821,854	209,795,803
C.TOTAL GROWING STOCK AND BENEFITS STREAM(A+B)	419,921,366	18,609,483	78,821,854	517,352,703
D. ADD MANAGEMENT COSTS				16,552,160
E. GRAND TOTAL ECONOMIC VALUES				533,904,863

5.0 Mitigation Plan

5.1 Stakeholder Roles

For the construction of the Wayleave through Mabira, Kifu and Namyoya Central Forest Reserves, four distinct stakeholders were identified – the NFA, the Developer, Private Tree Farmers (PTF) and the Communities in the forest enclaves and surrounding areas. Each stakeholder has specific roles as described below.

The NFA

- Disposes the growing stock in the impact area in Mabira CFR, to allow the Developer easy access and incurs the cost of removal of growing stock and receives all benefits realized therefrom.
- Acquires and disposes timber crop of the private tree farmers in Namyoya CFR.
- Disposes owned timber in Kifu CFR within the impact area.
- Allocates new planting area for affected tree farmers in Namyoya and Mabira CFRs
- Provides the local communities of Mabira CFR with compensatory benefits for lost values with respect to firewood and poles, NTFPs, and domestic water.
- Provides the global community with compensatory benefits for lost biodiversity and carbon sequestration values.
- Invests in natural forest rehabilitation from proceeds of the disposal of the standing timber crop.
- Prepares new Forest Management Plan for Mabira CFR taking into account the impacts of the Wayleave construction

The Developer

- Pays the NFA for lost investments in plantation crop to compensate affected tree farmers and the Authority's own crop.
- Pays the NFA for loss of future benefits streams.
- Pays the NFA ground rent annually or makes a one time payment of US\$ 13,635,166 representing the present value of annual payments.
- Meets the NFA's incremental management costs.
- *Does not* compensate the NFA for timber value of the growing stock since the Authority will supervise and realise benefits from the disposal of the timber in the impact area of Mabira.

Private Tree Farmers

- Receive payments for lost future crops
- The NFA allocates proportionate compensatory area for planting within suitable CFRs.

Communities

- Receive ‘compensatory benefits’ for lost livelihood values
- Get preferential treatment for employment (if suitably qualified) during the construction and maintenance of the Wayleave and any forestry-related activities.

5.2 Financial implications

The roles of the different stakeholders imply varying levels of financial commitments or benefits as described below.

The NFA

A. Receives

1. Compensation for benefits stream from the developer: US\$ 209,795,803
2. Incremental management costs from the Developer: US\$ 16,552,160
3. Auctions growing stock in the impact area in Mabira: US\$ 307,556,900.

Total receipts: US\$ 533,904,863

B. Pays out

1. Private tree farmers for lost timber values US\$ 79,371,891
2. Management costs: US\$ 16,552,160
3. Pays itself for lost *Araucaria* crop US\$ 17,990,650
4. Invests in forest rehabilitation and other forest management priorities, and compensatory investments in community social infrastructure: US\$ 419,990,162

The Developer

A. Receipts None

B. Payouts

Benefit streams Foregone paid to the NFA: US\$ 209,795,803
Incremental management costs paid to the NFA: US\$ 16,552,160
Total payout: US\$ 226,347,963

5.3 Summary

- The NFA will have to organise the disposal of the Mabira CFR standing timber crop in the impact area through its auction process.

- The NFA on its own or in collaboration with the affected Private Tree Farmers arranges to dispose of the immature plantation trees from the impact area in Kifu and Namyoya CFRs.
- The Developer pays the NFA cash amount equal to UShs 226,347,963 or US\$ 123,015 (using exchange rate of UShs 1,840 to the dollar).

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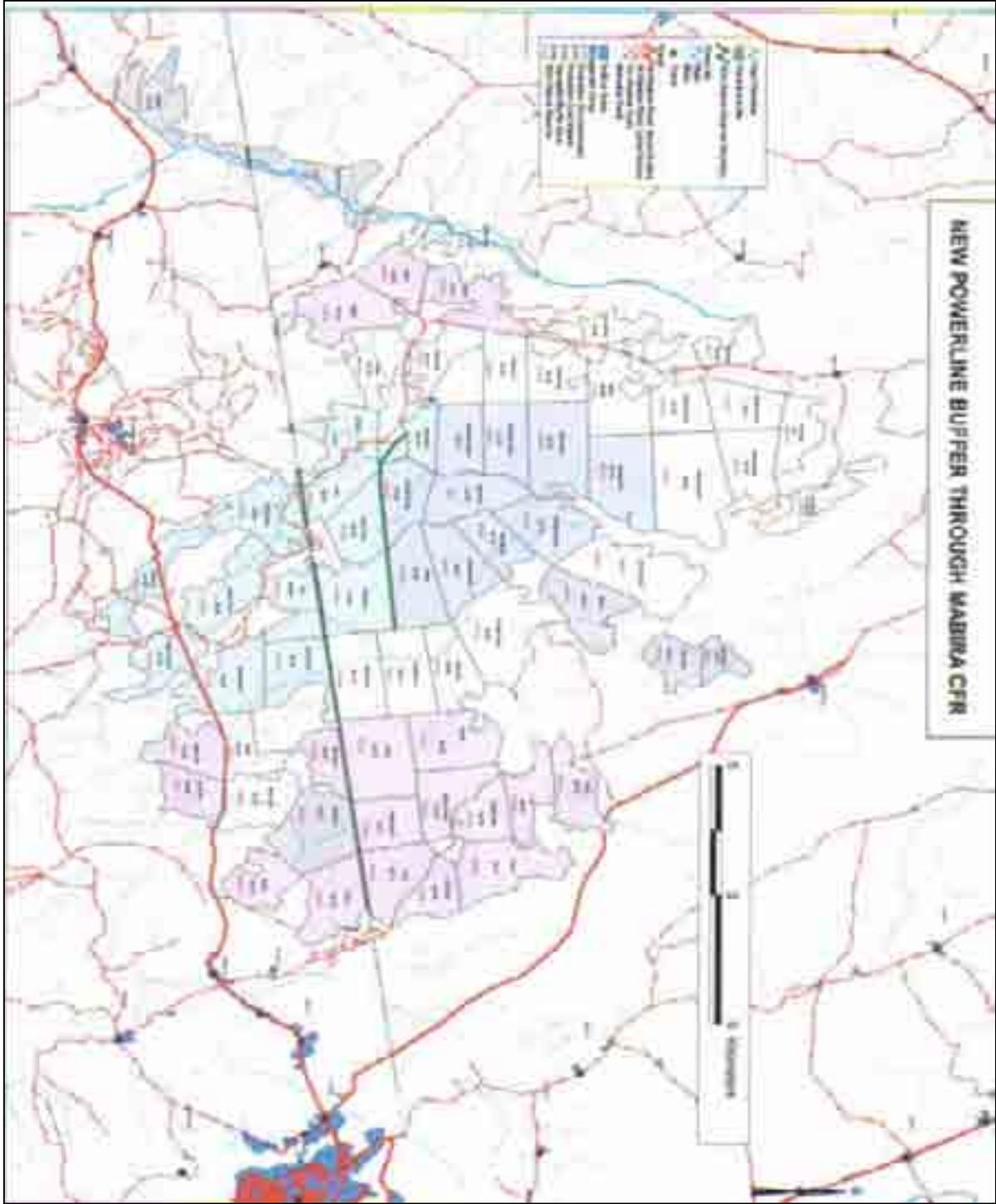
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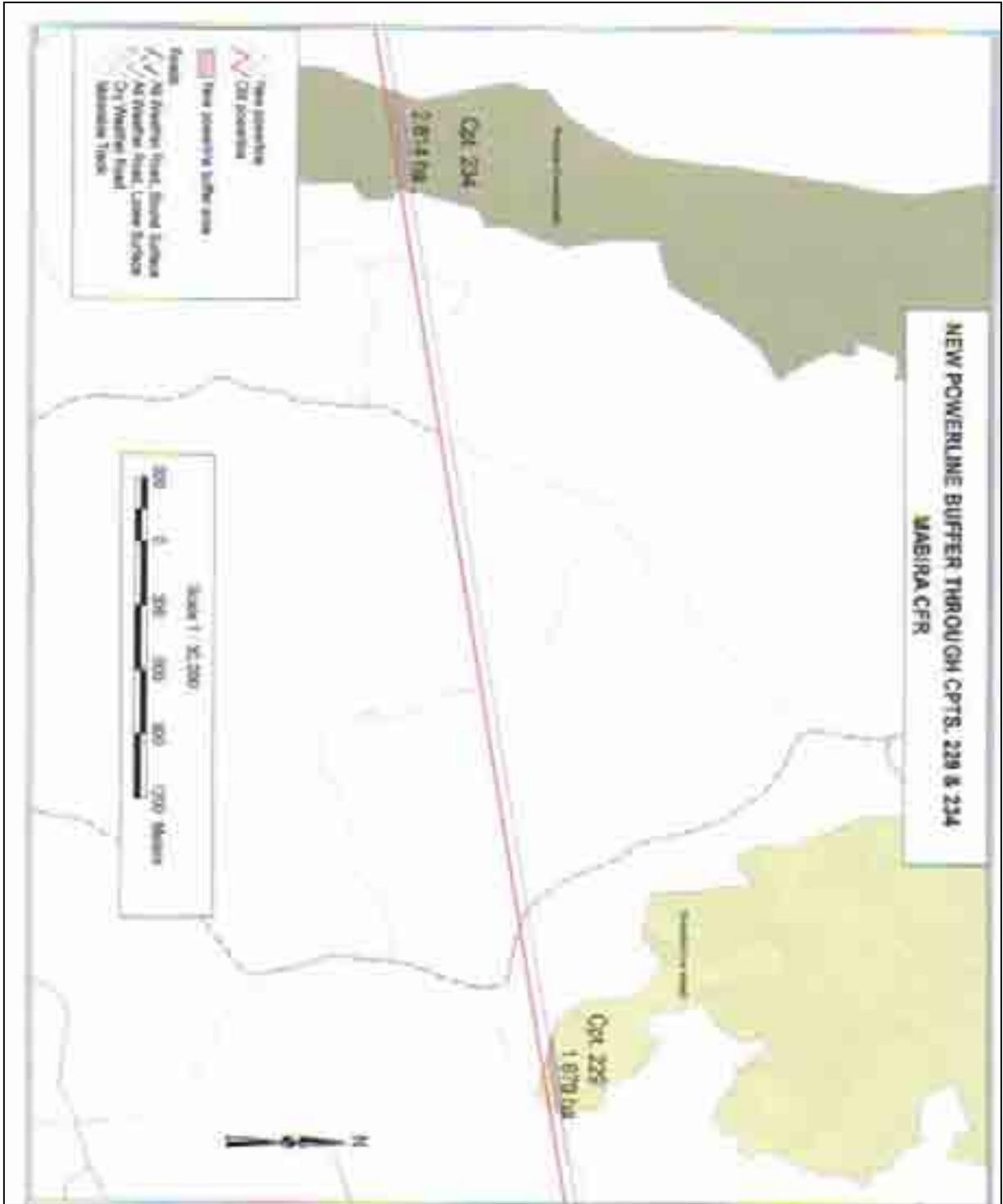
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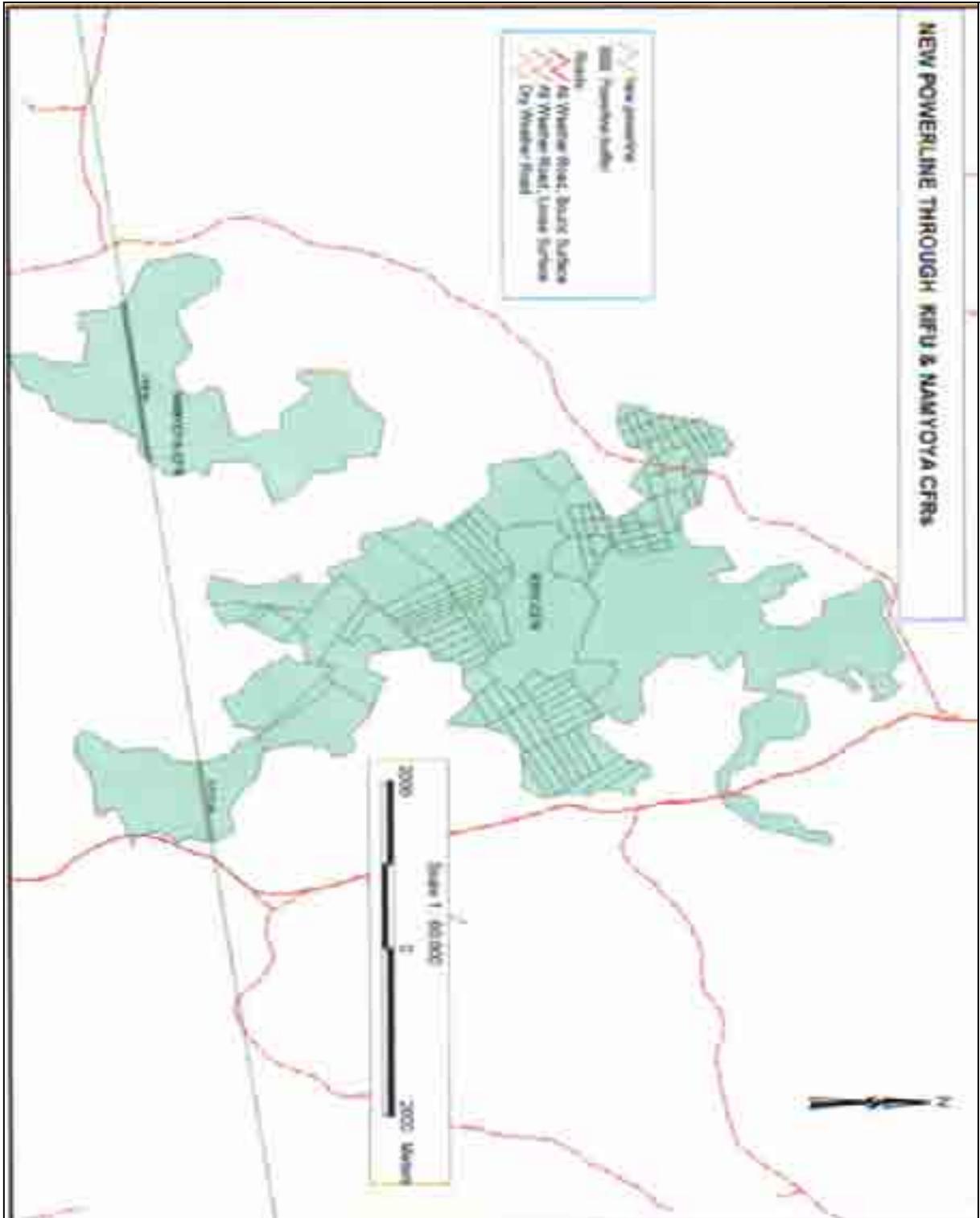
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Annexes

Annex 1 Maps of Impact Areas in Mabira, Kifu and Namyoya CFRs







Annex 2

Key Informant Interviews

The following people and groups were consulted in regards to the importance of Mabira CFR and the likely impacts of the Wayleave for the proposed transmission line. They were: Steven Khauka – formerly in planning at the NFA, and now, the Manager of Namanve Tree Seed Centre; the Executive Committee Members of Mabira Forest Integrated Community Organisation (MAFICO); and the staff of Mabira Ecotourism Centre.

1) *Steven Khauka*

Steven Khauka mentioned enrichment planting as the best option in managing degraded forests. It involves planting of selected tree species in the degraded areas. This helps faster and easy regeneration of the forests in areas where the required species are planted. The option also helps in the introduction of new tree species in the planted areas as opposed to natural regeneration. Despite being the best option however, the method requires high investment levels in terms of care and maintenance, which is not catered for in most cases. Maintenance costs involved include opening of canopy to create space for the newly planted trees and clearing of climbers, as they are easily attracted to opened spaces thereby hindering the growth of the planted trees. Enrichment planting using different tree species gives rise to mixed tree species in the forest, which caters for different values attached to the forests.

Steven felt that natural regeneration as a method of managing degraded forests is not feasible. This is because the method needs a long time for regeneration to take place and in cases where the parent trees are missing, which is a major phenomenon in degraded forests, quality regeneration may never be seen due to lack of seeds.

In terms of restoring degraded forests, the best method to be followed as per Steven's concern would be to identify the highly degraded forests. After this, carry out enrichment planting using mixed species for quick regeneration. The method is not new in Ugandan forest management as it was a method used to restore part of Mabira forest before recalls Steven. This can be recognised in places around the Ecotourism Centre and the Picnic site where almost trees of the same size and age can be identified.

The high existence of Paper Mulberry in some parts of Mabira Forest can be handled effectively through enrichment planting. Paper Mulberry can be cut and sold for firewood. This will help in creating space for the planting of new valuable trees. However, the method is expensive in terms of care and maintenance. This is due to the high regeneration rate of Paper Mulberry, which needs constant cutting of the re-growth if enrichment planting is to yield better results.

Steven also emphasized that with respect to restoring the integrity of Mabira CFR, the National Forestry Authority is better equipped to handle the value of a forest than any other organisation. That is for the 40 metres to be cut in Mabira Forest to create a

pathway for the Bujagali powerline in a way of compensation for the lost forested areas. There is need to channel part of the money in restoring degraded forest's integrity not by the powerline developer but by the National Forestry Authority.

2) *Mabira Forest Integrated Community Organisation (MAFICO)*

Committee members contacted

Kabali Juliet	Chairperson
Kiyimba Rajab	Administrative Secretary
Kungujje Robert	General Secretary
Tigawalana Sebastian	Publicity Secretary
Luyombya Moses	Secretary for Resource Conservation and tourism

The organisation started as a Community Based Organisation (CBO) in 1998 under the name of Mabira Tourism Advisory Committee. It was at the time of massive eviction of people from Mabira Forest and also at a time when Mabira Ecotourism Centre was being established. The main idea for the establishment of the organisation was to intervene on part of the communities affected by the action. At that time the organisation covered seven parishes of Najjembe Sub- County. Later, the organization's name changed to Mabira Forest Tourism Committee.

In 2000-2003 the idea of a Non-Governmental Organisation called MAFICO was born. That is between 2000-2002, the organisation was in place but not registered until 2003 when it started existing formally after registration.

Presently MAFICO covers Najjembe and Nagojje Sub-Counties performing a number of activities. These include: environmental education in schools; encouraging good forest activities like bee-keeping; community woodlot planting; provision of seedlings; and capacity building for Community Based Organisations like organising workshops and proposal writing among others.

The CBOs being assisted by MAFICO are under collaborative forest management organisations. The two are COFSDA, in Najjembe Sub-County covering Koko, and Buvunga villages and NACOBA in five villages of Nagojje Sub-County. These CBOs have enjoyed the benefits of working with MAFICO for example MAFICO helps NACOBA in proposal writing concerning bee-keeping. So far the proposal was accepted for funding by the National Forestry Authority in Compartment 222. The agreement between NACOBA and the NFA was signed on 22nd April, 2006. Under this agreement the NFA is to buy the beehives for the organisation. The NFA also promised to link the organisation to Uganda Bee-Keeping Association

MAFICO is looking forward to establishing a community ecotourism centre in Mabira Forest. The centre is to be set in Nagojje Sub-County. The planned site is about 2-3 km sq km from which several activities are to be carried out. There will be three

accommodation bandas, a campsite, and a visitor's centre. The project is to be funded by the United Nations Development Programme Small Grants Programme.

The planned site for the MAFICO ecotourism centre is located in compartment 207 which is a buffer zone; 30m north of the existing power line the buffer zone borders a strict nature reserve. This means that the proposed 40m of the new power line go into the planned site for the ecotourism centre reducing the space required to put up the centre which means the centre has to be pushed inward into the strict nature reserve. However it is important to note that no activity is allowed in the strict nature reserve and so it is impossible to push the planned site inward. The ecotourism centre may not be located in the proposed area. This may result in finding an alternative site for the centre away from the strict nature reserve where ecotourism is not allowed. It is possible MAFICO may abandon the whole project altogether because of the development.

It is important to note that the integrity or pristine nature of a forest makes ecotourism more meaningful and attractive. Recreation centres amidst forests have proved to control forest degradation by human beings since the recreation centres become no-go areas for timber and log cutters as well as charcoal burners. Setting up the recreation centre by MAFICO would mean a conservation opportunity for this part of the forest.

The opportunity cost of foregoing the location of the ecotourism centre in the proposed area is not for MAFICO alone but also for the communities. This is because a proposed percentage of revenue accruing from the centre was to go to the communities. Therefore the community will also be affected

3) *Mabira Ecotourism Centre*

The Mabira Ecotourism Centre is a tourism facility that offers walks ranging from 30 minutes to 3-4 hours, mountain biking, picnics, residences in camps, or bandas. All that comes with the forest setting with spectacular birds, butterflies, and monkeys. From July 2004-June 2005 the centre received Ushs 11,58,800 from entry permits, Ushs 343,100 from camping, Ushs 4,641,500 from Banda accommodation and Ushs 495,000 making a total of Ushs 16,638,400 as the revenue collected for the year. Twenty percent of the money goes to the communities (Ushs 3,327,680). In the past this money was given directly to the communities but in the new policy this money will be used to support bigger community developments like building schools, repairing and improving road criteria. It is important to note that the pristineness of a forest may determine its tourist value. Hence cutting down the forest causes tourism damage and this would affect the activities of the tourism centre especially reducing the revenue realised by the tourism centre, while in turn may affect the communities' gain of 20%.

Annex 3

Focus Group Discussions

Community members in the enclaves of Mabira CFR and the surrounding areas were consulted. Focus Group Discussions (FGDs) were held with communities in Buwoola, Ssanga and Ssesse.

All the communities consulted accepted using Mabira Forest for a variety of purposes. They derive a range of products which include firewood, medicinal plants, wild meat, among others. The communities also looked at the forest mainly as a source of the direct use values such as firewood and medicinal plants with hardly any mention of the other values of the forest, including indirect uses, option values bequest and existence values.

The communities also were not much concerned of any impacts from the proposed power line in the forest. This was showed by the urge and eagerness waiting to be accepted as part of the team to cut down the 40m in the forest. The communities also wanted to be given these trees as firewood, building poles, timber, among others.

The communities also demanded for the employment opportunities at the new power site. They proposed that when the time comes the LCs be contacted to recruit some of the community members in their villages.

The members present also wanted to know the reason for being consulted since previously during the construction of the powerline nothing transpired from the answers given to the people who visited the communities. They complained that since power was not going to the communities they had no reason to be consulted.

The communities also urged the National Forestry Authority officials to channel part of the compensation to community development. This could be in the form of assistance with the main area emphasised in the three communities being education. That is, build more school blocks for the government-funded schools in the area and the provision of timber materials for construction of desks as people kept on emphasizing what a shame it was for schools next to the forest being faced with a shortage of desks.

Communities also showed the urge to be provided with seedlings of valuable tree species that are either not in the forest any more or exotic species like pine, Cypress, etc to community members to plant on their farms.

The specific community reactions were as presented below.

1. Buwoola Community

Buwoola Parish is located in Najjembe Sub-County, Buikwe County, Mukono District. Buwoola is an enclave in Mabira Forest and consists of Nkaga, Ssanga and Bakata villages among others. The people of Buwoola depend on the forest for things like medicine, water,

and firewood, among others. The focus group discussion with the people of Buwoola highlighted what they get from the forest as follows.

Medicine is got from the forest. The medicines got include *Vernonia amygdalina* (mululuza), *Momordica foetida* (bombo), *Albizia zygia* (ennongo), *Syzygium cordatum* (kanzinzilo), *Albizia coriaria* (mugavu), *Warburgia ugandensis* (mukuzanume), among others. The medicine is mostly used for personal consumption and some people sell to their fellow community members for money.

Another resource they get from the forest is firewood. The community said they are not allowed to sell firewood or charcoal and it is illegal. However, they admitted to getting firewood for home consumption from the forest. Others establish wood lots on their own land where they get firewood.

Hunting is another activity carried out by the people of Buwoola. Several animals hunted include the kob, antelope, the wild pig and porcupine. Hunting is mostly done on Thursdays and Saturdays.

Had there been a vote about the construction of a new powerline, the majority of the people in Buwoola would have said no. However, they suggested if the powerline was built they should get bigger and better schools built for their use. Society benefits like a health centre were also suggested.

