Series No. 7

THE ECONOMIC VALUATION OF THE PROPOSED DEGAZETTEMENT OF MABIRA CENTRAL FOREST RESERVE

NatureUganda

Lead Consultants
Dr. Yakobo Moyini
Mr. Moses Masiga

2011

The Economic Valuation of the Proposed Degazettement of Mabira Central Forest Reserve

2011

With support from

BirdLife International | RSPB for birds for people for ever | BirdLife IBA Important Bird Area | NatureUganda

THE ECONOMIC VALUATION OF THE PROPOSED DEGAZETTEMENT OF MABIRA CENTRAL FOREST RESERVE

2011

Citation: *Nature*Uganda (2011). The Economic Valuation of the Proposed Degazettement of Mabira Central Forest Reserve. *Nature*Uganda Kampala

---

P.O.Box 27034,
Kampala Uganda
Plot 83 Tufnel Drive
Kamwokya.
Email nature@natureuganda.org
Website: www.natureuganda.org

ACKNOWLEDGEMENTS

This consultancy builds on NatureUganda earlier studies to identify important biodiversity areas in Uganda or key biodiveristy areas. Thirrty three (33) Important Bird Areas were identified including Mabira Forest Reserve.

In this study, we make a case that policy formulation about natural resources needs to be informed with facts in the present and full knowledge of the future or predicted long term consequences. We are grateful to BirdLife International Partnership particularly Royal Society for the Protection of Birds (RSPB) whose initial support enabled NatureUganda to undertake this study on the economic evaluation of a section of Mabira Forest Reserve that was proposed for degazzetment and EU financial support through Important Bird Areas (IBA) monitoring project.

The research work falls under our advocacy programme supported by various partners including BirdLife International through Jansen's Foundation programme on 'turning policy advantages into conservation gains'.
It is our sincere hope that this report will trigger and sustain informed debate on conservation value of natural resources particularly critical ecosystems such as Mabira Forest Reserve. NatureUganda recognised the importance of an economic evaluation of the Mabira Central Forest Reseve at a time when there was a debate piting conservation of natural resources against intensive use for agriculture and industry and this report will contribute useful information to the debate not only for Mabira Forest but for other natural resources in the country.

We acknowledge the support received from NatureUganda secretariat especially the Executive Director Mr. Achilles Byaruhanga for coordinating the study and providing the consultants with all logistical requirements.
We acknowledge contribution of Mr Telly Eugene Muramira who technically edited the report and Dr. Patrick Birungi of Makerere Univeristy for reading the earlier drafts.

Special tribute is paid to Dr. Yakobo Moyini (R.I.P) who was the lead consultant on this study.
Other persons who contributed to this report are Dr. Paul Segawa and Mr. Moses Masiga, Dr. Panta Kasoma and Roger Skeen for proof reading the report .

ACRONYMS AND ABBREVIATIONS

SCOUL	Sugar Corporation of Uganda Limited
VAT	Value Added Tax
PAYE	Pay as You Earn
CFR	Central Forest Reserve
UNFCCC	United Nations Framework Convention on Climate Change
NGO	Non-Governmental Organisation
CHOGM	Commonwealth Heads of Government Meeting
PFE	Permanent Forest Estate
CFR	Central Forest Reserve
CITES	Convention on International Trade of Flora and Fauna
TEV	Total Economic Value
NTFP	Non-Timber Forest Product
TCM	Travel Cost Method
CVM	Contingent Valuation Method
PV	Present Value
NFA	National Forestry Authority
FGD	Focus Group Discussion
RIL	Reduced Impact Logging
MPA	Management Plan Area
FD	Forest Department
PA	Protected Area
THF	Tropical High Forest
WTP	Willingness To Pay
GEF	Global Environment Facility

EXECUTIVE SUMMARY

The Government of Uganda received and tabled for discussion a proposal to degazette and change the land use of part of Mabira Central Forest Reserve to sugar cane production. The proposal proved very contentious and resulted in civil unrest and a raging debate on the merits and demerits of the proposed land use change. Those in favour of degazettement cited the numerous direct, indirect and multiplier economic impacts or benefits the change in land use will bring to Uganda. Those for conservation, on the other hand, cited the need to preserve the rich biodiversity of the forest, and the need to respect both regional and international agreements on the conservation of forests and the biodiversity therein. They also cited the public trust doctrine that charges government to manage and maintain forestry resources on behalf of the citizens of Uganda.