The communities also suggested that once the powerline started the jobs be given to the able youth and men of the village. They asked for repair of their roads. They complained that in the construction of the existing powerline, their roads were used and damaged but not repaired. They wanted to have better roads by the end of the construction of another powerline.

The people of Buwoola also suggested that power should be extended to the community. They complained that although cutting of the forest affected them they had no gains from the construction. One of the community members claimed that a piece of his land was in the 40 metre zone where the old power line passes and he wanted compensation.

2. Sanga Community

Ssanga Village an enclave in Mabira Forest is located in Buwoola Parish Najjembe Sub-County, Buikwe County. Ssanga Village is not at the border of the powerline; however, this community says any damage to the forest affects them because they depend on the whole forest.

Members of Ssanga get firewood from the forest. Although they did not agree to selling charcoal or firewood, one community member told us that a bundle of firewood goes for 250/= to 300/= as a bag of charcoal goes for 3000/=. The community also collects water from the forest.

The medicines got from the forests by the Ssanga community include *Alstonia boone* (Mubajjandalabi), *Albizia coriaria* (Mugavu), *Entada abyssinica* (Omwoloola), *Carrisa edulis* (Omuyoza), *Markharmia lutea* (Musambya), *Prunus africana* (Ntaseesa), and *Spathodea campanulata* (Kifabakazzi), among others.

Hunting is another activity carried out by the people of Ssanga. Hunting is done mainly on Tuesdays, Thursdays and Saturdays. However members sometimes go into the forest to hunt as individuals. The meat is sold to community members and some is taken to Najjembe market. The hunted animals include Antelope, Porcupine, Guinea fowl and wild pigs.

The people of Ssanga requested that trees cut at the site of the new powerline be given to them so that they would get charcoal and firewood to sell as a way of benefiting from the damage done to the forest. The members present especially the women requested that their sons be given jobs during the construction of the new powerline. They claimed that in the past jobs that would be done by community members were done by foreigners; they asked that this time they did not want foreigners to do the jobs which the community could do.

3. Ssesse Community

Just like the people of Ssanga, the people of Ssesse are not directly close to the powerline. However, they agreed to using the whole forest and throughout the year. The most important resources got from the forest were: water, firewood, timber, charcoal and fish from river Miasma and micro climate benefits.

The medicine got from the forest include *Alstonia boone* (Mubajjandalabi), *Albizia coriaria* (Mugavu), *Entada abyssinica* (Omwoloola), *Carrisa edulis* (Omuyoza), *Markharmia lutea* (Musambya), *Prunus africana* (Ntaseesa), and *Spathodea campanulata* (Kifabakazzi), *Vernonia amygalina* (mululuza), *albizia zyia* (enongo) *momordica foetida* (bombo), *Rhus vulgaris* (kakwansokwanso). Apart from the forest these community members have some of these trees in their woodlots in their homes. Some community members sell these medicines and even treat community members for money.

Hunting is also done by the communities. The animals hunted include the antelope, porcupine, guinea fowl, wild pig and the kob. Hunting is usually done on Saturdays and Thursdays though some community members go into the forest on other days to hunt. Mudfish is also got from River Musamya

Firewood and charcoal are collected from the forest. Though illegally, the communities sell firewood charcoal and timber, which are taken to Lugazi and Kawoolo. A bag of charcoal goes for about 2500-3000 Ush and a bundle of firewood goes for 250-500 Ush.

The communities asked for the wood cut down at the site of the new powerline so they would get firewood and charcoal to earn an income. They also said foreigners should not be brought from elsewhere to do work that can be done by community members that instead community members should be asked to do the work. In the construction of the old powerline the community roads were used and damaged by heavy trucks yet they were not repaired. They asked for improvement of their roads once the powerline was constructed. Some members

claimed that the powerline went through their land so they could not use the land, they wanted compensation. They requested that their bridge be repaired since it was in a very bad condition.

The community also asked for seeds for certain economic tree species that did not exist in the forest or those that did not exist anymore. Such trees include Albizia and Cypress.

4. *Names of Focus Group Discussion Participants**

a. Buwoola Participants

- 1) Nabatanzi Mary
- 2) Ngabirano Moses
- 3) Tusiime Gertrude
- 4) Okuta Charles
- 5) Kiziti Isaac
- 6) Bwanga Wilson
- 7) Mutebi Desire
- 8) Alice Nabagala
- 9) Wejjo Keluiris
- 10) Namayanja Efrancis
- 11) Alex Kinene
- 12) Akamanda Byekwaso
- 13) Musana Swaib Kinya David
- 14) Musoke Paul
- 15) Luyembya Grace
- 16) Leo Twinnomuhangi
- 17) Kiiza Kiviri
- 18) Byaruhanga Karugo Nuru
- 19) Sundar Viseti
- 20) Naggayi Sophia
- 21) Kibirige Catherine
- 22) Aisa Nasuuna
- 23) Kabuye Samuel
- 24) Nanyonjo Ritah
- 25) Babigunira Aziz
- 26) Wandera Masiga
- 27) Hussein Kabanda
- 28) Kayaga Betty
- 29) Naggiba Harriet
- 30) Nakayima Kiviri
- 31) Sande Moses
- 32) Matovu Tom
- 33) Ngabirano John
- 34) Namuyanja Christine

b. Sanga Participants

- 1) Nabatanzi Mary
- 2) Tusiime Gertrude
- 3) Mbabazi Patience
- 4) Natukunda Catherine
- 5) Moini Edward
- 6) Etyono Denis
- 7) Katusiime Cuthbert
- 8) Balidawa Simon
- 9) Kanku
- 10) Okoyu
- 11) Deo
- 12) Tadeo
- 13) Demaga
- 14) Zikulabe
- 15) Walusimbi Franco
- 16) Aguda Franco
- 17) Mubiru Paul
- 18) Lutakome
- 19) Sem Musisi
- 20) m. babalanda
- 21) amos mewda
- 22) h.kato
- 23) Bernard kibanda
- 24) Robat badaga
- 25) Lubwama R
- 26) Kyalimpa
- 27) Sande
- 28) Kako
- 29) Sebilagala
- 30) Katongole
- 31) Tegewagala M
- 32) Aku
- 33) Gwavunamuyanja Christine
- 34) Bilabwa
- 35) Namulondo
- 36) M.Namatovu
- 37) Maama Sabasi
- 38) Wampamba
- 39) Nankumba
- 40) Diya
- 41) Roko

c. Ssesse Participants

- 1) Nabatanzi Mary
- 2) Natukunda Catherine
- 3) Mbabazi Patience
- 4) Katusiime Gertrude
- 5) Moini Edward
- 6) Ssentamu Emmanuel
- 7) A.Tanga
- 8) Muwonge Rogers
- 9) Musa Mukwaya
- 10) Seidi
- 11) Galabuzi Jimmy
- 12) Mayambala
- 13) Nsubuga Steven
- 14) Kiggwe Steven Miburo Siraj
- 15) Kikomeko Omea
- 16) Bogere Edward
- 17) Mwanzi Ronald
- 18) Kyogulanyi Angelo
- 19) Kuiwanuka George
- 20) Bazilakye Steven
- 21) Mukasa David
- 22) Consta Nce Munyakazi
- 23) Yowasi Obulu
- 24) Mbaliire Robert
- 25) Baguma Henry
- 26) Kakooza George
- 27) Sulaiman Tibesigwa
- 28) Yiga Miche
- 29) Mukasa Nkugwa
- 30) Wajja Mutebi
- 31) Liiba Alaniya
- 32) Kayitana Pascal
- 33) Mujjesera Vincent
- 34) Falidah Namubiru
- 35) Kikomeko Abdul
- 36) Mwodi Martin kagere

* *Includes Consultants from YOMA*

Annex 4

Survey of Community Livelihoods from Mabira Forest

1.0 Introduction

The main objective or purpose of the survey was to find out the benefits and the costs the communities in the forest area and the NFA derive from the forest so that they are compensated as the 220 KV powerline which is going to run 40 metres north and parallel to the old powerline is going to traverse through the forest, and therefore some parts of the forest will be destroyed or cut in order to create a Wayleave for the new 220KV powerline.

Problem statement

Following a lot of load shedding over the years in Uganda the Government of the Republic of Uganda is under pressure from the public to do something in order to reduce on power outage. Therefore, the Government through a private developer is considering extending a new powerline 40metres parallel to the old one. The 220 KV new powerline is going to pass through Mabira Forest where some parts of the forest has to be cleared to create a Wayleave. Therefore, communities in and around Mabira Forest and the National Forestry Authority (NFA) need to be compensated for this loss of the part of the forest as this will present some opportunity costs to them as well as reduced forest benefits.

Coverage of the survey

The survey mainly covered villages of Ssesse, Ssanga, Nkaaga, Bakata all found in Buwola Parish, in Najjembe Sub-County, Mukono District. The reason for targeting these villages in Najjembe Sub-County was because of their close location to the new 220 KV powerline proposed area of passage.

Methodology

A questionnaire with 34 open-ended and close-ended questions was distributed to forty two (42) respondents selected at random from the villages of Nkaaga, Bakata, Ssanga, and Ssesse to find out their views about the benefits, costs and the likely compensation they expected due to the loss of the part of the forest as a result of the 220 KV powerline.

2. Findings

Distribution of respondents by sex

	Number of respondent by sex	Percentage	Valid percentage
Male	21	50.0	72.4
Female	8	19.0	27.6
Missing	29	69.0	
Total	42	100.00	100.00

Source; primary data

42 respondents were interviewed of which 21 were male and 8 were female respondents, whilst 29 did not state their gender.

Therefore, the valid percentage of respondents by sex is as follows; 72.4% are males and 27.6% are female as a percentage of the total valid responses.

Collection of medicinal plants from the forest

	Number of respondents	percentage	Valid percentage
Collect medicinal plants	32	76.2	82.1
Do not collect medicinal plants	7	16.7	17.9
Missing	3	7.1	
Total	42	100.0	100.0

Source; primary data

Of the 42 respondents, 82.1% and 17.9% collect medicinal plants from the forest and do not collect medicinal plants from the forest (Mabira forest) as a valid percentage, respectively.

Woodlot ownership

	Number of respondents	Percentage	Valid percentage
Wood lot	11	26.2	35.5
No wood lot	20	47.6	64.5
Missing	11	26.2	
Total	42	100.00	100.00

Source: Primary data.

Of the 42 respondents interviewed for ownership of woodlot, 35.5% own woodlots and 64.5% do not own woodlots as a valid percentage of valid responses.

This implies that most of the respondents do not own woodlots (64.5%) and therefore rely heavily on the forest (Mabira Forest) for firewood and other forest resources.

Use of the forest

	Number of Respondents	percentage	Valid percentage
Use the forest	37	88.1	90.2
Do not use the forest	4	9.5	9.8
Invalid	1	2.4	
Total	42	100.0	100

Source: primary data

90.2% of the respondents use the forest while only 9.8% do not use the forest. This is as a valid percentage of respondents. Therefore, communities (90.2%) depend on the forest for a variety of uses and benefits compared to only very few 9.8% who do not use the Forest as a valid percentage of respondents. Therefore, any development that is going to destroy the forest particularly as a whole is going to make them (communities) (90.2%) forego a lot of benefits and uses that they derive from the forest.

Reason	No of respondents	Percentage	Valid percentage
Own consumption	32	76.2	76.2
For sale	10	23.8	23.8
Total	42	100.00	100.00

Source: primary data.

32 (76.2%) of the respondents agree that they collect medicinal plants from the forest (Mabira forest) for own consumption while 10 (23.8%) agree that they collect the medicinal plants from Mabira forest for sale.

Therefore, it means majority of the respondents (76.2%) collect medicinal plants for their own consumption than for sale from the forest.

Willingness to Pay (WTP) and Willingness to Accept Compensation (WTA)

Statistic	WTA(Shs)	WTP (Shs)
Mean	5,010,265	175,788
Median	1,100,000	103,000
Sums of WTA and WTP	170,349,000	5,801,000

Source: primary data

Respondents were asked to vote for forest Department Management scheme that would prohibit the use of the forest for three months. Then asked how much they would accept to compensate their loss in livelihood in order to vote for the new regulation.

The sum of their willingness to accept compensation (WTA) is Shs 170,349,000. Mean Shs 5,010,265, and Median Shs 1,100,000 of willingness to accept compensation.

Mean willingness to accept compensation is Shs 5,010,265. It means on average the community members are willing to accept compensation of Shs 5,010,265. However, the mean is relevant if the valuation is for cost- benefit analysis.

Median Willingness to pay (WTP) is shillings US 1,100,000. The median is relevant for public choice since it corresponds to that amount which will receive a majority approval. Therefore, for the purpose of compensation, Median willingness to accept compensation (WTA) is best hence consideration of compensation of Shs 1,100,000 is quite relevant than the mean WTA.

The Respondents (42) were asked how much they are willing to pay (WTP) towards locally run Management Scheme that was designed to maintain and improve their forest resources so that they had secure access to and better quantity and quality of forest products. The sum of the willingness to pay is Shs 5,801,000. This means on average Respondents are willing to pay Shs.175,788 for locally-run Management Scheme. The median willingness to pay (WTP) is just Shs. 103,000.

Household Income/Consumption (Non-Forest Based)

Crop Name	Total annual income (Shs)	Percentage
Coffee	16,643,300	5.85
Staple food	27,367,700	9.63
Vegetables	9,160,660	3.22
Beans	83,100,300	29.24
Tea	000000	0.00
Cocoa	000000	0.00
Mairungi ⁸	147,887,000	32.04
Total	284,158,960	100

Source: primary data.

Of the respondents' Annual Income sources, Mairungi is the main annual source of income with value of Shs 17,887,000 (52.04%) followed by Beans (Shs 83,100,300) and coffee (16,643,300). This statistic is quite shocking in that 32% of household income is from al illegal crop. There is, therefore, need to assist the communities to identify alternative income generating opportunities. On the other hand, Mairungi is legally grown in Kenyan communities. The harmonization of the East African laws may need to address this issue and make Mairungi growing legal.

⁸ Mairungi or Khat is a narcotic in the Laws of Uganda and, therefore, illegal

Forest as Source of Water

Water source	Number of Respondents	Percentage	Valid percentage
Forest water	30	71.4	75.0
Non forest water	10	23.8	25.0
Missing	2	4.80	
Total	42	100.0	100.0

Source: primary data

When asked about water source whether forest or not, 75% of the Respondents as percentage of valid Respondents agreed to obtaining their water from forest whilst 25% of valid Respondent percentage claimed that they do not get water from the forest.

Therefore majority (75%) of the Respondents get their water from forest (Mabira).

Respondents' Distribution by Sources of Water

Water Source Name	Number Of Respondents	Percentage	Valid percentage
Borehole	6.0	14.3	14.3
Spring Protected	16.0	38.1	38.1
Spring unprotected	18.0	42.9	42.9
Pond or clan	2.0	4.8	4.8
Total	42	100	100

Source: Primary Data

Livestock Assets

Animal Name	Number of Household heads with animals	Total Number of Animals by Type
Goats	21	96
Sheep	6	31
Pigs	15	44
Chicken	33	733
Rabbits	1	2
Cows	10	83
Total		989

Source: Primary data

Total number of livestock is 989 including birds.33 of the respondents have Chicken and 21 of the respondents have Goats.

Head of household education level distribution

Education Level	Number of house holds heads	Percentage	Valid percentage
No formal Education	2	4.8	5.4
Primary Education	17	40.5	45.9
Secondary Education	14	33.3	37.8
College/University	4	9.5	10.8
Missing	5	11.9	
Total	42	100.0	100.00

Source: Primary data

Most of the household heads are educated up to the level of primary and secondary education with valid percentages of 45.9% and 37.8% respectively.

Head of households distribution by occupation

Occupation	Number of household Heads	Percentage	Valid percentage
Farming	32	76.2	82.1
Own Business	5	11.9	12.8
Salaried employee	1	2.4	2.6
Infant/old	1	2.4	2.6
Missing	3	7.1	
Total	42	100.00	100.0

Source; Primary Data

Most of the household heads of the respondents are engaged in farming (82.1) valid percentages while only 12.8% as valid percentage are involved in own Business. Forest and farming are many times antagonistic

Crop-raiding animals from the forest

Respondents were asked if they had problems with crop raiding animals from the forest. The table is the summary of their responses

Responses	Number of Respondents	Valid percentages
Problems	38	90.5
No problems	4	9.5
Total	42	100.00

Source; primary data

90.5% of the Respondents have problems with crop raiding animals as this negatively reduces their crop out put and quality. While 9.5% of the Respondents ascertain that they do not have problem with crop raiding animals.

The most problematic species from the forest (Mabira forest)

Specie Name	Number of Respondents	Valid percentage	Percentage
Monkeys	33	86.8	78.6
Wild pigs	5	13.2	11.9
Missing	4		9.5
Total	42	100	100

Source: primary data.

The most problematic species identified by the respondents from Mabira Forest are Monkeys and Wild pigs. 86.8% of the Respondents pointed at Monkeys as problematic and 13.2% of the Respondents also pointed at Wild pigs as being problematic. Therefore, the most Problematic species are the Monkeys.

Use of the Various Sources of Fuel

Use of Wood as Fuel

Do you use wood as fuel?

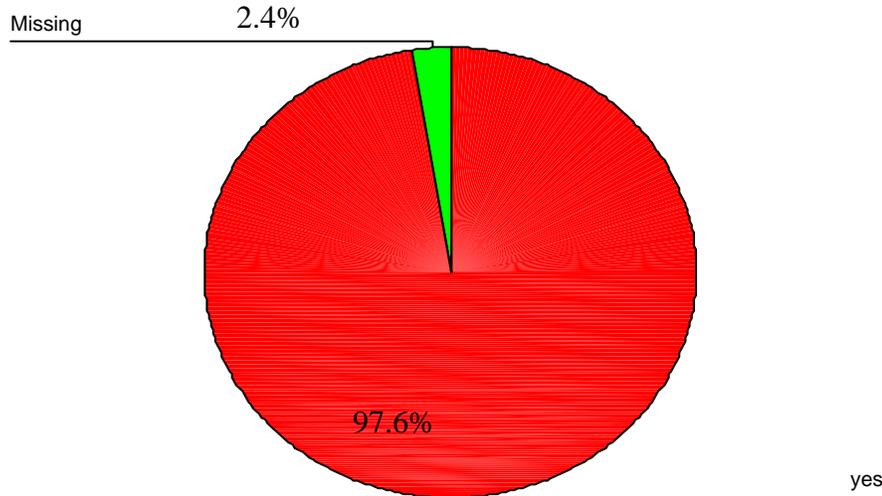
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source: Primary data

Respondents were asked if they use Wood as fuel, 97.6% accept that they use Wood as Fuel, whilst 2.4% of the respondents did not provide any responses. The valid percentage of the respondents who accept using wood as fuel is 100%.

The Pie chart below represents the responses of the forty two Respondents on whether they use Wood as fuel. Wood appears to be the main source of energy for the communities of Mabira Forest. This may threaten the sustainability of the Forest especially if the wood is mainly obtained from the forest and harvested in inappropriate ways.

do you use wood as fuel?



Use of Charcoal as Fuel

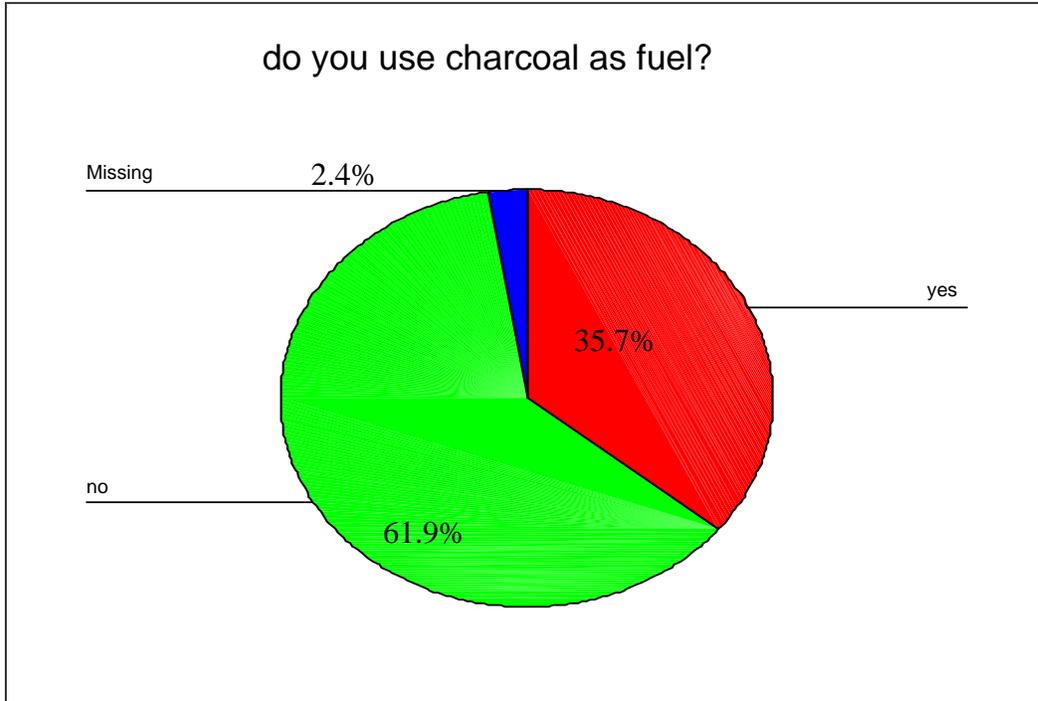
do you use charcoal as fuel?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	15	35.7	36.6	36.6
	no	26	61.9	63.4	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Source: Primary data

For Charcoal use as fuel, 35.7% of the Respondents use Charcoal as fuel whilst 61.9% do not use Charcoal as fuel and 2.4% of the responses are Invalid. Of the valid responses 36.6% and 63.4% use Charcoal and do not use charcoal as fuel, respectively.

The pie chart below represents the responses of the forty two respondents on whether they use Charcoal as fuel.



3.4.3 Use of Paraffin as Fuel

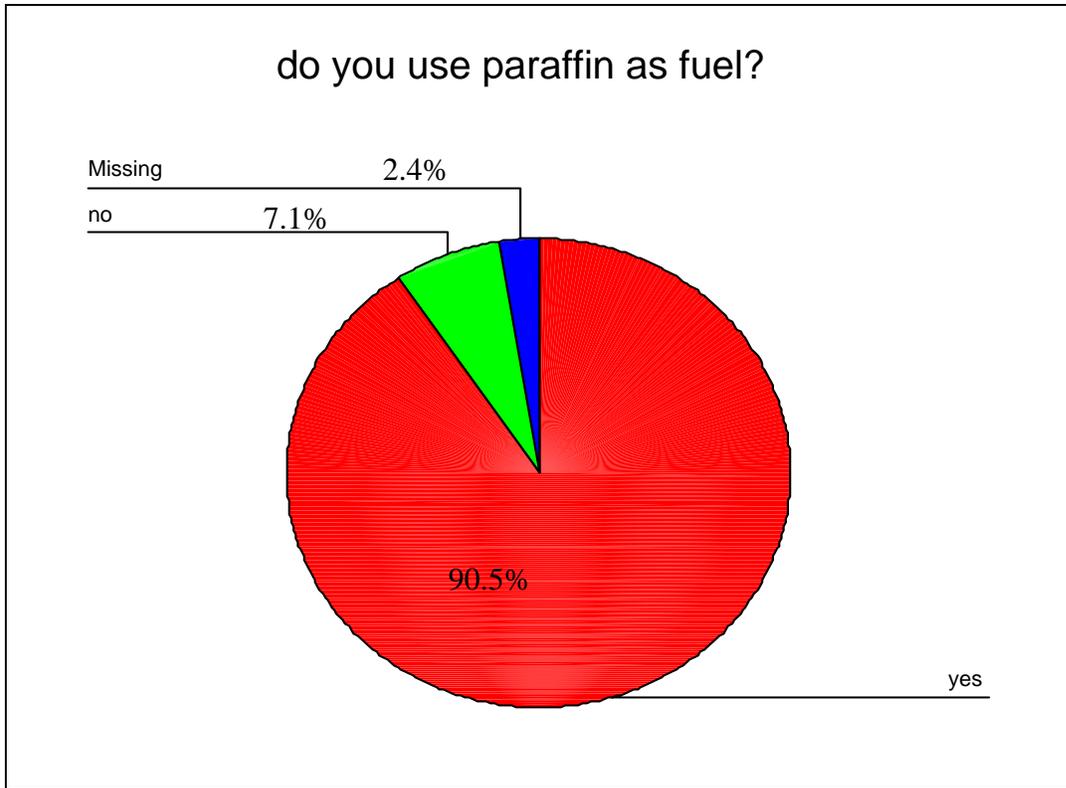
do you use paraffin as fuel?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	38	90.5	92.7	92.7
	no	3	7.1	7.3	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Source; Primary data

90.5% of the Respondents said they use Paraffin as Fuel and 7.1% do not. The valid Percentage of the Respondents who use and do not use Paraffin as fuel are 92.7% and 7.3%, respectively. Paraffin is mainly used for lighting.

Below is the Pie chart representing the responses of the Respondents on whether they use Paraffin as fuel or not.



Use of Gas as fuel

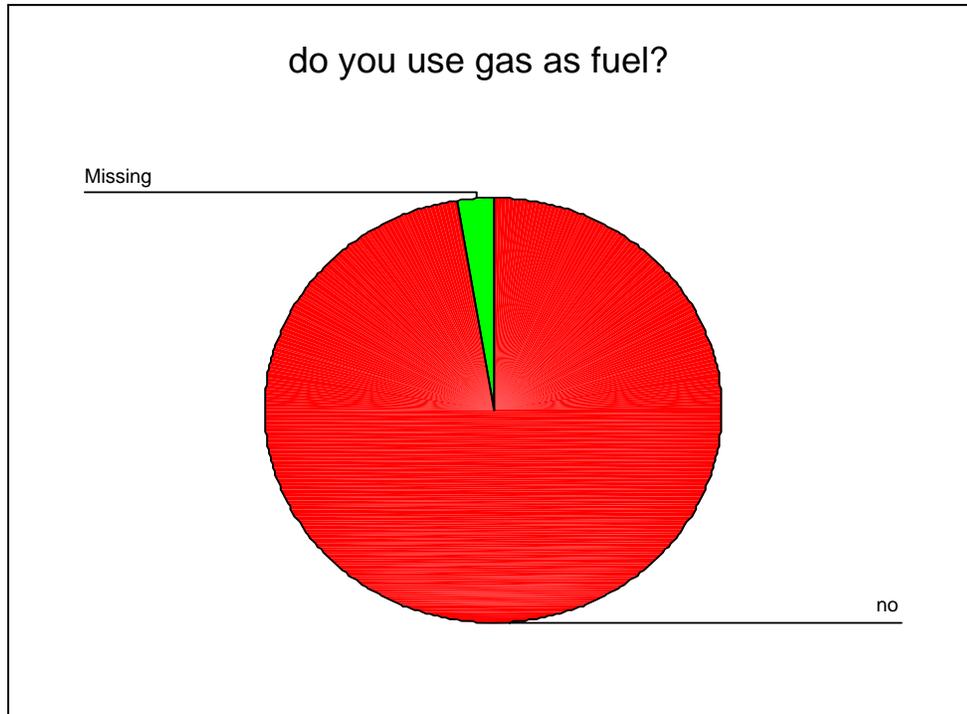
do you use gas as fuel?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source; Primary data

97.6% of the Respondents do not use Gas as fuel while 2.4% account for missing responses. Therefore, 100% of the Respondents do not use Gas as Fuel as a valid percentage.

The below Pie chart represent the responses of the respondents for the use of Gas as fuel including the missing percentage.



Use of Electricity as Fuel

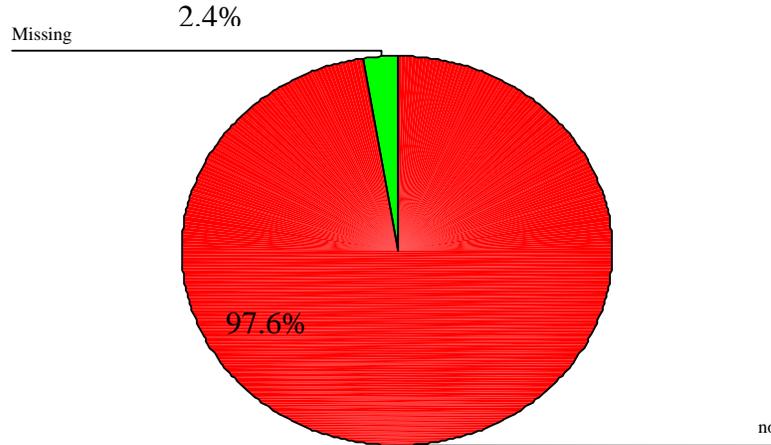
do you use electricity as fuel?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source; Primary data

97.6% of the Respondents do not use Electricity as fuel while 2.4% are missing responses. Therefore, the valid percentage of the respondents who do not use Electricity as fuel is 100%. It implies all the respondents do not use Electricity as fuel or Energy.

do you use electricity as fuel?



Reasons for Growing Crops in the Woodlot

Growing of Crops for Home Use Purpose

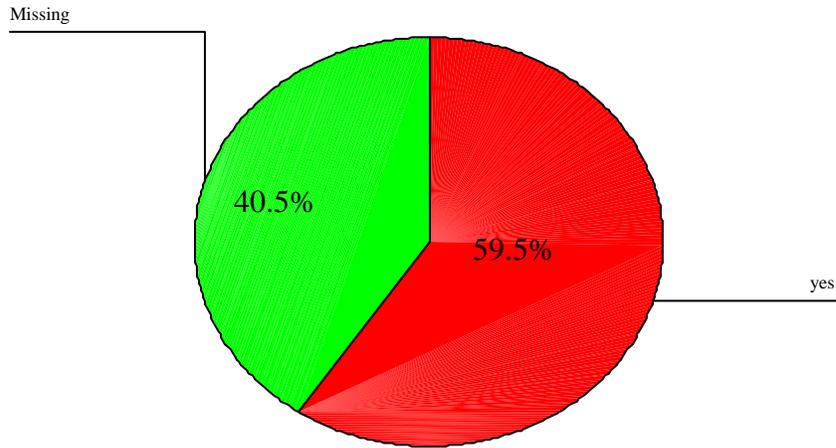
Do you grow the crop for Home use?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	25	59.5	100.0	100.0
Missing System	17	40.5		
Total	42	100.0		

Source: Primary data

Forty two respondents were asked if they grow crops in their woodlot for Home use purposes, 59.5% agree that the crops they grow in their woodlots are mainly for home use whilst 40.5% did not respond. Therefore the valid percentage of respondents who said they grow crops for home use is 100%. This means 100% of the respondents grow crops for home use purposes.

Do you grow the crop for Home use?



Growing of Crops for Income Generating Purposes

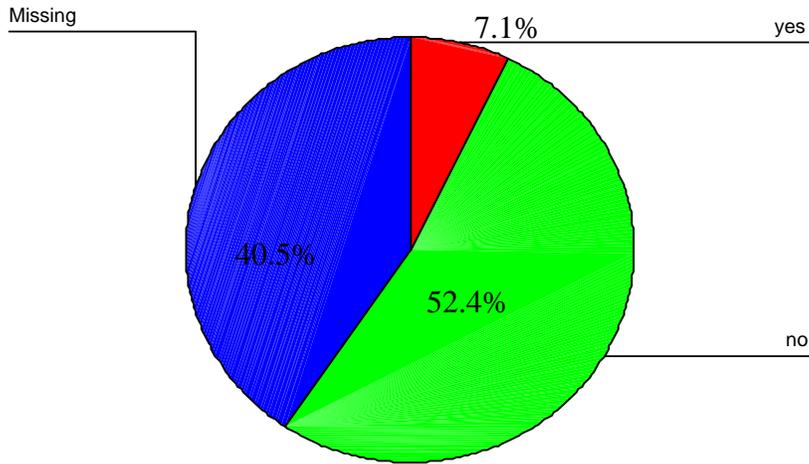
Do you grow the crop for income generating purpose?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	3	7.1	12.0	12.0
	no	22	52.4	88.0	100.0
	Total	25	59.5	100.0	
Missing	System	17	40.5		
Total		42	100.0		

Source: Primary data

Twelve percent (12%) of the Respondents said they Grow Crops in Their Woodlot for Income generating purposes and eighty eight percent(88%) of the Respondents when asked whether they grow the Crops in their Woodlot for Income generating purpose said no.

Do you grow the crop for income generating purpose?



Uses of the Various Sources of Fuel

Uses of Wood

uses of wood

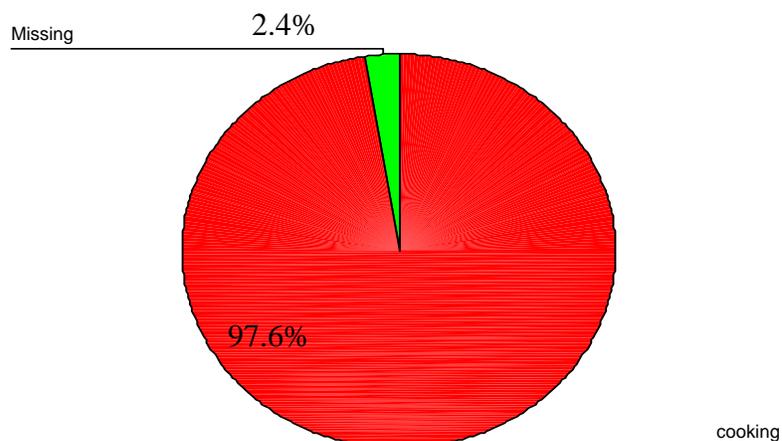
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid cooking	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source: Primary data

Three uses of sources of fuel like Paraffin, Electricity, Wood, Charcoal, and Gas were provided. The uses provided included: heating, lighting and cooking.

97.6% Of the Respondents use wood for Cooking while 2.4% are missing. This implies that 100% Of the Respondents use wood for Cooking. Therefore, all the Respondents use Wood for cooking.

uses of wood



Uses of Charcoal

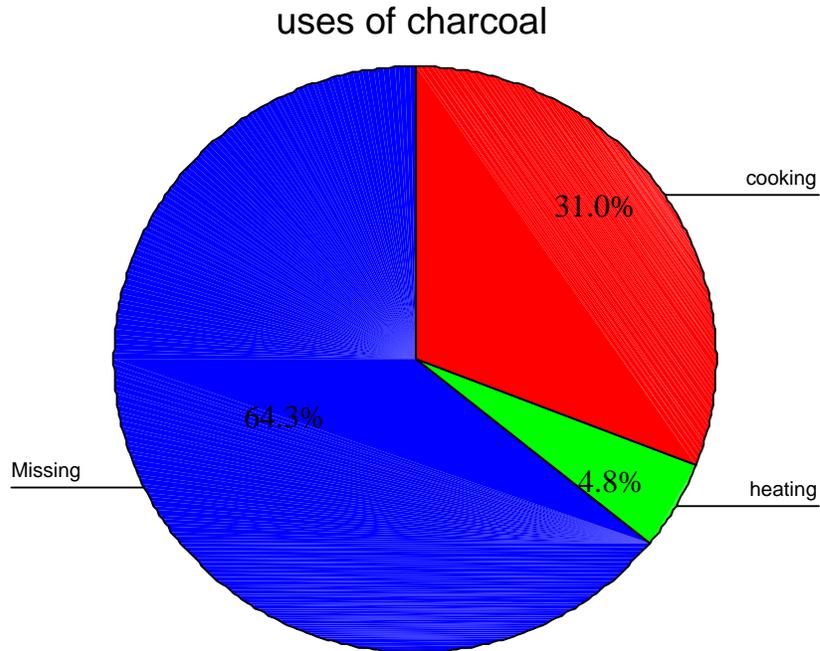
uses of charcoal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cooking	13	31.0	86.7	86.7
	heating	2	4.8	13.3	100.0
	Total	15	35.7	100.0	
Missing	System	27	64.3		
Total		42	100.0		

Source; Primary data

For uses of Charcoal, 31.0% use Charcoal for cooking, 4.8% use charcoal for heating and 64.3% are missing responses. Therefore, the valid percentage of respondents who use charcoal for cooking and heating is 86.7% and 13.3%, respectively. The implication is that majority of the Communities in Mabira forest use Charcoal for Cooking than for heating.

The Pie chart below represents the various uses of Charcoal for the respondents.



Uses of Paraffin

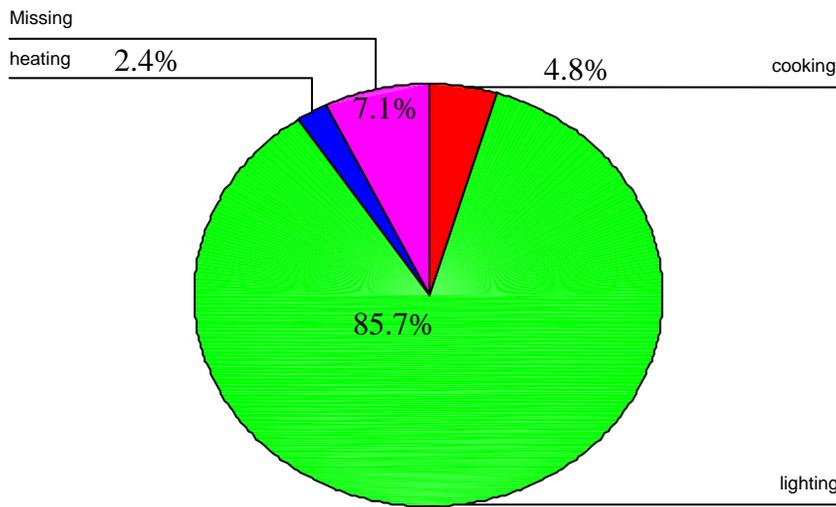
usesof paraffin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cooking	2	4.8	5.1	5.1
	lighting	36	85.7	92.3	97.4
	heating	1	2.4	2.6	100.0
	Total	39	92.9	100.0	
Missing	System	3	7.1		
Total		42	100.0		

Source: Primary data

For the uses of Paraffin, 5.1% of the Respondents use Paraffin for Cooking, 92.3% use Paraffin for lighting and 2.6% of the Respondents use Paraffin for heating. Therefore, Paraffin is mainly used for lighting as Electricity is not accessible to many of the Communities in and around Mabira Forest.

Uses of paraffin



3. Conclusion

- The local communities derive a lot of livelihoods from Mabira Forest. **90.2%** of the Respondents agree that they use the forest for a variety of uses

Some of the benefits from the forest that the communities derive among others include;

- Spring water both protected and unprotected. **81%** of the Respondents agree that they use spring water. And **75%** of the Respondents accept that they get their water from the Forest compared to only **25%** that claim they do not get their water from the Forest.
- Medicinal plants from the Forest. **82.1%** of the Respondents derive Medicinal plants from the Forest. However, 76.2% of the Respondents use the Medicinal plants for their own consumption and **23.8%** sell the Medicinal plants they derive from Mabira Forest. Therefore, it means that Medicinal plants are mainly collected for own consumption rather than for sale by the communities in and around Mabira Forest.
- Mairungi is the highest source of annual income. Mairungi earned an annual income of Shs.**147,887,000**.

Bujagali Hydro-Electric Power Project

Economic Assessment of Resource Values Affected by the 220 KV Powerline Wayleave Traversing Mabira, Kifu and Namyoya Central Forest Reserves

October, 2006

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Principal Associate
YOMA Consultants*

FINAL DRAFT REPORT

Acronyms and Abbreviations

AR	Average Annual Net Benefit
CFM	Collaborative Forest Management
CFR	Central Forest Reserve
CVM	Contingent Valuation Method
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
FD	Forest Department
FGD	Focus Group Discussion
FORRI	Forestry Resources Research Institute
Ha	Hectare
MAFICO	Mabira Forest Integrated Community Organisation
MPA	Management Plan Area
MUIENR	Makerere University Institute of Environment and Natural Resources
MW	Mega Watt
NARS	National Agricultural Research Systems
NFA	National Forestry Authority
NPV	Net Present Value
NTFP	Non-Timber Forest Product
SNR	Strict Nature Reserve
TCM	Travel Cost Method
TEV	Total Economic Value
THF	Tropical High Forest
ToR	Terms of Reference
TPV	Total Present Value
USD	United States Dollar
USHS	Uganda Shillings
WTP	Willingness to Pay

Executive Summary

In order to evacuate electricity from the proposed power plant at Dumbbell Island on the River Nile and carry it to Kampala and other parts of Uganda, a 220 KV transmission line is to be installed. The proposed routing of the line passes through Mabira, Kifu and Namyoya CFRs. The powerline Wayleave traversing the three forests is 40 metres wide on the northern side of the existing 132 KV line.

Both the *National Environment Act* and the *National Forestry and Tree Planting Act* require that for certain major developments such as the installation of the powerline through the three forests, an environmental impact assessment (or environmental impact study) should be carried out. The same requirement holds in respect of the World Bank environmental and social safeguard policies. This report constitutes part of the environmental impact assessment process. In particular, the study is concerned with assessing the economic impact of the development in terms of resources lost and benefits foregone. The estimates were derived from both primary and secondary data and follow the principle of total economic value of forests.

The results of the study suggest a timber stock (50 cm + dbh) worth US\$ 249.2 million will be lost in Mabira CFR. The present value of timber benefit streams obtained from long-run sustainable yield in Mabira CFR and timber values foregone in the plantations of Kifu and Namyoya CFRs were estimated at US\$ 157.3 million. Furthermore, the present value of other annual benefit streams from forest products, biodiversity, domestic water, carbon storage and ecotourism – was estimated at US\$ 35.9 million. The present value of annual ground rent payments was calculated to be US\$ 13.4 million. Other values which include immature tree plantings and incremental management costs had a present value of US\$ 18.4 million. Hence the total values lost or foregone was estimated at US\$ 474.2 million.

Of the total amount of values lost or foregone, the NFA realises US\$ 249.2 million from the disposal of the standing crop in Mabira CFR through its auction process. The Developer on the other hand, should compensate the NFA for lost forest benefits and added management responsibilities to the tune of US\$ 225.0 million. The table below shows a summary of economic values lost or foregone.

Impact Area Economic Values (US\$ '000s)*

<i>Value Sources</i>	<i>Amount</i>
A. NATURAL FOREST GROWING STOCK	249,220
B. PRESENT VALUE OF BENEFITS STREAMS	
1. Timber	157,314
2. Poles + Firewood	4,693
3. Non-Timber Forest Products	5,292
4. Biodiversity	1,525
5. Domestic Water	4,249
6. Carbon Storage	17,341
7. Ecotourism	2,831
8. Landtake	<u>13,412</u>
SubTotal B	<u>206,657</u>
C. OTHERS	
1. Immature tree plantings	1,826
2. Management Costs	<u>16,552</u>
SubTotal C	<u>18,378</u>
D. TOTAL (B+C)	<u>225,035</u>
E. TOTAL (A+B+C)	<u>474,225</u>

* - corrected to nearest 1000

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1.0 INTRODUCTION

1.1 Background

Bujagali Energy Ltd. (BEL), a project-specific company owned by World Power Holdings, LLC of Luxembourg and IPS (Kenya) Limited proposes to build, own and operate a 250 MW hydro electric power plant at Dumbbell Island on the River Nile. To evacuate electricity from the generating station Uganda Electricity Transmission Company Limited (UETCL) proposes to construct a transmission line from the power generation house to Kampala. The aligned route passes through mostly private land. However, the line also passes through three central forest reserves (CFRs) – Mabira CFR, Kifu CFR and Namyoya CFR (*Figure 1*). The powerline Wayleave through the three forests is 40 metres (m) wide along the northern side of the existing 132 kV transmission line.

The National Environment Act Cap 153 and the National Forestry and Tree Planting Act require that for certain developments such as the installation of the powerline in forest areas, an environmental impact assessment (EIA) should be carried out. The same holds with respect to the World Bank’s environmental and social safeguard policies. Furthermore, these policy and legal instruments call for the fair compensation of any resources that will be lost as a result of the development. This, therefore, calls for an economic assessment of the value of forest resources which will be lost as a result of the 40m wide Wayleave. Economic valuation is a tool that can provide decisionmakers with useful information with which to decide between alternatives or in favour of preferred combinations of possible interventions. In this case, economic valuation was used to arrive at a fair and objective estimation of the value of resources which will be lost or foregone as a result of the Wayleave so as to guide negotiations on the appropriate level of compensation. The value of forests depends not only on the market prices of its direct uses but is also based on other indirect uses of the forest resources that cannot be traded on some kind of market.

1.2 Project description

The project will involve the clearance of a 40m wide area along the entire length traversing Mabira, Kifu and Namyoya CFRs, on the northern side of the existing 132 kV line.

Table 1 shows the Mabira CFR compartments through which the proposed line passes. Within Mabira CFR, there are community enclaves. The line passes through Buwoola and Namusa enclaves, covering a length of 1.3 kilometres (km). Of the total length of 18.6 km, the remaining 17.3 km passes through 8.3 km of the production/encroachment management zone, 6.8 km of the recreation/buffer zone and 3.2 km of production/low impact zone¹.

Within Kifu CFR, the line passes through a 0.9 km stretch of forest plantation planted with *Araucaria cunninghamii* and owned by NFA. Similarly, the line passes through 1.9 km of *Eucalyptus grandis* plantation in Namyoya CFR.

¹ Although designated production/low impact management zone, the 0.7 km of the line passing through Compartment 234 is in a severely encroached area with no timber but containing a young crop of *Terminalia sp.*

Consequently, the total length of Wayleave through the CFRs is 21.4 km of which 1.3 km traverses through community enclaves leaving a net distance of 20.1 km going through natural and plantation forests.

Table 2 shows the total area of impact in the three CFRs is about 85.5 ha made up of 74.4 ha in Mabira CFR, 3.7 ha in Kifu CFR and 7.7 ha in Namuyoya CFR.