Whereas those in favour of degazettement have been quite eloquent in enumerating the economic benefits of sugarcane growing, the pro-conservation groups have largely focused on the physical side of the argument and presented little economic data to support their arguments. The purpose of this study was to assess and compare the economic implications of the two competing land use options.

To undertake the assessment, a Total Economic Value (TEV) framework was applied. This was in view of the fact that forests are complex ecosystems that generate a range of goods and services. The TEV framework is able to account for both use and non-use values of the forest and elaborate them into direct and indirect use values, option, bequest and existence values.

Lack of knowledge and awareness of the total value of the goods and services provided by forests previously obscured the ecological and social impact of the conversion of forests into other land uses. The TEV framework helps us to understand the extent to which those who benefit from the forest or its conversion also bear the associated management costs or opportunities foregone.

In undertaking this study, the biophysical attributes of Mabira CFR in general and the area of impact in particular were reviewed. The most current and relevant inventory data available for the production zone of Mabira CFR was used. The economics of sugarcane production in Uganda and globally was also reviewed. Additional data and information were derived from an extensive survey of available literature. All this background data and information were then used to derive the total economic value of the impact area within Mabira CFR and compare it with the potential economic yield of growing sugarcane.

The analysis concluded that the benefits of conserving Mabira CFR far exceeded those of sugarcane growing. The respective total economic value of conservation was estimated at US$ 45.1 compared to US$ 29.9 million which was the net present value of the annual benefits from sugar cane growing. The study therefore concluded that maintaining Mabira Central Forest Reserve under its current land use constituted a better option than sugarcane growing. This was the case when the total economic value of the forest was considered, but also when just timber values alone were counted. The study noted however, that the degazettement of Mabira CFR could still be favoured for other reasons other than economic considerations. The study recommended that should such a situation arise, then the developer (who is SCOUL) must undertake to compensate the National Forestry Authority for the total economic value (TEV) lost due to the change of land use. This requirement for compensation is legally provided for in the National Forestry and Tree Planting Act, the National Environment Act and provisions of the multilateral environmental agreements, especially the Convention on Biological Diversity. The compensation would also conform to the social and environmental safeguard policies of the Government of Uganda and its development partners, including the need to conduct a thorough environmental impact assessment (EIA). The appropriate level of compensation the developer will be required to pay is US$45.1 million, payable to the NFA to support conservation activities in the remaining part of Mabira CFR and other reserves.

The study also noted that Government could also waive the requirement for compensation. The study however, noted that such an action would tantamount to provision of a subsidy to SCOUL amounting to US$45.1 million or the total economic value of the lost value of the forest due to the proposed change in land use. The waiver would also tantamount to a gross policy failure, particularly in view of the efficiency questions surrounding SCOUL.

The study also noted that if the developer paid the US$45.1 million compensation, they would in effect be purchasing 7,186 ha of Mabira CFR at a fairly high cost per hectare. Land in the vicinity currently goes for UShs 500,000 to 1,000,000 per acre (or Ushs 1,250,000 –2,500,000 per hectare). If SCOUL were to pay UShs 2,500,000 per hectare, double the upper range, the company would purchase 30,668 ha of land. For the equivalent of 7,186 ha, if SCOUL purchased the land from private sources the company would pay UShs.17,965 million (or US$10.6 million), an amount less than the compensation figure calculated in the study.

The study finally noted that in addition to the financial and economic questions presented above, other equally valid issues needed further investigation. They include the need for compensation at 'fair and equal' value, the current implied objective of national self-sufficiency in sugar production; and land acquisition options available to the developer.

TABLE OF CONTENTS

List of Figures

List of Tables

List of Boxes

1.0. INTRODUCTION

1.1. BACKGROUND

The Government of Uganda received and tabled for discussion a proposal to expand sugar production by the Sugar Corporation of Uganda Limited (SCOUL) in 2007. The key elements of the proposal were to expand the acreage under sugar cane by the corporation by 7,100 hactares within the Mabira Central Forest Reserve. The proposed expansion would however have to be preceded by the degazettement of the affected area to pave way for private use by the Sugar Corporation of Uganda Limited.

The proposal sparked off a lot of controversy, with the key contentions centred on the clear need to conserve biodiversity and the permanent forest estate, notwithstanding the equally important need to expand sugar production to benefit from the large local, regional and international sugar commodity market.