Figure 1. Map of Forest Reserves and the Proposed Wayleave

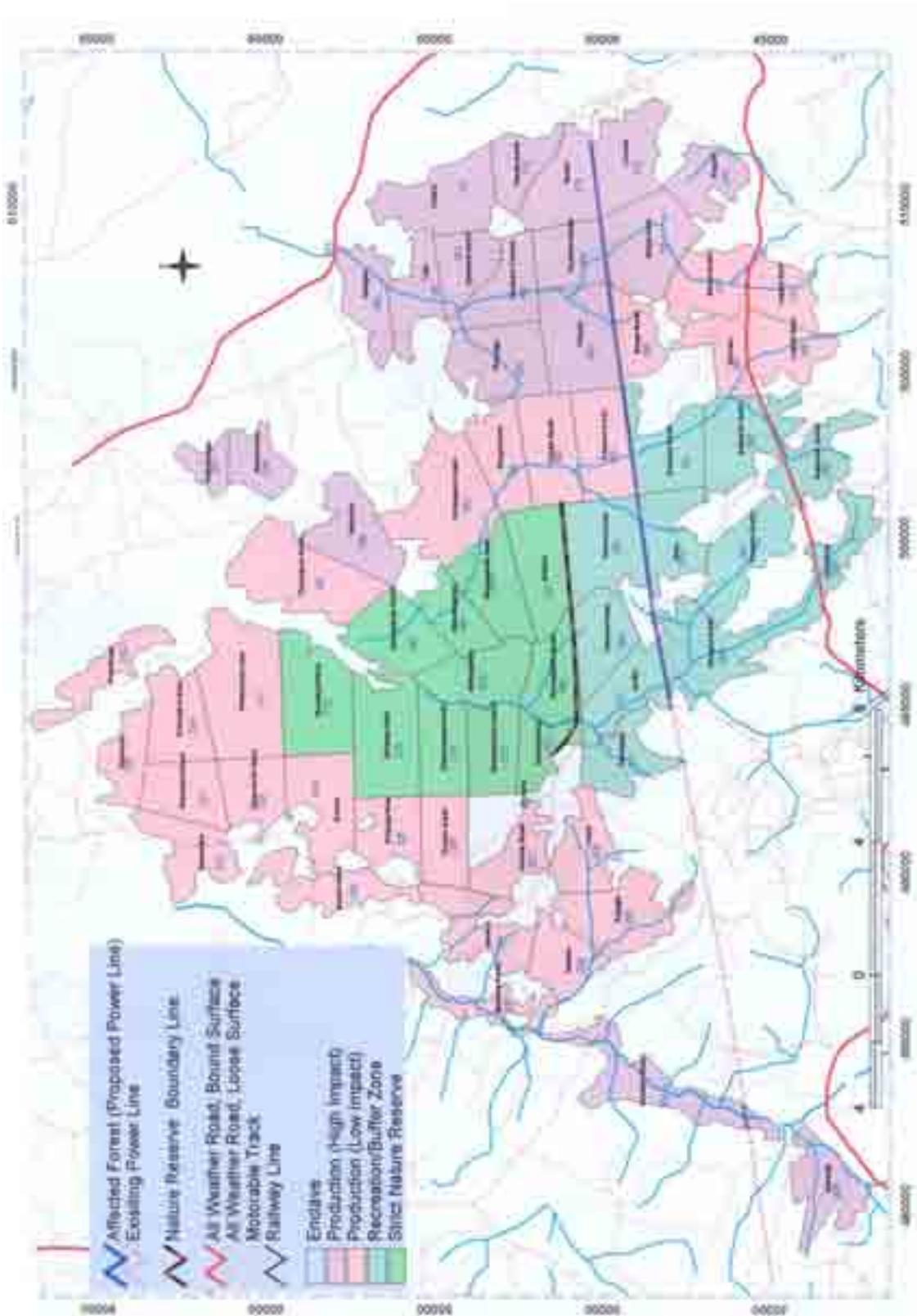


Table 1. Project area in Mabira CFR

Management Zone	Compartments	Impact Area	
		(ha)	% total
Production (Encroachment)	173,179,185	30.250	40.7%
Production (Low Impact)	192,229	8.715	11.7%
Production (Low Impact)/Plantation	234	2.814	3.8%
Recreation/Buffer Zone	191,203,206,211	27.341	36.8%
Community Enclaves	n/a	5.132	7.0%
Totals		74.252	100.0%

n/a – not applicable

Table 2. Project impact area in Mabira, Kifu and Namyoya CFRs

CFR	Size of area affected (ha)	Description
Mabira	5.2	Community enclave area
	33.2	Production/Encroachment Management Zone
	27.2	Recreation/Buffer Management Zone
	8.8	Production/Low Impact Management Zone (includes <i>Terminalia sp</i> crop of less than 1 year old)
	74.4	Total, Mabira
Kifu	3.7	<i>Araucaria cunninghamii</i> plantation owned by the NFA
Namyoya	7.7	<i>Eucalyptus grandis</i> plantations, privately owned and grown under licence/permit from the NFA
Total	85.5	

1.3 Scope of the assignment

The Terms of Reference (ToR) of the study required a comprehensive Environmental Economic Assessment of the environmental and natural resources impacts of the installation of the 220 kV Electric Transmission Wayleave through the central forest reserves.

The conceptual, spatial and temporal scope of the study were:

- the conceptual scope of the study involved the estimation of total economic value (TEV) of the forest areas affected. In this context, due to the small area of forestland withdrawn the bequest and existence values will not be significantly affected by the Wayleave. Hence, only direct use and indirect use and option values were considered. Direct use values are those deriving from timber, poles, firewood, non-timber forest products (NTFPs), water and ecotourism. The indirect use value considered consisted of carbon sequestration values since the area affected will be too small to make any significant impact on watershed values of the three CFRs. The option value considered concerning the loss of biodiversity.
- the temporal aspect of the study related to considering annualised stream of net resource benefits capitalised at an appropriate discount rate to arrive at net present values (NPVs); and
- the spatial scope of the study was limited to a 40m width along the entire length of the sections of CFRs the line is proposed to traverse. The spatial scope was indexed to the appropriate forest zones, considered on compartment by compartment basis in Mabira CFR, and ownership of planted crops in Kifu and Namyoya CFRs.

1.4 Report structure

This economic assessment report of forest values is divided into five chapters including this introduction as Chapter 1.0. Characteristics of the three CFRs is presented in Chapter 2.0 and relates primarily to general area physical characteristics, climate, flora, fauna and forest enclaves for Mabira; and descriptions of the plantations in Kifu and Namyoya. Chapter 3.0 was devoted to impact analysis beginning with defining the systems boundaries and then to a closer examination of the three CFRs. Chapter 4.0 was dedicated to economic valuation covering the theory and practice of forest valuation, methodologies employed and estimates of economic values of significant impacts. Chapter 5.0 looked at several mitigation options, and is followed by References and Annexes.

2.0 Area Characteristics

While the proposed transmission line passes through both public and private lands, this report covers the former. In particular, the report is devoted to the three CFRs – Mabira, Kifu and Namyoya. Hence any enclaves of community areas such as those in Mabira were not covered since they are not within the boundaries of the CFR and valuation follows different legal approaches.

2.2 Mabira Central Forest Reserve²

Mabira Forest reserve was established in 1900 (under the Buganda Agreement). It lies in the counties of Buikwe and Nakifuma in the administrative district of Mukono. It occupies an area of 306 km² with an altitudinal range of 1070-1340 m above sea level and is situated between latitude 0⁰ 22' and 0⁰ 35' and between longitude 32⁰ 56' and 33⁰ 02'E. The Forest Reserve is, therefore, the largest natural high forest in the Lake Victoria crescent.

Mabira Forest Reserve is located in a heavily settled agricultural area close to large urban centres including Kampala, Lugazi, Mukono and Jinja. This makes it a very important refugium and eco-tourist destination. The location of the forest also makes it a very important source of forest products whose demand has increasingly grown in the towns mentioned earlier. The management of Mabira forest therefore, currently caters for production, conservation and recreational functions of the forest ecosystem.

Whereas the forest suffered considerable destruction through illegal removal of forest produce and agricultural encroachment which activities threatened the integrity of the forest, these have now been controlled and the forest has near regained its original integrity.

Vegetation

The vegetation in Mabira Forest is dominated by *Celtis-Chrysophyllum* medium altitude moist semi-deciduous Tropical High Forest communities of type D1 (95% equivalent to 292 km²). The remaining 5 % of the forest area is made up of medium altitude moist evergreen forest communities of *Piptadeniastrum-Albizia-Celtis* tree species (Langdale-Brown, 1964).

Mabira Forest is a dominantly sub-climax forest which is just recovering from a long period of exploitation and encroachment. The forest is, therefore, made up of young colonising mixed forest trees dominated by *Maesopsis eminii* (25%), young mixed *Celtis-Holoptelea spp.* (60%), and mixed wet valley bottom species dominated by *Baikiaea spp.* (15%).

The forest also suffered selective felling (creaming) of high value trees (ie. Class 1A and B) in the last twenty or so years and today, only retains a small percentage of such trees (including *Milicia excelsa*, *Holoptelea grandis* and *Olea welwitschii*) in the growing stock (0.06%). Most trees in the forest are Class III fee group tree species making up as much as

² Description of Mabira CFR is adapted from Muramira (2000)

52.4% of all trees of all fee groups. The remaining 47.5% of the growing stock is comprised of Class II fee group tree species including *Celtis species*, *Albizia species*, *Alstonia boonei* and *Funtumia africana*. The forest is notably dominated by Paper Mulberry (*Broussonetia papyriferra*) particularly in the previously heavily encroached areas (25.1%). Whereas *Broussonetia papyriferra* is an exotic tree specie with clearly invasive characteristics, the specie is not considered a threat to natural regeneration. In fact, the tree species has been noticed to help the natural regeneration of indigenous tree species including *Antiaris africana*, *Prunus africana*, *Lovoa trichilioides* and *Celtis species*, which require shade and forest cover for their successful regeneration. *Broussonetia papyriferra* has also quickly taken up areas which would otherwise be invaded by pioneer grasses like *Imperata cylindricum* which discourage regeneration and growth of indigenous forest cover. The species is also a very important source of firewood (Davenport *et al*, 1996).

Birds

The birds of Mabira Forest have been subjected to a considerable amount of survey work including regular surveys, summarized by Carswell (1986). Birds are arguably therefore, the best known faunal group in Mabira forest.

The bird species list for Mabira Forest now stands at 287 species of which 109 were recorded during the 1992-1994 Forest Department Biodiversity Inventory (Davenport *et al*, 1996). These include three species listed as threatened by the Red Data Books (Collar *et al*, 1994) i.e. the blue swallow (*Hirundo atrocaerulea*), the papyrus Gonolek (*Laniarius mufumbiri*) and Nahan's Francolin (*Francolini nahani*).

Mammals

A number of recordings of the mammalian diversity of the Mabira Forest Reserve have been done in the last thirty years. The most comprehensive published study of the mammals of the forest however, is that by the Forest Department of 1996 (Davenport *et al* 1996). The Davenport report documented 17 new species of small mammals found in the forest. Other recordings include those by the Tropical Forest Diversity Project (1987-88 on woody vegetation, birds and mammals); Kingdon (1971) on mangabeys and red tailed monkeys; and Delany (1975) for rodents.

The Davenport report indicates a high incidence of small forest dependent mammal species including *Deomys ferrugineus* and *Scutisorex somereni*. The two mammals are closed forest-dependent specialists and are often regarded as the most sensitive indicators of forest disturbance. The Uganda endemic shrew *Crocidura selina*, only previously recorded in Mabira Forest and reported in 1990 is again recorded in the Davenport report (Davenport *et al*. 1996).

Butterflies and Moths

Mabira Forest Reserve is considered rich in terms of the diversity of its butterfly fauna (Davenport *et al*. 1996). The forest supports a variety of forest dependent butterflies, as well

as a number of uncommon and restricted-range species. Despite a recent history of intensive human disturbance, the butterfly fauna of Mabira Forest has shown marked resilience.

Mabira forest reserve is a home to two sub-species which are endemic to Uganda including *Tanuetheira timon orientius* (for which Ugandan forests are the eastern limit of the species' range) and *Acraea lycoentebbia* (Davenport *et al.* 1996).

The moth fauna is typical of large forests situated on the lake crescent. Mabira Forest Reserve supports a few rainforest species from West and Central Africa. A total of 52 hawk moth and 45 silk moth species characteristic of closed canopy forests and forest edges live in the forest. Several lowland species have also been recorded. Compared with other major forests in Southern and Western Uganda, Mabira Forest is a high-ranking site for silk moths, but less so for hawk moths. This is because the Eastern range of most West African hawk moth species does not extend to this region.

Objectives of Management

The location, unique species richness and productivity of Mabira Forest Reserve, impart to it special qualities demanding a multiple objective management approach. The objectives of management of the forest therefore, are:

- to conserve and enhance forest biodiversity and ecological conditions;
- to produce timber and non-timber products on a sustainable yield basis using the most efficient methods (i.e. without compromising the capability of the forest to provide environmental services);
- to integrate the communities within the forest enclaves and parishes surrounding the forest reserve into the management of the forest;
- to provide recreational facilities for the people of Ugandan citizen, visitors and tourists; and
- to carry out research aimed at obtaining information on various aspects of forest ecosystem dynamics for the improvement of the management of Mabira Forest in particular, and other forests in general.

To achieve the above management objectives, Mabira forest reserve is divided into five working circles namely:

- the conservation working circle consisting of 13 compartments including compartments 198-202, 207-210 and 213-216 as the Strict Nature Reserve;
- the production working circle consisting of 45 compartments which include compartments 171-188, 192-197, 217-237 and 71 ha of Kalagala Falls forest reserve;

- the community participation working circle to pilot Collaborative Forest Management (CFM) within selected forest enclaves and parishes surrounding the forest reserve;
- the recreation working circle consisting of 9 compartments which include compartments 189-191, 203-206, 211-212 and 33 ha of Kalagala Falls forest reserve totaling 4,097 ha; and
- the research working circle.

2.3 Kifu Central Forest Reserve³

Kifu CFR covers an area of 1419 ha (Statutory Instrument No. 63, 1998). It was gazetted in 1932. The CFR is located in close proximity to Mukono Town Council; just off the Mukono-Kayunga Highway (32 km from Kampala City and about 6 km from Mukono Town).

Originally Kifu CFR was a well-stocked Natural High Forest. It held Greater Forest Functions (GFF) in addition to water catchment. The CFR is drained by several rivers and streams (Kifu, Kasota, Lwajali and Ssezibwa) which flow into Lake Victoria. The population around Kifu CFR, rapidly urbanising, exerted pressure on the reserve as a result of ever greater demand for fuelwood and other livelihood activities. This pressure led to the degradation of the reserve and reduced the flow of most of the forest use values. Currently, the NFA is implementing the following management objectives:

- to restore the forest through planting of mixed broad leaved species;
- to demonstrate fast growing tree species with high yield;
- to promote *ex situ* conservation by way of maintaining superior seed tree species; and
- to implement technologies and forest management practices for poverty reduction and reduce pressure on the forest reserve.

The foregoing objectives are being met through the creation of three land use categories as follows.

- Research – 425 ha has been licensed to the Forestry Resources Research Institute (FORRI) under the National Agricultural Research Systems (NARS) programme
- Private plantation establishment (694 ha)
- NFA management practices (300 ha), of which about 79 ha has been planted (*Table 3*).

Wayleave construction in Kifu CFR passes through the land use category of NFA Management Practices, and covers 3.713 ha. Of this area only 2.4 ha has been planted. The crop of *Araucaria cunninghamii* is now 5 years old. The remainder is severely degraded natural forest area. *A. cunninghamii* is grown on 25-year economic rotation in Uganda.

³ The description which follows was obtained from NFA records.

Table 3. Demonstration, Restoration and Seed Species by NFA

Tree species	Area planted (ha)	Planting date	Age (yrs)	Remarks
<i>Araucaria cunninghamii</i>	26.5	May 2001 Oct 2002 April 2003	5 4 3	Fast growing timber species with high Yield
<i>Araucaria haustenii</i>	2	Oct 2002	4	
<i>Araucaria agathis</i>	2	Oct 2002	4	
<i>Araucaria cunninghamii</i> and <i>Araucaria haustenii</i>	6	1974	32yrs	Superior seed tree species /Seed/Mother stand for seedling production
	3	1971-72	34yrs	
<i>Araucaria cunninghamii</i> and <i>Araucaria haustenii</i>	10	1974	32yrs	Under trial
	4	1971-72	34yrs	
<i>Maesopsis emnii</i>	15	May 2001	5	Natural forest restoration / Broad leaved
<i>Cedrella odorata</i>	1	May 2002	4	Quality Timber species, High demand
<i>Eucalyptus Citrodora</i>	3.7	May 2004	2	Technology for poverty reduction (Essential oils / Medicinal)
<i>Eucalyptus paniculata</i>	1	May 2004	2	Charcoal production trials
	2	May 2005	1	
<i>Eucalyptus cleosiana</i>	1	May 2005	1	Poles and Charcoal production trials
<i>Eucalyptus grandis</i>	2	Dec 2004	2	Pole production
Grafted Pine	0.25	Nov 2002	4	Hybrid seed production

Total area planted = 79.45 ha

Source: NFA Records

2.4 Namyoya Central Forest Reserve

Similar to Kifu, the Namyoya CFR was originally a natural forest but now entirely converted to plantation forestry. The entire CFR is allocated to private tree farmers initially on 5-year lease permits by the Forest Department (FD). These permits are now being converted to 25-year licences which allows a private tree farmer to harvest at least three crops of Eucalyptus suitable as electric poles (on 8-year economic rotation basis).

3.0 Impact Analysis

3.1 Systems boundaries

The systems boundaries have been defined in terms of valuation area, magnitude of development impacts, management costs, and other considerations.

Valuation area

The valuation area is only 40 m wide on the northern side of the existing 132 kV line along sections of the forest through which the transmission line passes. Defined thus, the valuation area consists of both natural and plantation forests, the first assessed according to the different zones specified in the Forest Management Plan 1997-2007 for Mabira CFR; and the latter based on age and species of plantings for Kifu CFR and Namyoya CFR. For Mabira CFR recognition was given to the fact that not all compartments are homogenous and benefit streams were therefore estimated on compartment by compartment basis. Detailed maps of the three CFRs showing the areas to be impacted by the Wayleave construction are presented in *Annex 1*.

Magnitudes of development impacts

Only significant impacts were considered in the impact analysis. What this meant was that by and large, the hydrological functions of the forests will be largely left unaffected since much smaller areas relative to the total area of the reserve will be impacted. Similarly, the construction and subsequent maintenance of the Wayleave will have virtually no noticeable impact on options, bequest and existence values except for considerations of loss of biodiversity (under option values).

Management costs

Monitoring of mitigation measures will entail additional management effort by the NFA. Furthermore, the NFA is about to begin preparing a new Forest Management Plan (FMP) for Mabira CFR and, as such, the impacts of the proposed transmission line will also have to be addressed during the process.

Plantations

Only established plantation tree crops were considered for estimates of future values foregone based on the length of the license issued to the tree farmer. For the Kifu CFR plantation crop, the NFA is equated to a private tree farmer and applicable licence periods used as a basis for calculating benefits foregone. For eucalyptus planting, a crop of more than 1 year is considered established. For other species, a crop of 5 years is considered established. For plantings less than the age of establishment, investments lost in ground clearing, planting, beating up and weeding were considered.

Other considerations

Some 5.1 ha of land in community enclaves in Mabira CFR, owned by individuals, will be affected. These areas need to be compensated for to allow the Developer to enjoy unencumbered access. However, the compensation was excluded from the economic assessment in Mabira CFR, since a different methodology would be required and the areas are not part of the reserve as further explained below.

3.2 Effective area impacted

Table 4 shows the area of impact in the three CFRs including community enclaves in Mabira CFR. A total of 69.1 ha of Mabira CFR consisting of different management categories will be impacted. However, Compartment 234 is so severely degraded and devoid of any big trees that it cannot be considered a natural forest area. There is a wetland along the tributary of the Ssezibwa River, otherwise the area is scrub land except for about 0.2 ha of private planting of a *Terminalia sp.* crop of less than 1 year old. Hence in estimates of total natural forest area impacted, the zone in Compartment 234 should be removed altogether, leaving natural forest area impacted at 66.3 ha.

Two Community Enclaves – Buwoola and Namusa – within Mabira CFR will be impacted. An area of 5.1 ha is the impact zone. Although these enclaves are within the boundaries of Mabira CFR, they are not part of the reserve. The enclaves are settlements with subsistence agriculture practiced by the households. The land in question is owned by individuals. The value for the 5.1 ha of Community Enclave land is, therefore, outside the consideration of the forest area economic assessment of this assignment. Hence, this area is removed from further consideration.

The area the project will impact in Kifu CFR consists of 3.7 ha of *Araucaria cunninghamii* plantation. Similarly, 7.7 ha of privately-owned *Eucalyptus grandis* plantations in Namuyoya CFR will be affected by the development.

Subsequently, the effective area of impact for forest area by the project is made up of:

◆	natural forest in Mabira CFR	66.3 ha
◆	plantation area in Mabira CFR	0.2 ha
◆	plantation area in Kifu CFR	3.7 ha
◆	plantation area in Namuyoya CFR	<u>7.7 ha</u>
		<u>77.9 ha</u>

Table 4. Area of Impact

CFR/Other	Compartment No.	Effective Area Impacted (ha)	Management zone
MABIRA CFR	173	10.0	Production/Encroachment
	179	7.8	Production/Encroachment
	185	12.4	Production/Encroachment
	192	6.8	Production/Low Impact
	191	6.5	Recreation/Buffer Zone
	203	10.3	Recreation/Buffer Zone
	206	9.4	Recreation/Buffer Zone
	211	1.2	Recreation/Buffer Zone
	229	1.9	Production/Low Impact
	234	2.8	Production/Encroachment
TOTAL MABIRA		69.1	-
COMMUNITY ENCLAVES IN MABIRA CFR	Buwoola	0.2	-
	Namusa	4.9	-
TOTAL ENCLAVES		5.1	-
KIFU CFR	-	3.7	
NAMUYOYA CFR	-	7.7	
TOTAL IMPACT AREA	-	85.6	

3.3 Triangulation and ground truthing

A significant amount of the information used in the analytical part of this report was obtained from secondary sources. However, a conscious effort was made to triangulate and ‘ground truth’ the information with on the ground work. This was achieved using key informant interviews, focus group discussions, participant observations, and a semi-structured household survey using questionnaires.

In general, it was clear that Mabira CFR, the main area of concern because of its natural forest cover, provides a number of livelihood opportunities for the communities in the enclaves and the surrounding areas. From key informant interviews and participant observation, the restoration of the degraded parts of Mabira and maintaining the ecotourism attributes of the CFR features prominently as stakeholder interests. During the Focus Group Discussions (FGDs) hunting, firewood and the harvesting of medicinal plants for home consumption and limited intra-community sales were highlighted as significant non-timber uses. Households also emphasized the important role Mabira CFR plays in ensuring clean supplies of water.

On the other hand, communities were either ambivalent or welcomed the development. Those in favour of the development requested that suitable young and energetic members be considered for employment in project work. With respect to compensatory investments, the communities would like the Developer to commit resources towards putting up classroom

blocks and providing classroom furniture. The communities also requested that the Developer should ensure community roads used during the construction of the Wayleave be left in a sound condition. Finally, the communities requested that electricity be made available in their enclaves and surrounding areas.

Details of Key Informant Interviews are presented in *Annex 2*; Focus Group Discussions in *Annex 3*; and Household Survey in *Annex 4*.

4.0 Economic Valuation

4.1 Theory

Forests in general are complex ecosystems and generate a range of goods and services. For purposes of determining the magnitudes of net benefits lost due to conversion of a forest to other development options, the total economic value (TEV) approach was chosen as the most comprehensive. The TEV is made up of use and non-use values. The use values in turn consist of direct and indirect use values; while the non-use values consist of options, bequest and existence values. This classification was characterised by Monasinghe (1992). *Figure 2*, shows adaptation of the classification by Lette & de Boo (2002).

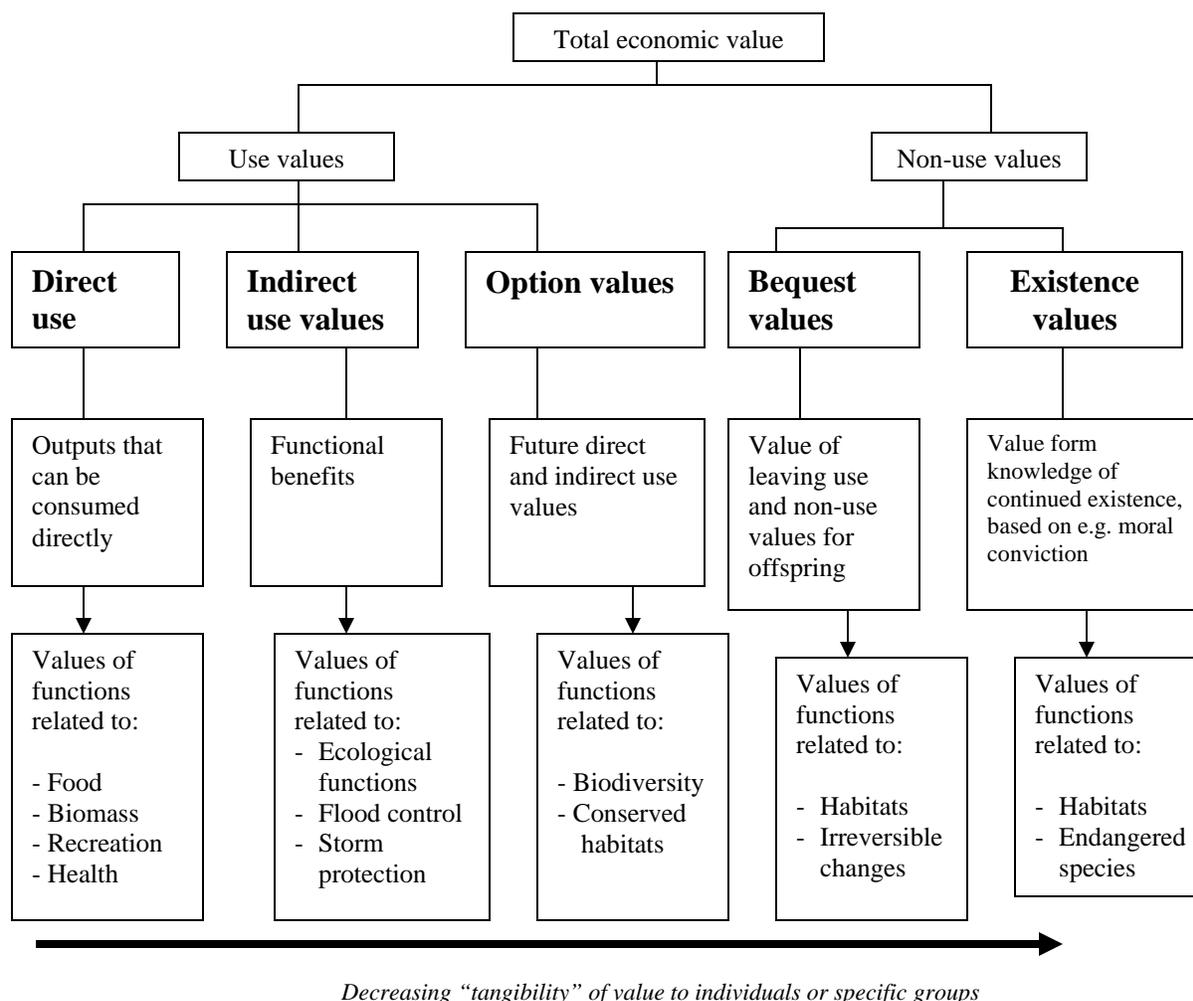
Economic valuation is a tool for decisionmaking intended to compare the advantages and disadvantages of alternative development options or alternatives. The value of forests depends not only on the market prices of its direct uses but is also based on other indirect uses of the forest resources that cannot be traded on some kind of market (Lette & de Boo 2002). Valuation of the goods and services provided by forests is needed because these areas are under great pressure and are in fact disappearing. Extensive areas of Mabira CFR were severely encroached not too long ago (Karani *et al* 1997). The natural forest cover of Kifu CFR and Namyoya CFR have been completely destroyed and the areas have now reverted to plantation forests. The lack of knowledge and awareness of the total value of the goods and services provided by the forest resources will obscure the ecological and social impact of the conversion of forests into other uses. Proper valuation of all goods and services provided by a forest can help us understand the extent to which those who benefit from the forest or its conversion also bear the associated management costs or opportunities foregone (Lette & de Boo 2002). As part of an expanding response to declining global biodiversity (Daily & Walker 2000), interdisciplinary research teams of economists and ecologists have conducted valuation exercises designed to estimate the costs (Ando *et al* 1998; Montgomery *et al* 1999; Balmford *et al* 2003) and benefits (Pimentel *et al* 1997; Costanza *et al* 1997; Balmford *et al* 2002) of forest use alterations.

Despite the importance of the valuation of forests and nature, under-valuation was and still is the order of the day, as a result of market and policy failures (Lette & de Boo 2002). Market failure has been identified as one of the major causes of under-valuation (Lette & de Boo 2002). For example, when determining the economic value of a forest, decisionmakers usually only take into account the easily quantifiable – financial – costs and benefits related to goods and services traded on the market, whereas there are numerous functions of forests for which markets malfunction, are distorted or simply do not exist (Lette & de Boo 2002). Markets only exist for some of the production functions of forests, such as timber, fuelwood, and non-timber products. However, even if markets exist, market prices for these goods may not reflect their real value, since markets can be distorted, for example by subsidies which represent policy failures (Lette & de Boo 2002). The authors suggest that the market price of a particular good may not reflect all the costs involved in producing that good because there may be benefits or costs enjoyed or borne by others not directly involved in the production of the good, what economists call externalities (Lette & de Boo 2002).

With respect to the valuation of a forest using the total economic value approach, the following terms are defined as follows.

- *direct use values* – benefits that accrue directly to the users of forests, whether extractive (e.g. timber and NTFPs) or non-extractive (e.g. ecotourism);
- *indirect use values* – benefits that accrue indirectly to users of forests, primarily ecological or environmental services;
- *option value* – the amount that individuals would be willing to pay to conserve a forest for future use (e.g. biodiversity values);
- *bequest value* – the value attached to the knowledge that others might benefit from a forest area in the future; and
- *existence value* – the value placed by non-users on the knowledge that something exists, i.e. its intrinsic value.

Figure 2. The Total Economic Value of Forests



Source: Lette & de Boo (2002); Munasinghe (1992)

Various valuation tools have been developed to estimate the monetary value of non-marketed goods and services (Lette & de Boo 2002). Munasinghe’s classification of major value categories has proved to be a useful analytical tool to link value categories and their underlying environmental goods and services with specific valuation tools (Munasinghe 1992; Lette & de Boo 2002) as shown in *Table 5*.

While the direct use value of goods and services traded on the market can be easily translated into monetary terms by taking their market prices, there are a lot of other goods and services often conceived as having direct use values. These functions can be better valued by means of other valuation tools (e.g. Related Goods Approach, Hedonic Pricing or Travel Cost Method). The regulation functions of forests from which indirect use value is perceived can also be valued by various valuation tools (e.g. Replacement Cost Technique, Production Function Approach). To capture option, bequest and existence values, Contingent Valuation

Method (CVM) is used to estimate the monetary value of environmental amenities. Lette & de Boo (2002) have cautioned on the use of valuation tools as follows:

“It must be emphasised that none of these valuation tools provides comprehensive answers. All of them value only part of the goods and services provided by forests and nature. They all have limitations and should be chosen and used with care. Using several valuation tools for a single object case, could contribute to a more complete valuation”

Table 5. Example of links between value category, functions and valuation tools

USE	USE VALUES		NON-USE VALUES		
	1. Direct use value	2. Indirect use value	3. Option value	4. Bequest value	5. Existence value
FUNCTIONS	Wood products (timber, fuel)	Watershed protection	Possible future uses of the goods and services mentioned in 1&2 (Use Values) by actual stakeholders	Possible future uses of the goods and services mentioned in 1&2 (use Values) by the offspring of actual stakeholders	Biodiversity Culture, heritage Benefits to stakeholders of only knowing of the existence of goods or services without using them
	Non-wood products (food, medicine, genetic material)	Nutrient cycling			
	Educational, recreational and cultural uses	Air pollution reduction			
	Human habitat	Micro-climatic regulation			
		Carbon storage			
	Tool to be used:	Tool to be used:	Tool to be used:	Tool to be used:	Tool to be used:
VALUATION TOOLS	Market Analysis	Restoration Cost	Contingent Valuation Method	Contingent Valuation Method	Contingent Valuation Method
	Related Goods Approaches	Preventive Expenditure			
	Travel Cost Method	Production Function Approach			
	Contingent Valuation Method	Replacement Costs			
	Hedonic Pricing				

Source: Lette & de Boo (2002)

The foregoing tools have been successfully applied in the valuation of several tropical high forests and other ecosystems. Naidoo & Adamowicz (2005) quantified the costs and benefits of avian biodiversity in Mabira CFR through a combination of economic surveys of tourists, spatial land-use analyses, and species-area relationship. The results showed that revising entrance fees and redistributing ecotourism revenues would protect 114 of the 143 forest bird

species under current market conditions. This total would increase if entrance fees were optimised to capture the tourists' willingness to pay for forest visits and the chance of seeing increased numbers of bird species.

Beukering & Cesar (2001) calculated the total economic value of the Leuser ecosystem in the Philippines under conservation and deforestation scenarios using extended Cost-Benefit Analysis and found that the conservation scenario far outweighed the deforestation scenario and they concluded that the ecosystem would be in the interests of the local population, local and national governments, and the international community. Hadker *et al* (1997) used the Contingent Valuation Method to estimate willingness-to-pay on the part of residents of Bombay (Mumbai) for the maintenance of Borivli National Park, located within the City's limits. The study arrived at a willingness-to-pay of 7.5 rupees per month per household, which amounted to a total present value of 1033 million rupees (or USD 31.6 million). The authors suggested that this figure could be used to influence policy decisions, given that the Protected Area at the time ran on a budget of 17 million rupees (USD 520 000).

Menkhaus & Lober (1995) used the Travel Cost Method (TCM) to determine the value that tourists from the US placed on Costa Rican rainforests as ecotourism destinations using the Monteverde Cloud Reserve as a sampling site. Consumer surplus was estimated to be approximately USD 1150, representing the average annual per person valuation of the ecotourism value of PAs in Costa Rica. The ecotourist value of the Monteverde Cloud Forest Reserve was obtained by multiplying the total number of visitors by the average consumer surplus. This resulted in a total annual US ecotourism value of USD 4.5 million for the Monteverde Reserve.

Janssen & Padilla (1999) used a combination of Cost-Benefit Analysis and Multi-Criteria Analysis to assess the opportunity cost of preservation and analyse tradeoffs to be made in deciding whether to preserve or convert a mangrove forest in the Philippines. The result showed that the aquaculture alternatives performed better than the forestry alternatives and preservation in terms of economic efficiency.

Kramer *et al* (1995) used a combination of valuation tools (Contingent Valuation combined with Opportunity Cost Analysis and Recreation Demand Analysis) to investigate changes in environmental values resulting from the creation of Mantadia National Park in Madagascar. Kramer *et al* (1993) used Contingent Valuation Method to determine the value of tropical rainforest protection as a global environmental good. Using two approaches the authors determined the average willingness-to-pay of US citizens at USD 24 to 31 and extending to all US households, total willingness-to-pay was estimated at USD 2180 to 2820 million per year.

Sikoyo (1995), used the Contingent Valuation Method to determine community direct use benefits from Bwindi Impenetrable Forest National Park in Uganda; while Moyini & Uwimbabazi (2001) used the Travel Cost Method and the Contingent Valuation Method to determine the Mountain gorilla tourism value of Bwindi Impenetrable Forest National Park. The results showed a consumer surplus of USD 100.

Muramira (2000) estimated the value of the overall impact of Wayleave construction through Mabira at USD 340,202 and suggested that this money be set aside to address the environmental impacts of the development. The author used inventory and market analysis, secondary information on resource usage and willingness-to-pay studies in comparable areas and project data.

4.2 Analytical framework

The analytical approach adopted in this report consists of the following.

1. Resource values were estimated from the perspective of net benefit streams, annualised, and then their present values obtained by capitalising the average annual benefits stream using the Government of Uganda's social opportunity cost of capital of 12%.

That is, the present value of product or service (i) equals average annual net benefits (economic rent) capitalised by the social opportunity cost of capital, or:

$$PV_i = AR_i/r$$

where

PV_i - present value of product i

AR_i – average annual net benefit from product i

r – social opportunity cost of capital (discount rate)

Subsequently, the total present value of the Wayleave impact area is given by the equation $TPV = \sum_{i=1}^n (AR_i/r)$

where

TPV-stands for total present value.

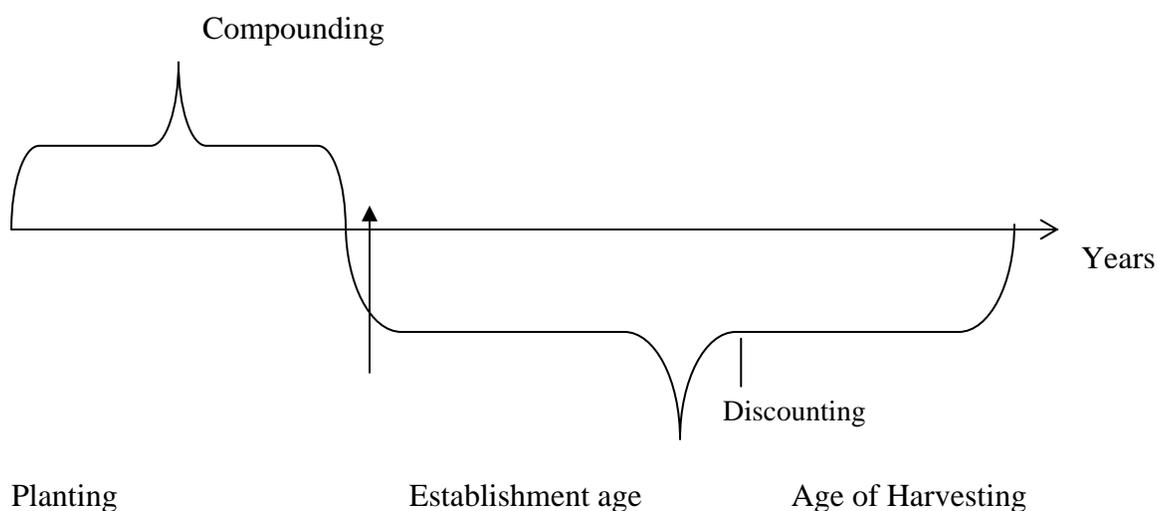
n – number of products

The approach is a good measure of the opportunity cost (or forest benefits foregone) as a result of the Wayleave construction in Mabira CFR.

2. For Mabira CFR, the volume of the standing timber is the capital stock from which benefits are derived, and not the stream of benefits themselves. The Developer compensates the NFA for forest benefits foregone. Therefore, the capital stock remains the property of the NFA and represents an encumbrance to the construction of the Wayleave. One option is for the NFA to issue a salvage operation licence for a third party to remove this encumbrance, preferably at a net benefit to the Authority.
3. In calculating the streams of benefits arising from timber, poles and firewood, stumpage values and not market prices were used.
4. The powerline from Bujagali while passing through Mabira CFR also traverses Kifu CFR and Namyoya CFR, areas which are now under plantation, rather than natural,

forests compared to Mabira CFR. The plantations are production-oriented, supplying timber, poles and firewood. Where the tree crop is below the age which is considered established, the present value of costs incurred was the eligible item for compensation. On the other hand, benefits streams were calculated for tree crops above establishment stage using the appropriate stumpage values.

For the forest plantations of Kifu and Namyoya CFRs, the capitalisation of annual benefits would not be appropriate. For one, the yield of benefits are not annual. Rather, they are periodic. For purposes of this valuation 25 years for *Eucalyptus sp* and 50 years for *Araucaria sp* were used since the permits granted though renewable do not immediately satisfy long-run continuity conditions and the areas planted have not been compartmentalised to yield even annual returns. Hence, plantation expenses incurred up to establishment age should be compounded while those to be incurred from the present to full rotation age discounted as shown below. The same applies to benefits.



In other words, the present value of net benefits accruing between now and subsequent harvests is given by the following formulae:

$$PVc = C / 1/(1+r)^t \text{ for costs; and}$$

$$PVb = B / 1/(1+r)^t \text{ for benefits}$$

$$\text{or } PVnb = (B-C) / 1/(1+r)^t$$

where:

PVc – present value of cost

PVb – present value of benefit

C – cost

B – benefit

PVnb – present value of net benefits (benefits less costs)

r – social opportunity cost of capital

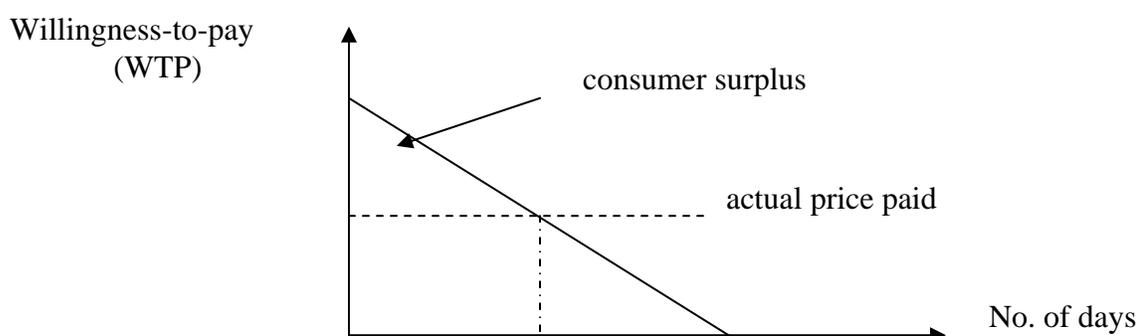
t – time

On the other hand, for expenses incurred earlier – such as planting, beating up and weeding before a crop is considered established – the value of those investments were amortised as follows:

$$PVc = C (1+r)^t$$

5. The basis for calculating the value of forests for ecotourism is the consumer surplus, representing the price tourists are willing-to-pay, up and above what they actually pay for the ecotourism experience (*Figure 3*). Ecotourism is an important activity in Mabira CFR but not Kifu and Namyoya central forest reserves.

Figure 3. Graphic Illustration of Willingness to Pay



6. *Non-timber forest products* are harvested in Mabira CFR and not the other two reserves. This study used the extensive research of Bush *et al* (2004) on community livelihoods in representative forests in Uganda. The results of their research was used in this study, augmented by the Consultants' household survey and Focus Group Discussions (FGDs), among others.
7. *Carbon sequestration* values were derived from Bush *et al* (2004) where average values of tonnes of carbon per unit area per year have been estimated multiplied by the appropriate domestic market price prevailing then for carbon.
8. *Hydrological functions* were omitted from calculations for compensation for the reason that the area of forest removed for the Wayleave construction is too small to affect the hydrological functions of the forest. However, water conservation values, based on supply of water for forest communities were estimated as part of the livelihoods contribution.
9. *Bequest and Existence Values* were also removed from the calculations on the basis that the area required for the Wayleave construction is too small to significantly affect the bequest and existence values of Mabira CFR.

10. Biodiversity values were estimated using secondary data from research in comparable areas. Being forest plantation areas, Kifu CFR and Namyoya CFR were assumed to have minimal biodiversity richness and hence values were estimated only for Mabira CFR.
11. Small parts of Buwoola and Namusa community enclaves extend into Mabira CFR and will be impacted by the development. This *land is owned by individuals* who should be compensated so that the Developer has quiet enjoyment of its use rights in Mabira. However, the valuation of the lands is outside the scope of this study as explained earlier.
12. *Landtake*. The Developer is expected to obtain a use right for the Wayleave construction from the NFA. The use right is issued free of charge. However, an annual ground rent will be levied on forest land withdrawals for the Wayleave Construction. The NFA charges a ground rent of US\$ 20,000 per hectare per annum. The present value of this annual payment was estimated.

4.3 Data gathering methods

The study used six approaches to gathering data, as shown below.

Secondary data through review of literature, project documents and records of the NFA. Data on forest characteristics, value of the forest for community livelihoods, carbon sequestration and biodiversity values were derived.

Consultations and meetings were held with the management and field staff of the NFA, and with representatives of community organisations to obtain site-specific information.

Stock assessment. The Makerere University Institute of Environment and Natural Resources (MUIENR) carried out detailed biodiversity assessment in Mabira CFR as part of a biodiversity inventory survey. The data related to timber stocking was to be used to calculate the volume of timber which would be removed as a result of the Wayleave construction. However, to the extent that the NFA is best suited to carry out timber inventory for its auction process and preparation of management plans, the accuracy of the volume of standing timber crop is less important compared to estimates of annual allowance cut (AAC). Hence timber inventory data from the Forest Management Plan were used. Plantation data for Kifu and Namyoya were obtained from the inventory work of the NFA.

Key informant interviews were conducted with individuals who were informed about the three CFRs. They were: Steven Khauka currently Manager of the Tree Seed Centre and formerly in charge of planning at the NFA; executive committee members of Mabira Forest Integrated Conservation Organisation (MAFICO); and the staff of the Mabira Ecotourism Centre. Their views are presented in *Annex 2*.

Focus Group Discussions (FGDs) were held with three communities within the enclaves and surrounding Mabira CFR. Meetings were held at Buwoola, Ssesse and Sanga. The purpose of these meetings was to elicit the views of the communities with respect to the importance they attach to, and the livelihoods values they derive from, Mabira forest (see *Annex 3* for details).

Household survey was conducted using a structured questionnaire based on the format of the Bush *et al* (2004) study to determine community livelihoods derived from Mabira CFR. It was assumed the benefits to communities surrounding Kifu CFR and Namyoya CFR were negligible and therefore these were excluded from the calculations of total livelihoods. Results of the household survey are presented in *Annex 4*.

4.4 Mabira CFR

Timber

Table 6 shows that the impact area for the line passing through Mabira CFR holds a standing volume of 2,219.9 m³ for trees of 50 cm diameter at breast height (dbh) and above.

Table 7 shows the exploitable timber yield. The data indicate a long-run sustainable yield (LRSY) of 1m³/ha/year for the species desired for timber made up of 21% Class I, 31% of Class III and 48% of Class II timber.

The LRSY timber yield in the Wayleave impact area was, therefore, estimated at 66.1m³/year (*Table 8*).

To convert the sustainable volume removals into monetary terms, the stumpage values (or reserve prices the NFA uses for its timber auctioning business) were obtained from the Authority. The stumpage value for each timber utilisation class was simply the average for all the species in that class. *Table 9* shows stumpage values for different species in Mabira CFR. Average stumpage values (at 100% management costs, per cubic metre) for the different utilisation classes were estimated as: UShs 172,770 for Class I; UShs 102,511 for Class II and UShs 86,385 for Class III⁴.

⁴ Historically bidders have paid prices slightly above the reserve prices.

Table 6. Standing Crop (50cm db+) in Area of Impact^a

Compartment	Impact Area (ha)	Volume/ha ^b (m ³ /ha)	Total Volume (m ³)	Management Zone
173	10.0	8.1	81.0	Production /Encroachment
179	7.8	30.2	235.6	Production /Encroachment
185	12.4	8.1	100.4	Production /Encroachment
192	6.8	60.3	410.0	Production /Low impact
191	6.5	8.1	52.7	Recreation / Buffer Zone
203	10.3	61.8	636.5	Recreation / Buffer Zone
206	9.4	56.4	530.2	Recreation / Buffer Zone
211	1.2	60.7	72.8	Recreation / Buffer Zone
229	1.9	53.0	100.7	Production /Low Impact
	66.3	-	2,219.9	-

/a – Compartment 234 excluded because there were no large trees in the area of impact

/b – Appendix 7 Mabira FMP 1997 - 2007

Source: Karani *et al* (1997)

**Table 7. Mabira Forest Exploitable Timber Yield Trees above 50cm dbh
(based on 60 year felling cycle for whole forest - 30,305 ha)**

A. By Species	Utilisation Class	m ³ /ha	m ³ /yr	m ³ /ha/yr
Holoptelea	I	5.3	2,676	0.088
Albizia	I	7.2	3,636	0.120
Alstonia	II	3.4	1,717	0.057
Antiaris	II	4.6	2,323	0.077
Celtis	II	18.3	9,243	0.305
Chrysophyllum	II	2.4	1,212	0.040
Trilepsium	III	1.9	959	0.031
Cola gigantea	III	1.2	606	0.020
Ficus	III	2.7	1,363	0.045
Other species	III	13	6,866	0.217
		60.0	30,305	1.000
B. By Utilisation Class				
		12.5	6,312	0.208
Class I		28.7	14,495	0.479
Class II		18.8	9,794	0.313
Class III		60	30,601	1.000

Source: Karani *et al* (1997), Table 9.

Table 8. Exploitable Natural Forest Timber Yield in Impact Area

Compartment	Impact Area (ha)	Annual timber yield (m ³ /year)			TOTAL
		Class I	Class II	Class III	
173	10.0	2.1	4.8	3.1	10.0
179	7.8	1.6	3.7	2.4	7.7
185	12.4	2.6	5.9	3.9	12.4
192	6.8	1.4	3.3	2.1	6.8
191	6.5	1.4	3.1	2.0	6.5
203	10.3	2.1	4.9	3.2	10.2
206	9.4	2.0	4.5	2.9	9.4
211	1.2	0.2	0.6	0.4	1.2
229	1.9	0.4	0.9	0.6	1.9
	66.3	13.8	31.7	20.6	66.1

* - based on the following: 0.208m³/ha/year for Class I, 0.479 m³/ha/year for Class II and 0.313 m³/ha/year for Class III. Derived from Karani *et al* (1997) Table 9.

To convert the sustainable volume removals into monetary terms, the stumpage values (reserve prices the NFA uses for its timber auctioning business) were obtained from the Authority. The stumpage value for each timber utilisation class was arrived at by obtaining the average for all species in that class. *Table 9* shows stumpage values for different species in Mabira CFR. Average stumpage values per cubic metre (at 100% management costs) for the different utilisation classes were subsequently estimated at: Ushs 172,770 for Class I; Ushs 102,511 for Class II; and Ushs 86,386 for Class III⁵.

Using the foregoing stumpage values multiplied by the volumes in each class presented in *Table 8*, one arrives at an annual stream of timber values of:

Class	Amount (Ushs)/year
I	2,384,226
II	3,249,599
III	1,779,531
Total	7,413,356

Capitalising this annual timber benefits flow by 12% per year (social opportunity cost of capital) gives a present value of Ushs 61,777,967, representing the timber (sawlogs/peer logs) production opportunity cost.

The value of the standing crop was estimated using data presented in *Table 6* and assuming the total volume represents 21% Class I, 48% Class II, and 31% Class III. That is:

⁵ Historically, purchases of standing timber have paid in excess of the NFA's reserve prices. Hence, these values should be considered conservative.

$$V_{sc} = P_1 (2219.9 * S_{pi}) + P_2 (2219.9 * S_{pii}) + P_3 (2219.9 * S_{piii})$$

where

V_{sc} – volume of standing crop in the impact area

S_{pi} , S_{pii} and S_{piii} represent stumpage values for Class I, Class II and Class III, respectively

P_1 , P_2 , and P_3 represent the proportion of the different utilisation classes, where $P_1 = 0.21$, $P_2 = 0.48$, and $P_3 = 0.31$.

Therefore:

$$\begin{aligned} V_{sc} &= 0.21 (2219.9 * 172,770) + 0.48 (2219.9 * 102,511) + 0.31 (2219.9 * 86,385) \\ &= 80,541,746 + 109,230,801 + 59,447,479 \\ &= 249,220,026 \end{aligned}$$

Hence the value of the standing timber crop in Mabira CFR area of impact was established to be Ushs 249,220,026 for trees having dbh of 50 cm and above.

Table 9. Stumpage Values for Mabira

Species	Stumpage Values (Ushs /m ³)		
	Base	75%*	100%*
Muvule	126,667	151,553	201,565
Nkoba	90,476	108,252	143,975
Aningeria / chysophyllum	104,953	125,572	167,011
Albizia	72,381	86,602	115,181
Maesopsis	65,143	77,942	103,663
Nkuzanyana	54,289	64,951	86,385
Antiaris	25,333	30,311	40,314

* refers to management cost levels

Source: NFA databank

Poles and Firewood

The Management Plan for Mabira CFR 1997-2007 did not encourage the harvesting of poles from the forest. The Plan had this to say in Prescription No. 30.

“ Though a limited quantity of poles is permitted for domestic use, there are attempts to collect and sell poles due to socioeconomic pressures. There is absolute need to watch out for any large quantities collected by people neighbouring the reserves, as a small business. The FD (now the NFA) staff will investigate any suspected cases and take appropriate steps to stamp out the practice”.

Karani, *et al* (1997).

Similarly, for fuelwood or woodfuel (representing firewood and charcoal), the Management Plan 1997-2007 Prescription 31 said thus.

“ Fuelwood cutting (sic) and charcoal production are destructive to a standing crop, as licence holders are indiscriminate i.e. cutting young trees of marketable species. *Fuelwood cutting (sic) and charcoal production shall not be allowed in the MPA (Management Plan Area)*”. Karani *et al* (1997).

From the foregoing, harvesting of both poles and firewood in commercial quantities is prohibited. However, harvesting the products in limited quantities for own use is permissible. Hence the approach to estimating the combined stream of values from firewood and poles was the one Bush *et al* (2004) used based on household livelihoods.

Bush *et al* (2004) estimated the total livelihood value of timber (largely poles and firewood) and non-timber products from a typical protected tropical high forest in Uganda at US\$ 18,074 per ha per year, of which 47% was timber and 53% non-timber forest products. Hence the combined annual stream of poles and firewood values was estimated at US\$ 8,495/ha. Since the impact area in Mabira CFR is estimated at 66.3 ha, this gives a benefit stream of US\$ 563,219/year. Capitalising this annual benefit stream by 12% gives a net present value for poles and firewood of US\$ 4,693,492. Bush *et al* (2004) cautioned as follows.

“ It is important to note at this point that the values calculated *do not* imply that the level of economic value derived is sustainable. (They estimated economic value based on the current levels of use). However, it is reasonable to assume that protected THF [Tropical High Forest] values are closer to sustainable harvest rates considering the management efforts of the NFA”.

In summary, the values of poles and firewood were arrived at as follows.

Poles + Firewood livelihood value	US\$ 8,495/ha/year
Size of Impact Area	66.3 ha
Total annual benefit stream	US\$ 563,219/year
Present Value of Poles + Firewood benefits	US\$ 4,693,492

Non-timber forest products

Prescription 32 of the Mabira Forest Management Plan 1997-2007 had this to say about handicrafts materials.

“*Demand for handicraft products, including easy chairs, stools, mats and baskets is rising. Although limited quantities, for domestic use, are permitted free of charge under the FORESTS ACT, a system shall be devised to monitor, record and control harvesting. Any*

collection/harvesting for commercial purposes shall be fully charged at appropriate rates of such forest product”. Karani et al (1997).

For other non-timber forest products, Prescription 33 of the Mabira Forest Management Plan 1997-2007 stated as follows:

“Domestic collection of medicinal herbs, edible plants and other food materials does not pose any immediate danger to the resource or the standing forest crop. Such collection may promote protection and conservation of the respective forest resource in the MPA by neighbouring communities. However, levels of harvesting shall be controlled and in case of commercial interests, corresponding fees shall be charged. In case of any destruction to standing forest crop, e.g. debarking and uprooting, the FD (now NFA) officers shall take steps to immediately stop such actions”. Karani et al (1997).

To estimate the benefits stream from non-timber forest products, the Bush *et al* (2004) study was used. The results of the research showed that typical tropical high forest protected areas (PAs) on average generate US\$ 9,579/ha/year, an amount much lower than Afromontane forest PAs, private THFs and savanna woodland/bushland. Nonetheless, the value for tropical high forest PA is thought to be the closest to the Mabira situation. Using the approach similar to the one for poles and firewood, the present value of the benefits stream from non-timber forest products was estimated at US\$ 5,292,398 as shown below.

NTFPs livelihood value	US\$ 9,579/ha/year
Size of impact area	66.3 ha
Annual benefit stream	US\$ 635,088/year
Present Value of NTFPs	US\$ 5,292,398

Biodiversity

Mabira CFR is rich in biodiversity. Although the area of impact of the Wayleave construction is small and, therefore, unlikely to affect overall biodiversity richness, it is possible even in a small area some may be lost.

Biodiversity richness of a forest represents an option value; and it is perhaps one of the least tangible benefits of Uganda’s forests (Bush *et al* 2004). The value of biodiversity lies partly in the development of plant-based pharmaceuticals (Bush *et al* 2004; Emerton & Muramira 1999; Mendelsohn & Balik 1997; Howard 1995; Pearce & Moran 1994; Ruitenbeek 1989). In addition to undiscovered plant-based pharmaceuticals, Howard (1995) reported that there is potential in wild coffee genetic material. According to Bush *et al* (2004), Uganda’s farmed coffee is being hit by a *Fusarium* wilt against which no known cultural or chemical practices appear to succeed and wild coffee is known to be resistant to it (Bush *et al* 2004).

Various estimates have been made of the value of forest biodiversity. Ruitenbeek (1989) estimated the biodiversity of Korup Park in Cameroon at £0.1/ha/annum. Pearce & Moran (1994) provided a range of values for tropical forest, ranging from US\$0.1/ha to US \$ 21/ha.

Mendelsohn & Balik (1997) produced a value for undiscovered plant-based drugs in tropical forest with average plant endemism of US\$3/ha. Howard (1995) suggested that Uganda's forests are not as species rich as Korup Park and the country would be less competitive in say supply of *Prunus africana*. Bush *et al* (2004), suggest an average value for biodiversity at US\$1.50/ha/year. Using this estimate the biodiversity opportunities foregone in the impact area would be US\$ 182,988/year (using an exchange rate of 1 US\$ = US\$ 1840). This annual benefit stream translates into a present value of US\$ 1,524,900.

Domestic water conservation

During Focus Group Discussions with communities surrounding Mabira CFR and living in the forest enclaves (*Annex 3*), they revealed that to them the most important use of the forest was for water collection. All the surrounding communities and those living in the forest enclaves, said they get their water from the forest. This view tallies with the observation of Bush *et al* (2004), where the forests surveyed across Uganda represented important sources of water for local communities.

Bush *et al* (2004) estimated the mean value of water provision for both humans and livestock per household at US\$ 18,415 per annum, and ranges from US\$ 12,078 per annum for Budongo CFR to US\$ 30,928 per annum for Ruwenzori Mountains National Park. In this report, the value for Budongo CFR which is relatively similar to Mabira CFR was used in estimating community water benefits.

Muramira (2000) estimated the number of households in the enclaves and within the proximity of Mabira at 15,631. Assuming population growth rate of 3.4% per annum (UBOS 2002), by 2006, this population would have increased to about 19,103 households. Therefore multiplying the mean value of water provision of US\$ 12,078 per annum by the number of households gives a total value of US\$ 230,726,034 per annum. However, the impact area is 66.3 ha out of the total size of about 30,000 ha. Therefore, the value of water provision in impact area which will be lost is equivalent to US\$ 509,905 per annum. Holding this value constant over the project period, the net present value of domestic water provision translates into a conservative estimate of US\$ 4,249,204⁶.

Carbon storage

The removal of tree cover as a result of the Wayleave construction will result in loss of some of the carbon storage capacity of Mabira CFR. According to Bush *et al* (2004), at the global level, the forestry sub-sector is an important carbon sink, helping to reduce accumulation of greenhouse gases and hence global warming which will lead to adverse changes in climate.

⁴The estimate is conservative because the population in the enclaves and the surrounding areas will increase over the years. However, it is possible with increased development, alternative water sources are likely to be developed.

Emerton & Muramira (1999) and Bush *et al* (2004) give the following carbon storage values for different vegetation types: primary closed forest US\$ 54,660/ha/year; degraded forest US\$ 32,538/ha/year; and woodland, bushland and grassland US\$ 2,603/ha/year. The Wayleave construction is expected to leave the cleared impact area under grassland instead of bare ground. Furthermore, the Production (Encroachment) and the Recreation/Buffer Zone would have carbon sink values equivalent to a degraded forest. The Production (Low Impact) zone on the other hand should have carbon sink values somewhere between the primary and degraded forests. Subsequently, the value of carbon sink/ha/year for the Production/Encroachment and Recreation/Buffer Zone was estimated at US\$ 32,358/ha/year less grassland value of US\$ 2,603/ha/year giving a net value of US\$ 29,935/ha/year. Using a similar approach, the carbon sink value for the Production/Low Impact Zone would be US\$ 40,996/ha/year, using the average value for a primary closed forest and a degraded forest and deducting grassland values.

Multiplying the carbon sink values by the size of the applicable impact area, *Table 10* shows the annual values lost. The Wayleave construction is expected to result in a loss of carbon sink values equivalent to US\$ 2,080,921/year. Capitalised at the social opportunity cost of capital, the annual stream gives a present value of US\$ 17,341,008.

Table 10. Carbon Sink Values

Management Zone in Mabira	Impact Area (ha)	Value of Carbon sequestered/ha/yr*	Total Value/year (U Shs)
Production (Encroachment)	30.2	29,935	904,037
Production (Low Impact)	8.7	40,996	356,665
Recreation / Buffer Zone	27.4	29,935	820,219
	66.3		2,080,921

*adapted from Bush *et al* (2004) and Emerton & Muramira (1999)

Landtake

The total impact area in Mabira CFR was estimated at 69.1 ha (including Compartment 234). An annual ground rent of US\$ 20,000/ha/year is charged by the NFA. Therefore the annual benefit stream from landtake was estimated at US\$ 1,382,000; and the present value of this annualised series was US\$ 11,516,667.

Ecotourism

According to Muramira (2000), Uganda's tropical high forests have some of the richest biodiversity of plant and animal life in the world. The biodiversity inventory for Mabira CFR revealed that the forest has average biodiversity attributes (Davenport *et al* 1996). However, the ecotourism value of Mabira lies in the fact that it is the only THF protected area within the Lake Victoria shore crescent. Furthermore, Mabira CFR is close to the urban centres of Kampala (50km) and Jinja (21km). There is increasing interest in ecotourism in Mabira CFR

as shown in *Table 11*. Finally, in addition to the Ecotourism Centre operated by the NFA, new developments are either nearing completion (for example the facility of Ecolodges) or are in the early stages of development (for example the plans of MAFICO).

Table 11. Visitor statistics

Year	Foreigners/ Foreign Residents	Locals	Total
2005/06	1,989	2,854	4,843
1999	1,312	2,880	4,172
1998	1,450	1,125	2,575
1997	1,304	1,094	2,398
1996	1,097	515	1,612

*Source : data for 2005/06 fiscal year from the NFA
: data for remaining years, Muramira (2000)*

The basis to estimating the annual value of ecotourism is the consumer surplus, the difference between the price tourists are willing to pay and the price they actually paid. Naidoo & Adamowicz (2005) found that an entrance of US\$47 would maximise tourism value i.e. the amount foreign and foreign residents of Uganda are currently charged US\$5 to visit Mabira CFR (Naidoo & Adamowicz 2005). This dramatic under-valuation of the willingness to pay of tourist visitors is consistent with results from other tropical areas and suggests much room for improvement in entrance fee policy (Naidoo & Adamowicz 2005).

From the above, the consumer surplus for foreigners and foreign residents is US\$42 per tourist. In the absence of data on the local tourists' willingness-to-pay and considering their low income levels, this study assumes a zero consumer surplus pertaining to local tourists. For foreigners and foreign residents US\$ 42 or US\$ 77,280 (at exchange rate of US\$ 1840 to the US\$) – was used. Furthermore, using the 2005/06 data for foreigners and foreign residents of 1,989 tourists, the annual value of ecotourism for the whole Mabira CFR was estimated at US\$ 153,709,920/year. Mabira CFR is about 30,000 ha in size and it would be incorrect to allocate all the annual value lost due to the impact area of 66.3 ha. Hence, the proportionate share of ecotourism benefits lost was estimated as a fraction of the value for Mabira as a whole (that is, US\$ 153,709,920/year x 66.3/30,000) giving a value of US\$ 339,699.

Subsequently, the present value of the ecotourism benefits foregone as a result of the Wayleave construction translates into US\$ 2,830,824.

Recently planted crop

In Compartment 234, there was a crop of *Terminalia sp* less than 1 year old and hence below the age of establishment. Nonetheless, the private tree farmer ought to be compensated for expenses incurred assuming that the money will be realised in the third year. Total expenses

were estimated at US\$ 1,300,000 (based on NFA experience). When this amount was compounded by 3 years, the present value equaled to US\$ 1,826,370.

4.5 Kifu CFR

Timber

On a plot of 10m x 20m or 0.02 ha, 15 standing trees of average dbh of 6.5 cm-12.4 cm and height of 2-3 m were counted in Kifu CFR. This gives a stocking rate of 750 trees/ha. The latest yield recording for *Araucaria sp.* was 1,400 m³/ha. The stumpage value was US\$ 86,000/m³. The area impacted by the Wayleave construction in the part of Kifu forest was 3.713 ha. However only about 600 m by 40 m is planted, indicating an area of 2.4 ha. A crop of *Araucaria* matures in 25 years (economic rotation age). Licence for growing *Araucaria* is 50 years, renewable, meaning 2 rotations are realisable. Therefore, the total Present Value for the *Araucaria* crop is given by US\$ 288,960,000 each received in the 25th and 50th years based on present stumpage values. When the two receipts were discounted at the appropriate social opportunity cost of capital, the present value of future benefits foregone was equal to US\$ 17,990,650, or put in another way US\$ 7,496,104/ha.

Landtake

In addition to this foregone benefit payable to the crop owner, the Developer is also required to pay US\$ 20,000 /ha/year of ground rent to the NFA. Therefore, payment of ground rent for the impact area of 3.713 ha was estimated at US\$ 74,260/year, giving a present value of US\$ 618,833.

4.6 Namyoya CFR

Timber

On a plot of 10m x 20m or 0.02 ha, 16 standing trees of *Eucalyptus grandis* of average dbh of 3.8 to 10.6 cm were counted in Namyoya CFR. This gives a stocking rate of 800 trees/ha. It is assumed that all 800 trees would be suitable for electric poles. The stumpage value for electric poles is US\$ 20,000/tree. The area impacted by the Wayleave construction in Namyoya CFR was 7.658 ha. Production of electricity poles from *E. grandis* takes 8 years and the tree growers now have 25-year licences, renewable which gives them an opportunity to raise three crops during the licence period. Therefore, the total Present Value for the *Eucalyptus* crops is given by US\$ 122,528,000 each received in the 8th, 16th and 24th years based on present stumpage values. When the three harvest payments were discounted at the appropriate social opportunity cost of capital, the total present value of future benefits foregone was equal to US\$ 77,545,521 or put in another way, US\$ 10,126,080/ha of area impacted.

Landtake

In addition to this foregone benefit payable to the crop owner, the Developer is also required to pay US\$ 20,000/ha/year of ground rent to the NFA. Therefore, payment of ground rent for the impact area of 7.658 ha was estimated at US\$ 153,160/year, giving a present value of US\$ 1,276,333.

4.7 Management costs

The NFA will need to commit staff and equipment to monitor the implementation of the mitigation measures proposed in the project EIS. Second, there is a need to revise the management plan for Mabira CFR but not Kifu and Namyoya reserves. Third, the NFA will need to allocate other lands for the private tree farmers whose land is to be affected by the construction of the Wayleave. The attendant costs will be one time expenditures and even if they cover a period of 18 months (e.g. monitoring), the cost figures were treated as present values.

Muramira (2000) estimated the cost of monitoring to be US\$ 6,526,080. This cost is probably on the lower side since the remuneration of the staff of the NFA has gone up and so has the cost of fuel. Therefore, a doubling of this cost at US\$ 13,052,160 would be more reasonable.

Revision of the management plan for Mabira CFR was estimated at US\$ 2,000,000. Finally the cost of demarcating new areas to be allocated to tree farmers in Kifu and Namyoya CFR is expected to cost a nominal amount of US\$ 1,500,000.

Subsequently, total management costs were estimated at US\$ 16,552,160 as follows.

Monitoring of EIS	US\$ 13,052,160
Revision of management plan	US\$ 2,000,000
Planting area allocation	<u>US\$ 1,500,000</u>
	<u>US\$ 16,552,160</u>

It is worth noting that the NFA will incur additional costs in removing the timber stock in the area of impact. However, it is expected that the Authority will meet this cost from proceeds it gets from issuing salvage felling licenses to third parties.

4.8 Summary of economic values

This section provides a summary of the economic value lost or foregone as a result of the construction of the Wayleave for the new 220 KV transmission line north of the existing 132 KV line. *Table 12* shows a summary of the overall economic impact.

The data show a growing stock (50 cm dbh +) in Mabira CFR worth US\$ 249,220,026 will have to be cleared to make way for the transmission line. Furthermore, the present value of use and non-use values foregone including land and compensation for recently planted crop of *Terminalia sp.* and a small compensation for private land, would amount to US\$ 111,052,830.

In Kifu CFR the value of timber benefits foregone and annual payments of ground rent would amount to a present value of US\$ 18,609,483. Similarly, in Namyoya CFR, foregone timber values and annual ground rent payments would give a present value of US\$ 78,821,854.

The NFA would incur incremental management costs arising from monitoring of the EIS; preparation of a new management plan for Mabira CFR; administering the allocation of new areas to the private tree farmers who are expected to lose their planting area as a result of the Wayleave construction. These added management costs were estimated at US\$ 16,552,160.

Finally, the present value of the growing stock for Mabira, the benefit streams foregone in all the three CFRs together with associated incremental management costs were estimated to total US\$ 474,256,353.

Table 12. Summary of Economic Values

Economic Value Sources	Mabira CFR	Kifu CFR	Namyoya CFR	TOTAL
A. GROWING STOCK	249,220,026	0	0	249,220,026
B. BENEFITS STREAM (Present Values)				
1. Timber	61,777,967	17,990,650	77,545,521	157,314,138
2. Poles + Firewood	4,693,492	0	0	4,693,492
3. Non-Timber Forest Products	5,292,398	0	0	5,292,398
4. Biodiversity	1,524,900	0	0	1,524,900
5. Domestic Water	4,249,204	0	0	4,249,204
6. Carbon Storage/Sequestration	17,341,008	0	0	17,341,008
7. Ecotourism	2,830,824	0	0	2,830,824
8. Landtake	11,516,667	618,833	1,276,333	13,411,833
9. Immature plantings	1,826,370	0	0	1,826,370
Sub total Benefits Streams	111,052,830	18,609,483	78,821,854	208,484,167
C. TOTAL GROWING STOCK AND BENEFITS STREAM(A+B)	360,272,856	18,609,483	78,821,854	457,704,193
D. ADD MANAGEMENT COSTS				16,552,160
E. GRAND TOTAL ECONOMIC VALUES				474,256,353

5.0 Mitigation Plan

5.1 Stakeholder Roles

For the construction of the Wayleave through Mabira, Kifu and Namyoya Central Forest Reserves, four distinct stakeholders were identified – the NFA, the Developer, Private Tree Farmers (PTF) and the Communities in the forest enclaves and surrounding areas. Each stakeholder has specific roles as described below.

The NFA

- Disposes the growing stock in the impact area in Mabira CFR, to allow the Developer easy access and incurs the cost of removal of growing stock and receives all benefits realized therefrom.
- Acquires and disposes timber crop of the private tree farmers in Namyoya CFR.
- Disposes owned timber in Kifu CFR within the impact area.
- Allocates new planting area for affected tree farmers in Namuyoya and Mabira CFRs
- Provides the local communities of Mabira CFR with compensatory benefits for lost values with respect to firewood and poles, NTFPs, and domestic water.
- Provides the global community with compensatory benefits for lost biodiversity and carbon sequestration values.
- Invests in natural forest rehabilitation from proceeds of the disposal of the standing timber crop.
- Prepares new Forest Management Plan for Mabira CFR taking into account the impacts of the Wayleave construction

The Developer

- Pays the NFA for lost investments in plantation crop to compensate affected tree farmers and the Authority's own crop.
- Pays the NFA for loss of benefit streams.
- Pays the NFA ground rent annually or makes a one time payment of US\$ 13,411,833 representing the present value of annual payments.
- Meets the NFA's incremental management costs.
- *Does not* compensate the NFA for timber value of the growing stock since the Authority will supervise and realise benefits from the sale of the timber in the impact area of Mabira.

Private Tree Farmers

- Receive payment for lost future crop
- The NFA allocates proportionate area for planting within suitable CFRs.

Communities

- Receive ‘compensatory benefits’ for lost livelihood values
- Get preferential treatment for employment (if suitably qualified) during the construction and maintenance of the Wayleave and any forestry-related activities.

5.2 Financial implications

The roles of the different stakeholders imply varying levels of financial commitments or benefits as described below.

The NFA

A. Receives

1. Compensation for benefits stream from the developer: US\$ 208,484,167
2. Incremental management costs from the Developer: US\$ 16,552,160
3. Auctions growing stock in the impact area in Mabira: US\$ 249,220,026.

Total receipts: US\$ 474,256,353

B. Pays out

1. Private tree farmers for lost timber values US\$ 79,371,891
2. Management costs: US\$ 16,552,160
3. Pays itself for lost *Araucaria* crop US\$ 17,990,650
4. Invests in forest rehabilitation and other forest management priorities, and compensatory investments in community social infrastructure: US\$ 360,341,652

The Developer

A. Receipts None

B. Payouts

Benefit streams Foregone paid to the NFA: US\$ 208,484,167
Incremental management costs paid to the NFA: US\$ 16,552,160
Total payout: US\$ 225,036,327

5.3 Summary

- The NFA will have to organise the harvesting of the Mabira CFR standing timber crop in the impact area through its auction process.

- The NFA on its own or in collaboration with the affected Private Tree Farmers arranges to dispose of the immature plantation trees from the impact area in Kifu and Namyoya CFRs.
- The Developer pays the NFA cash amount equal to UShs 225,036,327 or US\$ 122,302 (using exchange rate of UShs 1,840 to the dollar).

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Annexes

Annex 1
Maps of Impact Areas in Mabira, Kifu and Namyoya CFRs

Annex 2

Key Informant Interviews

The following people and groups were consulted in regards to the importance of Mabira CFR and the likely impacts of the Wayleave for the proposed transmission line. They were: Steven Khauka – formerly in planning at the NFA, and now, the Manager of Namanve Tree Seed Centre; the Executive Committee Members of Mabira Forest Integrated Community Organisation (MAFICO); and the staff of Mabira Ecotourism Centre.

1) *Steven Khauka*

Steven Khauka mentioned enrichment planting as the best option in managing degraded forests. It involves planting of selected tree species in the degraded areas. This helps faster and easy regeneration of the forests in areas where the required species are planted. The option also helps in the introduction of new tree species in the planted areas as opposed to natural regeneration. Despite being the best option however, the method requires high investment levels in terms of care and maintenance, which is not catered for in most cases. Maintenance costs involved include opening of canopy to create space for the newly planted trees and clearing of climbers, as they are easily attracted to opened spaces thereby hindering the growth of the planted trees. Enrichment planting using different tree species gives rise to mixed tree species in the forest, which caters for different values attached to the forests.

Steven felt that natural regeneration as a method of managing degraded forests is not feasible. This is because the method needs a long time for regeneration to take place and in cases where the parent trees are missing, which is a major phenomenon in degraded forests, quality regeneration may never be seen due to lack of seeds.

In terms of restoring degraded forests, the best method to be followed as per Steven's concern would be to identify the highly degraded forests. After this, carry out enrichment planting using mixed species for quick regeneration. The method is not new in Ugandan forest management as it was a method used to restore part of Mabira forest before recalls Steven. This can be recognised in places around the Ecotourism Centre and the Picnic site where almost trees of the same size and age can be identified.

The high existence of Paper Mulberry in some parts of Mabira Forest can be handled effectively through enrichment planting. Paper Mulberry can be cut and sold for firewood. This will help in creating space for the planting of new valuable trees. However, the method is expensive in terms of care and maintenance. This is due to the high regeneration rate of Paper Mulberry, which needs constant cutting of the re-growth if enrichment planting is to yield better results.

Steven also emphasized that with respect to restoring the integrity of Mabira CFR, the National Forestry Authority is better equipped to handle the value of a forest than any other organisation. That is for the 40 metres to be cut in Mabira Forest to create a

pathway for the Bujagali powerline in a way of compensation for the lost forested areas. There is need to channel part of the money in restoring degraded forest's integrity not by the powerline developer but by the National Forestry Authority.

2) *Mabira Forest Integrated Community Organisation (MAFICO)*

Committee members contacted

Kabali Juliet	Chairperson
Kiyimba Rajab	Administrative Secretary
Kungujje Robert	General Secretary
Tigawalana Sebastian	Publicity Secretary
Luyombya Moses	Secretary for Resource Conservation and tourism

The organisation started as a Community Based Organisation (CBO) in 1998 under the name of Mabira Tourism Advisory Committee. It was at the time of massive eviction of people from Mabira Forest and also at a time when Mabira Ecotourism Centre was being established. The main idea for the establishment of the organisation was to intervene on part of the communities affected by the action. At that time the organisation covered seven parishes of Najjembe Sub- County. Later, the organization's name changed to Mabira Forest Tourism Committee.

In 2000-2003 the idea of a Non-Governmental Organisation called MAFICO was born. That is between 2000-2002, the organisation was in place but not registered until 2003 when it started existing formally after registration.

Presently MAFICO covers Najjembe and Nagojje Sub-Counties performing a number of activities. These include: environmental education in schools; encouraging good forest activities like bee-keeping; community woodlot planting; provision of seedlings; and capacity building for Community Based Organisations like organising workshops and proposal writing among others.

The CBOs being assisted by MAFICO are under collaborative forest management organisations. The two are COFSDA, in Najjembe Sub-County covering Koko, and Buvunga villages and NACOBA in five villages of Nagojje Sub-County. These CBOs have enjoyed the benefits of working with MAFICO for example MAFICO helps NACOBA in proposal writing concerning bee-keeping. So far the proposal was accepted for funding by the National Forestry Authority in Compartment 222. The agreement between NACOBA and the NFA was signed on 22nd April, 2006. Under this agreement the NFA is to buy the beehives for the organisation. The NFA also promised to link the organisation to Uganda Bee-Keeping Association

MAFICO is looking forward to establishing a community ecotourism centre in Mabira Forest. The centre is to be set in Nagojje Sub-County. The planned site is about 2-3 km sq km from which several activities are to be carried out. There will be three

accommodation bandas, a campsite, and a visitor's centre. The project is to be funded by the United Nations Development Programme Small Grants Programme.

The planned site for the MAFICO ecotourism centre is located in compartment 207 which is a buffer zone; 30m north of the existing power line the buffer zone borders a strict nature reserve. This means that the proposed 40m of the new power line go into the planned site for the ecotourism centre reducing the space required to put up the centre which means the centre has to be pushed inward into the strict nature reserve. However it is important to note that no activity is allowed in the strict nature reserve and so it is impossible to push the planned site inward. The ecotourism centre may not be located in the proposed area. This may result in finding an alternative site for the centre away from the strict nature reserve where ecotourism is not allowed. It is possible MAFICO may abandon the whole project altogether because of the development.

It is important to note that the integrity or pristine nature of a forest makes ecotourism more meaningful and attractive. Recreation centres amidst forests have proved to control forest degradation by human beings since the recreation centres become no-go areas for timber and log cutters as well as charcoal burners. Setting up the recreation centre by MAFICO would mean a conservation opportunity for this part of the forest.

The opportunity cost of foregoing the location of the ecotourism centre in the proposed area is not for MAFICO alone but also for the communities. This is because a proposed percentage of revenue accruing from the centre was to go to the communities. Therefore the community will also be affected

3) *Mabira Ecotourism Centre*

The Mabira Ecotourism Centre is a tourism facility that offers walks ranging from 30 minutes to 3-4 hours, mountain biking, picnics, residences in camps, or bandas. All that comes with the forest setting with spectacular birds, butterflies, and monkeys. From July 2004-June 2005 the centre received Ushs 11,58,800 from entry permits, Ushs 343,100 from camping, Ushs 4,641,500 from Banda accommodation and Ushs 495,000 making a total of Ushs 16,638,400 as the revenue collected for the year. Twenty percent of the money goes to the communities (Ushs 3,327,680). In the past this money was given directly to the communities but in the new policy this money will be used to support bigger community developments like building schools, repairing and improving road criteria. It is important to note that the pristineness of a forest may determine its tourist value. Hence cutting down the forest causes tourism damage and this would affect the activities of the tourism centre especially reducing the revenue realised by the tourism centre, while in turn may affect the communities' gain of 20%.

Annex 3

Focus Group Discussions

Community members in the enclaves of Mabira CFR and the surrounding areas were consulted. Focus Group Discussions (FGDs) were held with communities in Buwoola, Ssanga and Ssesse.

All the communities consulted accepted using Mabira Forest for a variety of purposes. They derive a range of products which include firewood, medicinal plants, wild meat, among others. The communities also looked at the forest mainly as a source of the direct use values such as firewood and medicinal plants with hardly any mention of the other values of the forest, including indirect uses, option values bequest and existence values.

The communities also were not much concerned of any impacts from the proposed power line in the forest. This was showed by the urge and eagerness waiting to be accepted as part of the team to cut down the 40m in the forest. The communities also wanted to be given these trees as firewood, building poles, timber, among others.

The communities also demanded for the employment opportunities at the new power site. They proposed that when the time comes the LCs be contacted to recruit some of the community members in their villages.

The members present also wanted to know the reason for being consulted since previously during the construction of the powerline nothing transpired from the answers given to the people who visited the communities. They complained that since power was not going to the communities they had no reason to be consulted.

The communities also urged the National Forestry Authority officials to channel part of the compensation to community development. This could be in the form of assistance with the main area emphasised in the three communities being education. That is, build more school blocks for the government-funded schools in the area and the provision of timber materials for construction of desks as people kept on emphasizing what a shame it was for schools next to the forest being faced with a shortage of desks.

Communities also showed the urge to be provided with seedlings of valuable tree species that are either not in the forest any more or exotic species like pine, Cypress, etc to community members to plant on their farms.

The specific community reactions were as presented below.

1. Buwoola Community

Buwoola Parish is located in Najjembe Sub-County, Buikwe County, Mukono District. Buwoola is an enclave in Mabira Forest and consists of Nkaga, Ssanga and Bakata villages among others. The people of Buwoola depend on the forest for things like medicine, water,

and firewood, among others. The focus group discussion with the people of Buwoola highlighted what they get from the forest as follows.

Medicine is got from the forest. The medicines got include *Vernonia amygdalina* (mululuza), *Momordica foetida* (bombo), *Albizia zygia* (ennongo), *Syzygium cordatum* (kanzinzilo), *Albizia coriaria* (mugavu), *Warburgia ugandensis* (mukuzanume), among others. The medicine is mostly used for personal consumption and some people sell to their fellow community members for money.

Another resource they get from the forest is firewood. The community said they are not allowed to sell firewood or charcoal and it is illegal. However, they admitted to getting firewood for home consumption from the forest. Others establish wood lots on their own land where they get firewood.

Hunting is another activity carried out by the people of Buwoola. Several animals hunted include the kob, antelope, the wild pig and porcupine. Hunting is mostly done on Thursdays and Saturdays.

Had there been a vote about the construction of a new powerline, the majority of the people in Buwoola would have said no. However, they suggested if the powerline was built they should get bigger and better schools built for their use. Society benefits like a health centre were also suggested.

The communities also suggested that once the powerline started the jobs be given to the able youth and men of the village. They asked for repair of their roads. They complained that in the construction of the existing powerline, their roads were used and damaged but not repaired. They wanted to have better roads by the end of the construction of another powerline.

The people of Buwoola also suggested that power should be extended to the community. They complained that although cutting of the forest affected them they had no gains from the construction. One of the community members claimed that a piece of his land was in the 40 metre zone where the old power line passes and he wanted compensation.

2. Sanga Community

Ssanga Village an enclave in Mabira Forest is located in Buwoola Parish Najjembe Sub-County, Buikwe County. Ssanga Village is not at the border of the powerline; however, this community says any damage to the forest affects them because they depend on the whole forest.

Members of Ssanga get firewood from the forest. Although they did not agree to selling charcoal or firewood, one community member told us that a bundle of firewood goes for 250/= to 300/= as a bag of charcoal goes for 3000/=. The community also collects water from the forest.

The medicines got from the forests by the Ssanga community include *Alstonia boone* (Mubajjandalabi), *Albizia coriaria* (Mugavu), *Entada abyssinica* (Omwoloola), *Carrisa edulis* (Omuyoza), *Markharmia lutea* (Musambya), *Prunus africana* (Ntaseesa), and *Spathodea campanulata* (Kifabakazzi), among others.

Hunting is another activity carried out by the people of Ssanga. Hunting is done mainly on Tuesdays, Thursdays and Saturdays. However members sometimes go into the forest to hunt as individuals. The meat is sold to community members and some is taken to Najjembe market. The hunted animals include Antelope, Porcupine, Guinea fowl and wild pigs.

The people of Ssanga requested that trees cut at the site of the new powerline be given to them so that they would get charcoal and firewood to sell as a way of benefiting from the damage done to the forest. The members present especially the women requested that their sons be given jobs during the construction of the new powerline. They claimed that in the past jobs that would be done by community members were done by foreigners; they asked that this time they did not want foreigners to do the jobs which the community could do.

3. Ssesse Community

Just like the people of Ssanga, the people of Ssesse are not directly close to the powerline. However, they agreed to using the whole forest and throughout the year. The most important resources got from the forest were: water, firewood, timber, charcoal and fish from river Miasma and micro climate benefits.

The medicine got from the forest include *Alstonia boone* (Mubajjandalabi), *Albizia coriaria* (Mugavu), *Entada abyssinica* (Omwoloola), *Carrisa edulis* (Omuyoza), *Markharmia lutea* (Musambya), *Prunus africana* (Ntaseesa), and *Spathodea campanulata* (Kifabakazzi), *Vernonia amygalina* (mululuza), *albizia zyia* (enongo) *momordica foetida* (bombo), *Rhus vulgaris* (kakwansokwanso). Apart from the forest these community members have some of these trees in their woodlots in their homes. Some community members sell these medicines and even treat community members for money.

Hunting is also done by the communities. The animals hunted include the antelope, porcupine, guinea fowl, wild pig and the kob. Hunting is usually done on Saturdays and Thursdays though some community members go into the forest on other days to hunt. Mudfish is also got from River Musamya

Firewood and charcoal are collected from the forest. Though illegally, the communities sell firewood charcoal and timber, which are taken to Lugazi and Kawoolo. A bag of charcoal goes for about 2500-3000 Ush and a bundle of firewood goes for 250-500 Ush.

The communities asked for the wood cut down at the site of the new powerline so they would get firewood and charcoal to earn an income. They also said foreigners should not be brought from elsewhere to do work that can be done by community members that instead community members should be asked to do the work. In the construction of the old powerline the community roads were used and damaged by heavy trucks yet they were not repaired. They asked for improvement of their roads once the powerline was constructed. Some members

claimed that the powerline went through their land so they could not use the land, they wanted compensation. They requested that their bridge be repaired since it was in a very bad condition.

The community also asked for seeds for certain economic tree species that did not exist in the forest or those that did not exist anymore. Such trees include Albizia and Cypress.

*4. Names of Focus Group Discussion Participants**

a. Buwoola Participants

- 1) Nabatanzi Mary
- 2) Ngabirano Moses
- 3) Tusiime Gertrude
- 4) Okuta Charles
- 5) Kiziti Isaac
- 6) Bwanga Wilson
- 7) Mutebi Desire
- 8) Alice Nabagala
- 9) Wejjo Keluiris
- 10) Namayanja Efrancis
- 11) Alex Kinene
- 12) Akamanda Byekwaso
- 13) Musana Swaib Kinya David
- 14) Musoke Paul
- 15) Luyembya Grace
- 16) Leo Twinnomuhangi
- 17) Kiiza Kiviri
- 18) Byaruhanga Karugo Nuru
- 19) Sundar Viseti
- 20) Naggayi Sophia
- 21) Kibirige Catherine
- 22) Aisa Nasuuna
- 23) Kabuye Samuel
- 24) Nanyonjo Ritah
- 25) Babigunira Aziz
- 26) Wandera Masiga
- 27) Hussein Kabanda
- 28) Kayaga Betty
- 29) Naggiba Harriet
- 30) Nakayima Kiviri
- 31) Sande Moses
- 32) Matovu Tom
- 33) Ngabirano John
- 34) Namuyanja Christine

b. Sanga Participants

- 1) Nabatanzi Mary
- 2) Tusiime Gertrude
- 3) Mbabazi Patience
- 4) Natukunda Catherine
- 5) Moini Edward
- 6) Etyono Denis
- 7) Katusiime Cuthbert
- 8) Balidawa Simon
- 9) Kanku
- 10) Okoyu
- 11) Deo
- 12) Tadeo
- 13) Demaga
- 14) Zikulabe
- 15) Walusimbi Franco
- 16) Aguda Franco
- 17) Mubiru Paul
- 18) Lutakome
- 19) Sem Musisi
- 20) m. babalanda
- 21) amos mewda
- 22) h.kato
- 23) Bernard kibanda
- 24) Robat badaga
- 25) Lubwama R
- 26) Kyalimpa
- 27) Sande
- 28) Kako
- 29) Sebilagala
- 30) Katongole
- 31) Tegewagala M
- 32) Aku
- 33) Gwavunamuyanja Christine
- 34) Bilabwa
- 35) Namulondo
- 36) M.Namatovu
- 37) Maama Sabasi
- 38) Wampamba
- 39) Nankumba
- 40) Diya
- 41) Roko

c. Ssesse Participants

- 1) Nabatanzi Mary
- 2) Natukunda Catherine
- 3) Mbabazi Patience
- 4) Katusiime Gertrude
- 5) Moini Edward
- 6) Ssentamu Emmanuel
- 7) A.Tanga
- 8) Muwonge Rogers
- 9) Musa Mukwaya
- 10) Seidi
- 11) Galabuzi Jimmy
- 12) Mayambala
- 13) Nsubuga Steven
- 14) Kiggwe Steven Miburo Siraj
- 15) Kikomeko Omea
- 16) Bogere Edward
- 17) Mwanzi Ronald
- 18) Kyogulanyi Angelo
- 19) Kuiwanuka George
- 20) Bazilakye Steven
- 21) Mukasa David
- 22) Consta Nce Munyakazi
- 23) Yowasi Obulu
- 24) Mbaliire Robert
- 25) Baguma Henry
- 26) Kakooza George
- 27) Sulaiman Tibesigwa
- 28) Yiga Miche
- 29) Mukasa Nkugwa
- 30) Wajja Mutebi
- 31) Liiba Alaniya
- 32) Kayitana Pascal
- 33) Mujjesera Vincent
- 34) Falidah Namubiru
- 35) Kikomeko Abdul
- 36) Mwodi Martin kagere

* *Includes Consultants from YOMA*

Annex 4

Survey of Community Livelihoods from Mabira Forest

1.0 Introduction

The main objective or purpose of the survey was to find out the benefits and the costs the communities in the forest area and the NFA derive from the forest so that they are compensated as the 220 KV powerline which is going to run 40 metres north and parallel to the old powerline is going to traverse through the forest, and therefore some parts of the forest will be destroyed or cut in order to create a Wayleave for the new 220KV powerline.

Problem statement

Following a lot of load shedding over the years in Uganda the Government of the Republic of Uganda is under pressure from the public to do something in order to reduce on power outage. Therefore, the Government through a private developer is considering extending a new powerline 40metres parallel to the old one. The 220 KV new powerline is going to pass through Mabira Forest where some parts of the forest has to be cleared to create a Wayleave. Therefore, communities in and around Mabira Forest and the National Forestry Authority (NFA) need to be compensated for this loss of the part of the forest as this will present some opportunity costs to them as well as reduced forest benefits.

Coverage of the survey

The survey mainly covered villages of Ssese, Ssanga, Nkaaga, Bakata all found in Buwola Parish, in Najjembe Sub-County, Mukono District. The reason for targeting these villages in Najjembe Sub-County was because of their close location to the new 220 KV powerline proposed area of passage.

Methodology

A questionnaire with 34 open-ended and close-ended questions was distributed to forty two (42) respondents selected at random from the villages of Nkaaga, Bakata, Ssanga, and Ssese to find out their views about the benefits, costs and the likely compensation they expected due to the loss of the part of the forest as a result of the 220 KV powerline.

2. Findings

Distribution of respondents by sex

	Number of respondent by sex	Percentage	Valid percentage
Male	21	50.0	72.4
Female	8	19.0	27.6
Missing	29	69.0	
Total	42	100.00	100.00

Source; primary data

42 respondents were interviewed of which 21 were male and 8 were female respondents, whilst 29 did not state their gender.

Therefore, the valid percentage of respondents by sex is as follows; 72.4% are males and 27.6% are female as a percentage of the total valid responses.

Collection of medicinal plants from the forest

	Number of respondents	percentage	Valid percentage
Collect medicinal plants	32	76.2	82.1
Do not collect medicinal plants	7	16.7	17.9
Missing	3	7.1	
Total	42	100.0	100.0

Source; primary data

Of the 42 respondents, 82.1% and 17.9% collect medicinal plants from the forest and do not collect medicinal plants from the forest (Mabira forest) as a valid percentage, respectively.

Woodlot ownership

	Number of respondents	Percentage	Valid percentage
Wood lot	11	26.2	35.5
No wood lot	20	47.6	64.5
Missing	11	26.2	
Total	42	100.00	100.00

Source: Primary data.

Of the 42 respondents interviewed for ownership of woodlot, 35.5% own woodlots and 64.5% do not own woodlots as a valid percentage of valid responses.

This implies that most of the respondents do not own woodlots (64.5%) and therefore rely heavily on the forest (Mabira Forest) for firewood and other forest resources.

Use of the forest

	Number of Respondents	percentage	Valid percentage
Use the forest	37	88.1	90.2
Do not use the forest	4	9.5	9.8
Invalid	1	2.4	
Total	42	100.0	100

Source: primary data

90.2% of the respondents use the forest while only 9.8% do not use the forest. This is as a valid percentage of respondents. Therefore, communities (90.2%) depend on the forest for a variety of uses and benefits compared to only very few 9.8% who do not use the Forest as a valid percentage of respondents. Therefore, any development that is going to destroy the forest particularly as a whole is going to make them (communities) (90.2%) forego a lot of benefits and uses that they derive from the forest.

Reason	No of respondents	Percentage	Valid percentage
Own consumption	32	76.2	76.2
For sale	10	23.8	23.8
Total	42	100.00	100.00

Source: primary data.

32 (76.2%) of the respondents agree that they collect medicinal plants from the forest (Mabira forest) for own consumption while 10 (23.8%) agree that they collect the medicinal plants from Mabira forest for sale.

Therefore, it means majority of the respondents (76.2%) collect medicinal plants for their own consumption than for sale from the forest.

Willingness to Pay (WTP) and Willingness to Accept Compensation (WTA)

Statistic	WTA(Shs)	WTP (Shs)
Mean	5,010,265	175,788
Median	1,100,000	103,000
Sums of WTA and WTP	170,349,000	5,801,000

Source: primary data

Respondents were asked to vote for forest Department Management scheme that would prohibit the use of the forest for three months. Then asked how much they would accept to compensate their loss in livelihood in order to vote for the new regulation.

The sum of their willingness to accept compensation (WTA) is Shs 170,349,000. Mean Shs 5,010,265, and Median Shs 1,100,000 of willingness to accept compensation.

Mean willingness to accept compensation is Shs 5,010,265. It means on average the community members are willing to accept compensation of Shs 5,010,265. However, the mean is relevant if the valuation is for cost- benefit analysis.

Median Willingness to pay (WTP) is shillings US 1,100,000. The median is relevant for public choice since it corresponds to that amount which will receive a majority approval. Therefore, for the purpose of compensation, Median willingness to accept compensation (WTA) is best hence consideration of compensation of Shs 1,100,000 is quite relevant than the mean WTA.

The Respondents (42) were asked how much they are willing to pay (WTP) towards locally run Management Scheme that was designed to maintain and improve their forest resources so that they had secure access to and better quantity and quality of forest products. The sum of the willingness to pay is Shs 5,801,000. This means on average Respondents are willing to pay Shs.175,788 for locally-run Management Scheme. The median willingness to pay (WTP) is just Shs. 103,000.

Household Income/Consumption (Non-Forest Based)

Crop Name	Total annual income (Shs)	Percentage
Coffee	16,643,300	5.85
Staple food	27,367,700	9.63
Vegetables	9,160,660	3.22
Beans	83,100,300	29.24
Tea	000000	0.00
Cocoa	000000	0.00
Mairungi ⁷	147,887,000	32.04
Total	284,158,960	100

Source: primary data.

Of the respondents' Annual Income sources, Mairungi is the main annual source of income with value of Shs 17,887,000 (52.04%) followed by Beans (Shs 83,100,300) and coffee (16,643,300). This statistic is quite shocking in that 32% of household income is from al illegal crop. There is, therefore, need to assist the communities to identify alternative income generating opportunities. On the other hand, Mairungi is legally grown in Kenyan communities. The harmonization of the East African laws may need to address this issue and make Mairungi growing legal.

⁷ Mairungi or Khat is a narcotic in the Laws of Uganda and, therefore, illegal

Forest as Source of Water

Water source	Number of Respondents	Percentage	Valid percentage
Forest water	30	71.4	75.0
Non forest water	10	23.8	25.0
Missing	2	4.80	
Total	42	100.0	100.0

Source: primary data

When asked about water source whether forest or not, 75% of the Respondents as percentage of valid Respondents agreed to obtaining their water from forest whilst 25% of valid Respondent percentage claimed that they do not get water from the forest.

Therefore majority (75%) of the Respondents get their water from forest (Mabira).

Respondents' Distribution by Sources of Water

Water Source Name	Number Of Respondents	Percentage	Valid percentage
Borehole	6.0	14.3	14.3
Spring Protected	16.0	38.1	38.1
Spring unprotected	18.0	42.9	42.9
Pond or clan	2.0	4.8	4.8
Total	42	100	100

Source: Primary Data

Livestock Assets

Animal Name	Number of Household heads with animals	Total Number of Animals by Type
Goats	21	96
Sheep	6	31
Pigs	15	44
Chicken	33	733
Rabbits	1	2
Cows	10	83
Total		989

Source: Primary data

Total number of livestock is 989 including birds.33 of the respondents have Chicken and 21 of the respondents have Goats.

Head of household education level distribution

Education Level	Number of house holds heads	Percentage	Valid percentage
No formal Education	2	4.8	5.4
Primary Education	17	40.5	45.9
Secondary Education	14	33.3	37.8
College/University	4	9.5	10.8
Missing	5	11.9	
Total	42	100.0	100.00

Source: Primary data

Most of the household heads are educated up to the level of primary and secondary education with valid percentages of 45.9% and 37.8% respectively.

Head of households distribution by occupation

Occupation	Number of household Heads	Percentage	Valid percentage
Farming	32	76.2	82.1
Own Business	5	11.9	12.8
Salaried employee	1	2.4	2.6
Infant/old	1	2.4	2.6
Missing	3	7.1	
Total	42	100.00	100.0

Source; Primary Data

Most of the household heads of the respondents are engaged in farming (82.1) valid percentages while only 12.8% as valid percentage are involved in own Business. Forest and farming are many times antagonistic

Crop-raiding animals from the forest

Respondents were asked if they had problems with crop raiding animals from the forest. The table is the summary of their responses

Responses	Number of Respondents	Valid percentages
Problems	38	90.5
No problems	4	9.5
Total	42	100.00

Source; primary data

90.5% of the Respondents have problems with crop raiding animals as this negatively reduces their crop out put and quality. While 9.5% of the Respondents ascertain that they do not have problem with crop raiding animals.

The most problematic species from the forest (Mabira forest)

Specie Name	Number of Respondents	Valid percentage	Percentage
Monkeys	33	86.8	78.6
Wild pigs	5	13.2	11.9
Missing	4		9.5
Total	42	100	100

Source: primary data.

The most problematic species identified by the respondents from Mabira Forest are Monkeys and Wild pigs. 86.8% of the Respondents pointed at Monkeys as problematic and 13.2% of the Respondents also pointed at Wild pigs as being problematic. Therefore, the most Problematic species are the Monkeys.

Use of the Various Sources of Fuel

Use of Wood as Fuel

Do you use wood as fuel?

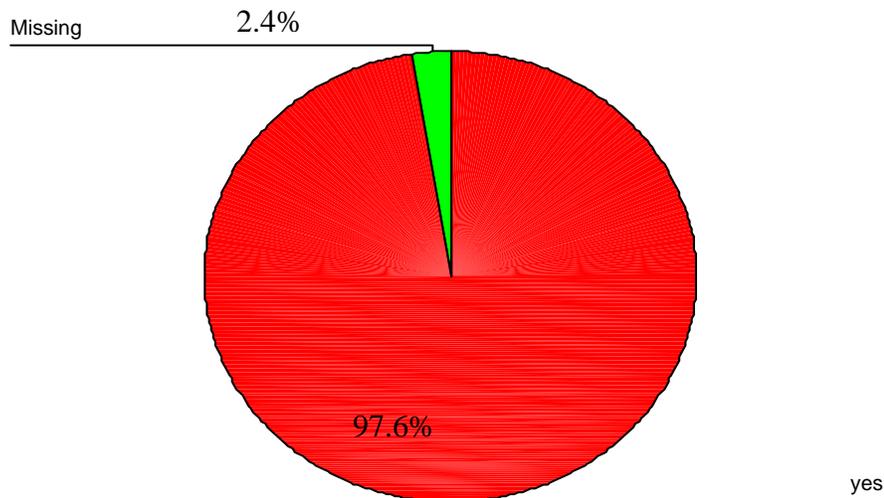
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source: Primary data

Respondents were asked if they use Wood as fuel, 97.6% accept that they use Wood as Fuel, whilst 2.4% of the respondents did not provide any responses. The valid percentage of the respondents who accept using wood as fuel is 100%.

The Pie chart below represents the responses of the forty two Respondents on whether they use Wood as fuel. Wood appears to be the main source of energy for the communities of Mabira Forest. This may threaten the sustainability of the Forest especially if the wood is mainly obtained from the forest and harvested in inappropriate ways.

do you use wood as fuel?



Use of Charcoal as Fuel

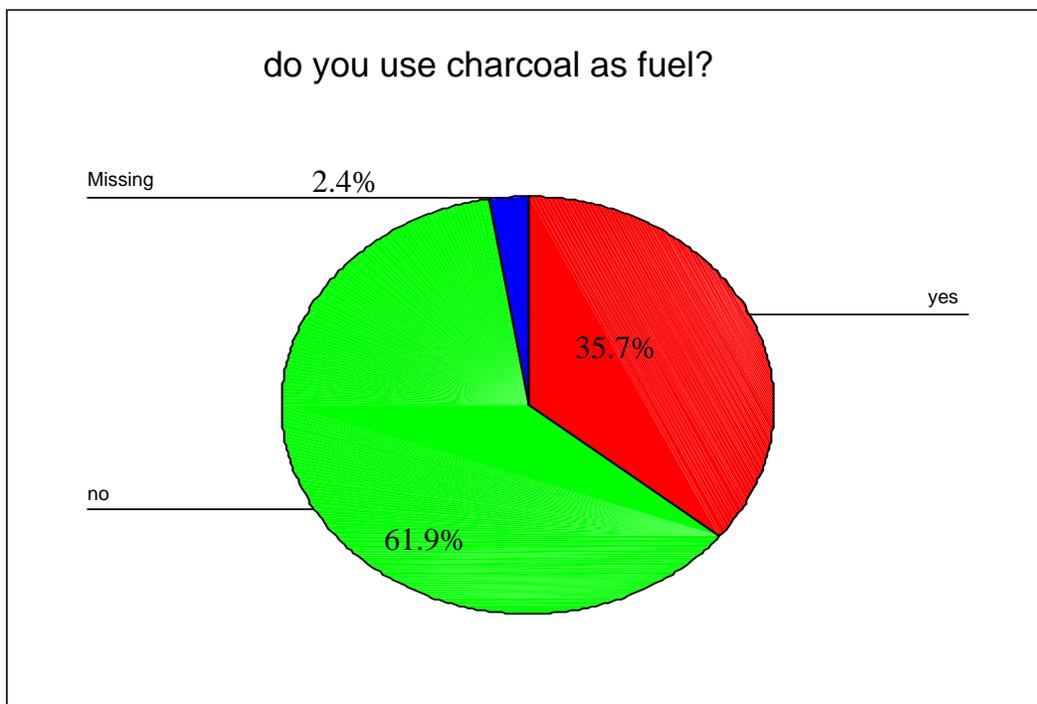
do you use charcoal as fuel?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	15	35.7	36.6	36.6
	no	26	61.9	63.4	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Source: Primary data

For Charcoal use as fuel, 35.7% of the Respondents use Charcoal as fuel whilst 61.9% do not use Charcoal as fuel and 2.4% of the responses are Invalid. Of the valid responses 36.6% and 63.4% use Charcoal and do not use charcoal as fuel, respectively.

The pie chart below represents the responses of the forty two respondents on whether they use Charcoal as fuel.



3.4.3 Use of Paraffin as Fuel

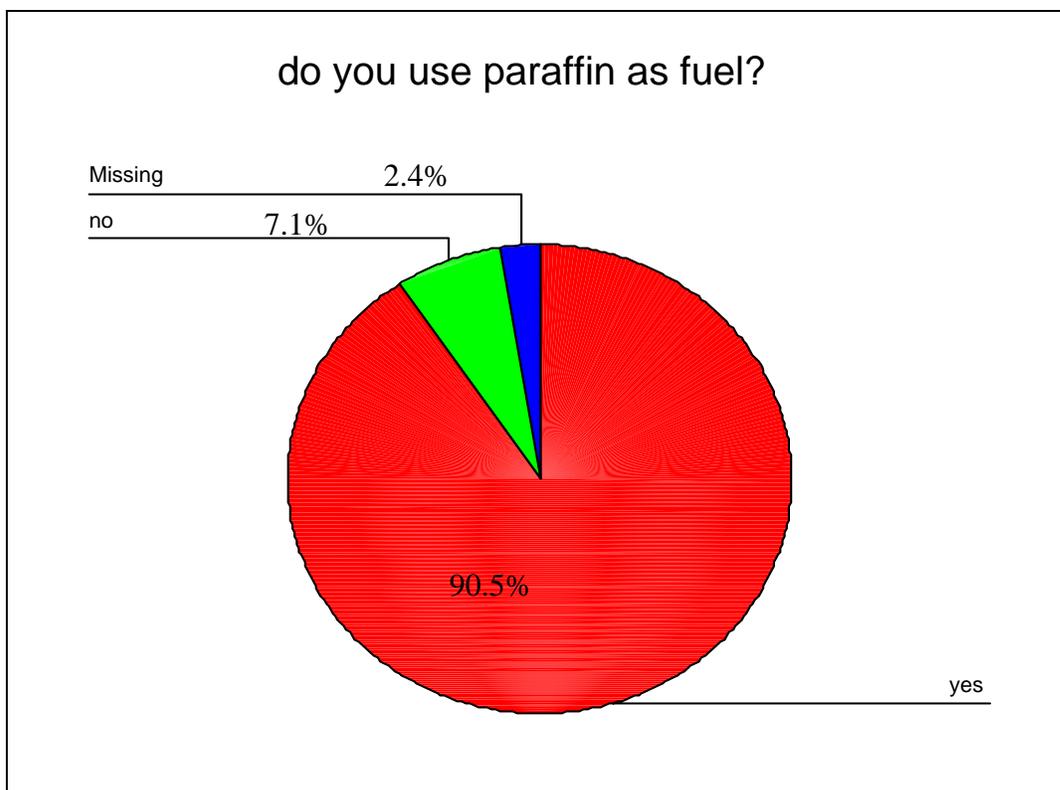
do you use paraffin as fuel?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	38	90.5	92.7	92.7
	no	3	7.1	7.3	100.0
	Total	41	97.6	100.0	
Missing	System	1	2.4		
Total		42	100.0		

Source; Primary data

90.5% of the Respondents said they use Paraffin as Fuel and 7.1% do not. The valid Percentage of the Respondents who use and do not use Paraffin as fuel are 92.7% and 7.3%, respectively. Paraffin is mainly used for lighting.

Below is the Pie chart representing the responses of the Respondents on whether they use Paraffin as fuel or not.



Use of Gas as fuel

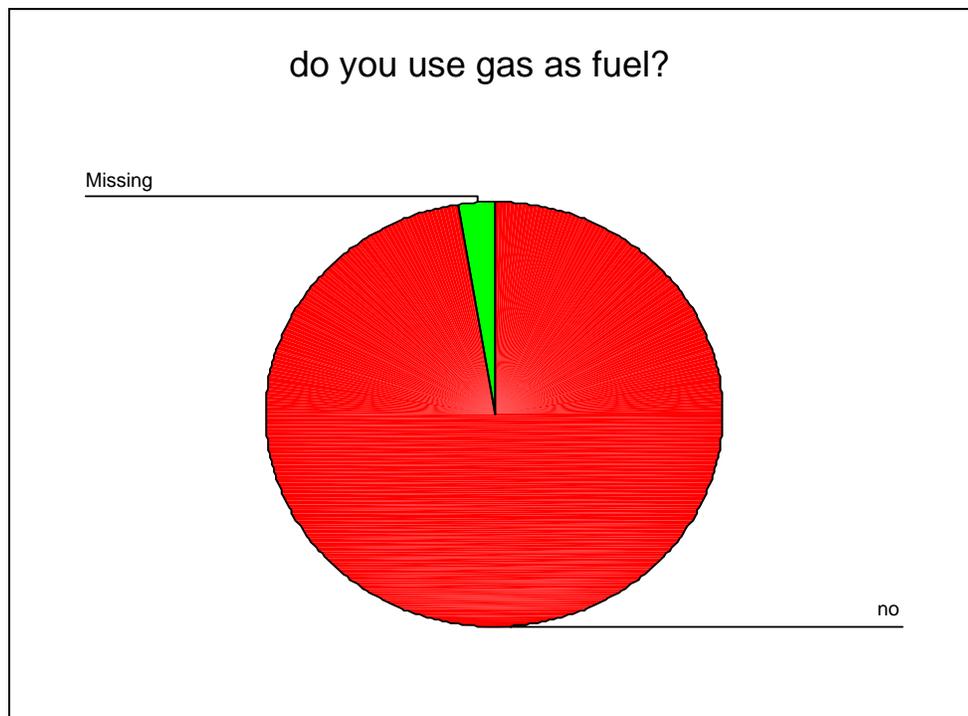
do you use gas as fuel?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source; Primary data

97.6% of the Respondents do not use Gas as fuel while 2.4% account for missing responses. Therefore, 100% of the Respondents do not use Gas as Fuel as a valid percentage.

The below Pie chart represent the responses of the respondents for the use of Gas as fuel including the missing percentage.



Use of Electricity as Fuel

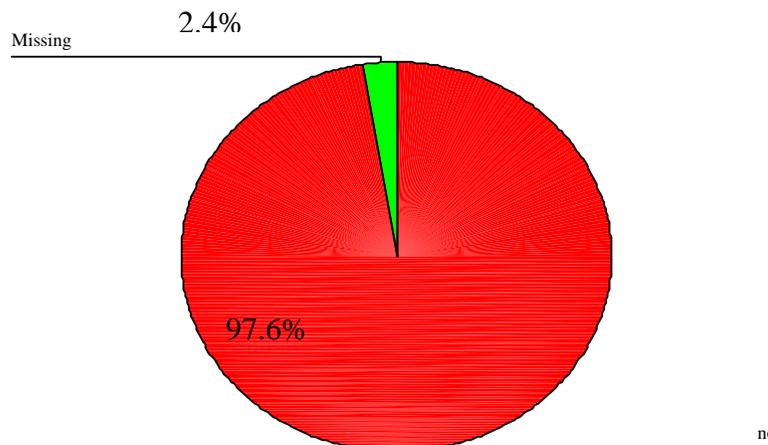
do you use electricity as fuel?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid no	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source; Primary data

97.6% of the Respondents do not use Electricity as fuel while 2.4% are missing responses. Therefore, the valid percentage of the respondents who do not use Electricity as fuel is 100%. It implies all the respondents do not use Electricity as fuel or Energy.

do you use electricity as fuel?



Reasons for Growing Crops in the Woodlot

Growing of Crops for Home Use Purpose

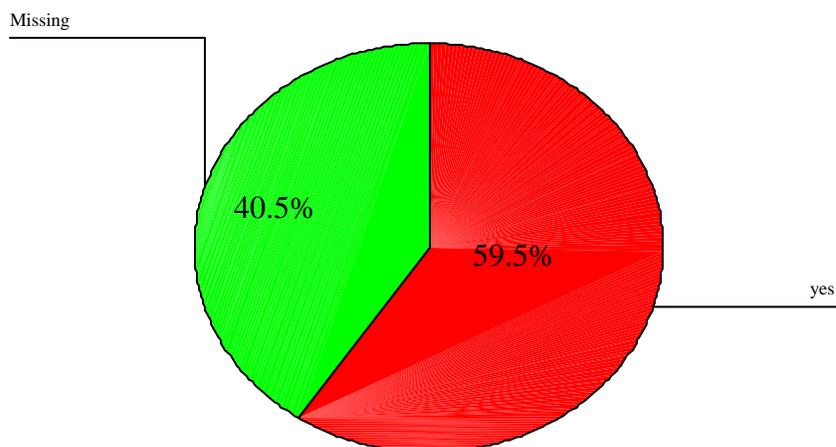
Do you grow the crop for Home use?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid yes	25	59.5	100.0	100.0
Missing System	17	40.5		
Total	42	100.0		

Source: Primary data

Forty two respondents were asked if they grow crops in their woodlot for Home use purposes, 59.5% agree that the crops they grow in their woodlots are mainly for home use whilst 40.5% did not respond. Therefore the valid percentage of respondents who said they grow crops for home use is 100%. This means 100% of the respondents grow crops for home use purposes.

Do you grow the crop for Home use?



Growing of Crops for Income Generating Purposes

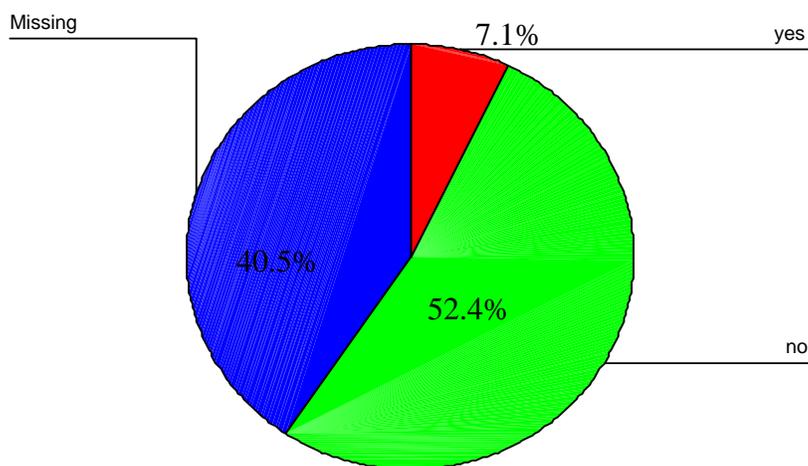
Do you grow the crop for income generating purpose?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	3	7.1	12.0	12.0
	no	22	52.4	88.0	100.0
	Total	25	59.5	100.0	
Missing	System	17	40.5		
Total		42	100.0		

Source: Primary data

Twelve percent (12%) of the Respondents said they Grow Crops in Their Woodlot for Income generating purposes and eighty eight percent(88%) of the Respondents when asked whether they grow the Crops in their Woodlot for Income generating purpose said no.

Do you grow the crop for income generating purpose?



Uses of the Various Sources of Fuel

Uses of Wood

uses of wood

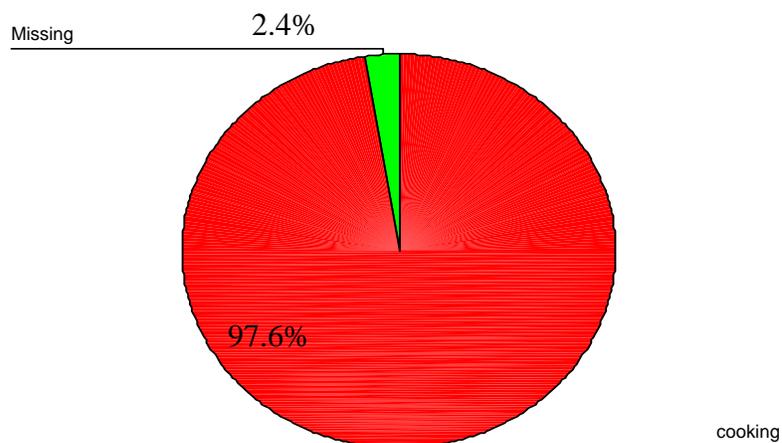
	Frequency	Percent	Valid Percent	Cumulative Percent
Valid cooking	41	97.6	100.0	100.0
Missing System	1	2.4		
Total	42	100.0		

Source: Primary data

Three uses of sources of fuel like Paraffin, Electricity, Wood, Charcoal, and Gas were provided. The uses provided included: heating, lighting and cooking.

97.6% Of the Respondents use wood for Cooking while 2.4% are missing. This implies that 100% Of the Respondents use wood for Cooking. Therefore, all the Respondents use Wood for cooking.

uses of wood



Uses of Charcoal

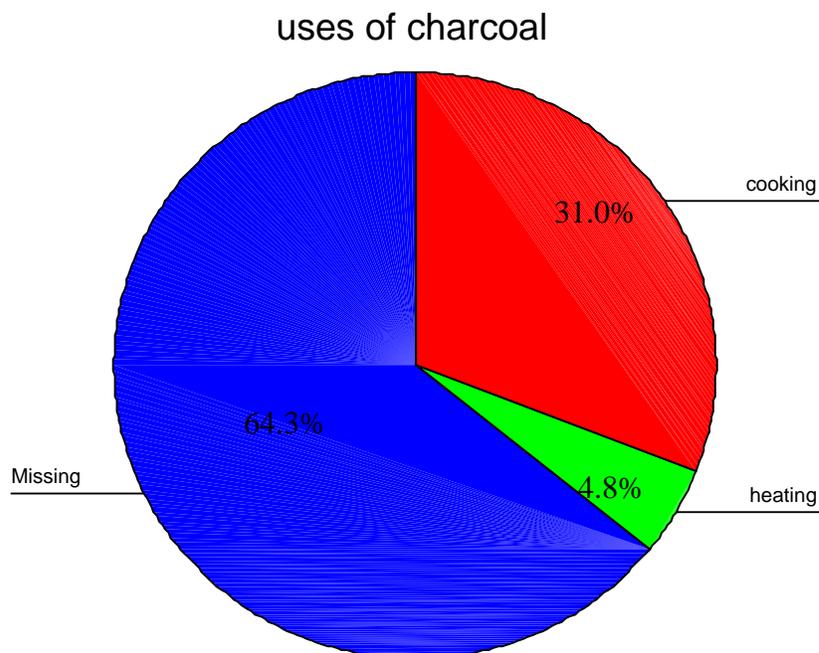
uses of charcoal

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cooking	13	31.0	86.7	86.7
	heating	2	4.8	13.3	100.0
	Total	15	35.7	100.0	
Missing	System	27	64.3		
Total		42	100.0		

Source; Primary data

For uses of Charcoal, 31.0% use Charcoal for cooking, 4.8% use charcoal for heating and 64.3% are missing responses. Therefore, the valid percentage of respondents who use charcoal for cooking and heating is 86.7% and 13.3%, respectively. The implication is that majority of the Communities in Mabira forest use Charcoal for Cooking than for heating.

The Pie chart below represents the various uses of Charcoal for the respondents.



Uses of Paraffin

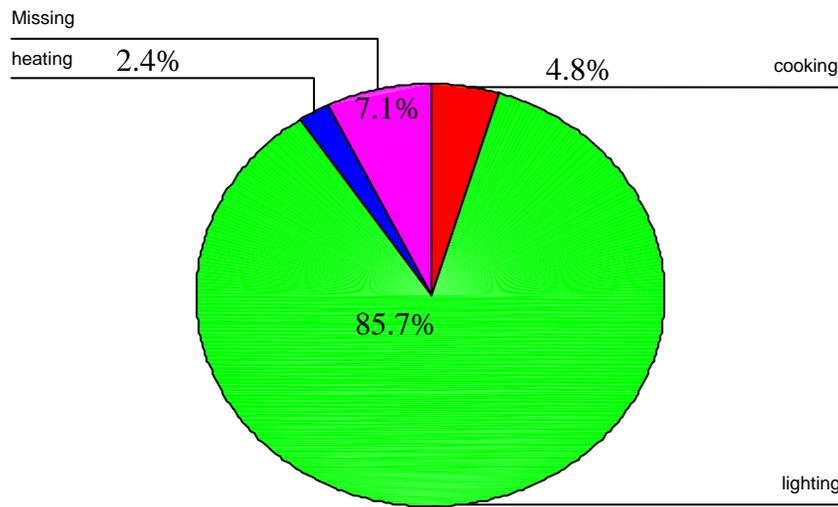
usesof paraffin

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	cooking	2	4.8	5.1	5.1
	lighting	36	85.7	92.3	97.4
	heating	1	2.4	2.6	100.0
	Total	39	92.9	100.0	
Missing	System	3	7.1		
Total		42	100.0		

Source: Primary data

For the uses of Paraffin, 5.1% of the Respondents use Paraffin for Cooking, 92.3% use Paraffin for lighting and 2.6% of the Respondents use Paraffin for heating. Therefore, Paraffin is mainly used for lighting as Electricity is not accessible to many of the Communities in and around Mabira Forest.

Uses of paraffin



3. Conclusion

- The local communities derive a lot of livelihoods from Mabira Forest. **90.2%** of the Respondents agree that they use the forest for a variety of uses

Some of the benefits from the forest that the communities derive among others include;

- Spring water both protected and unprotected. **81%** of the Respondents agree that they use spring water. And **75%** of the Respondents accept that they get their water from the Forest compared to only **25%** that claim they do not get their water from the Forest.
- Medicinal plants from the Forest. **82.1%** of the Respondents derive Medicinal plants from the Forest. However, 76.2% of the Respondents use the Medicinal plants for their own consumption and **23.8%** sell the Medicinal plants they derive from Mabira Forest. Therefore, it means that Medicinal plants are mainly collected for own consumption rather than for sale by the communities in and around Mabira Forest.
- Mairungi is the highest source of annual income. Mairungi earned an annual income of Shs.**147,887,000**.