Mabira Central Forest Reserve was gazetted as a central forest reserve in 1900 under the famous Buganda agreement between the British Colonizers and the Buganda Kingdom. The reserve is found in Buikwe and Mukono Districts in Central Uganda and covers an area of 306 Km^2 across an altitudinal range of 1070 – 1340 m above sea level. The forest reserve is currently the largest natural high forest in the Lake Victoria crescent.

The Sugar Corporation of Uganda Limited on the other hand is a limited liability company jointly owned by the Mehta Family (76%) and the Government of Uganda (24%). Increased sugar production by the corporation should therefore, in theory benefit both the Mehta Family as majority shareholders and Ugandans as minority shareholders. The converse is also true that a degradation to the value of SCOUL affects both the Mehta family and Ugandans.

The Sugar Corporation of Uganda Limited argues and as published in the press (The Monitor Newspaper, 2007; New Vision News Paper, 2007; East African News Paper, 2007): that the allocation of an additional 7,186 ha out of Mabira Central Forest Reserve will:

1. Increase sugar production and save foreign exchange of US$ 20 – 25m per annum.
2. Enable the generation of an additional 1-12 MW of electricity which can be supplied to the national grid and onward to a number of industries in and around Lugazi Town.
3. Create an additional 3,500 jobs with an annual earning of Shs 3 billion.
4. Lead to the development of additional infrastructure investments (schools, houses, dispensaries) worth Shs. 3.5 billion;
5. Require the development of 300 km of road in the newly allotted areas, an investment of Shs. 2bn.
6. Generate additional taxes in the form of value added tax (VAT), Excise Duty, pay as you earn (PAYE) and import duty in the range of Shs. 11.5m (per year).
7. Enable the production of ethyl alcohol which can be blended with petrol to the extent of 10-15%, to form gasohol, an alternative vehicle fuel.
8. Commit SCOUL and the Government of Uganda not to develop any more areas near the banks of River Nile and the shores of Lake Victoria and hence preserve the ecology of the rest of Mabira CFR.
9. Commit SCOUL to participate in tree planting on those areas which are not suitable for sugarcane production.

The pro-conservation groups who are are opposed to the degazettement of part of Mabira CFR on the other hand argue that:

1. Mabira Central Forest Reserve has unique bird, plant, primate, butterfly and tree species;
2. Mabira Central 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;
3. 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 regained its original integrity;
4. 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 (***Francolinus nahani***);
5. 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 ; the present value of other annual benefit streams from forest products, biodiversity, domestic water, carbon storage and ecotourism; and the present value of annual ground rent payments would have to be foregone if the land use for Mabira CFR was changed;
6. The Mabira CFR in its entirerity is an important water catchment forest. The CFR is a source of two main rivers – Musamya and Sezibwa – which flow into Lake Kyoga;
7. Because of its strategic location close to the River Nile the Mabira CFR is a critical component of the local and regional hydrological cycle. There is therefore a likelihood of reduced water retention of water flow to the lakes and rivers;
8. A large population living in and around Mabira CFR relies on the extraction of forest products to sustain their livelihoods;
9. Uganda is a signatory to a number of key Conventions that protect forests including the UN Framework Convention on Climate Change, the Convention on Biological Diversity (CBD) and the Kyoto Protocol among others;
10. Change of land use in part of the forest will make it difficult to control futher encroachment.
11. Any degradation of Mabira represents loss of a unique ecosystem and unique biodiversity and loss of known and unknown plants and animals of medicinal value;
12. Mabira contributes to temperature regulation in the central part of the country, and any reduction is likely to lead to changes in temperature;
13. The publicity resulting from converting part of the CFR will result in tourism becoming less attractive;
14. A number of individuals, NGOs and corporations currently licensed to carry out activities in line with sustainable forest management will have their investment and planned activities affected;
15. Investors in industrial plantations elsewhere in the country may face hostility from local people who may themselves desire to acquire forest land, which they see as being allocated to foreign investors;
16. There are no indications that the public opposition to the degazzettement of the CFR will diminish;
17. There could be insecurity to the investor over Mabira allocation;
18. The proposed degazettement is likely to impact negatively on the image of the country

As indicated above, both sides of the contention have strong arguments for their case. The arguments have however, not been translated into a common denominator to allow for impartial comparison of the benefits and costs of degazetting part of the forest.

The purpose of this study therefore is to use economic analysis to determine the merits and demerits of degazettement of part of Mabira Central Forest Reserve for sugar cane production.

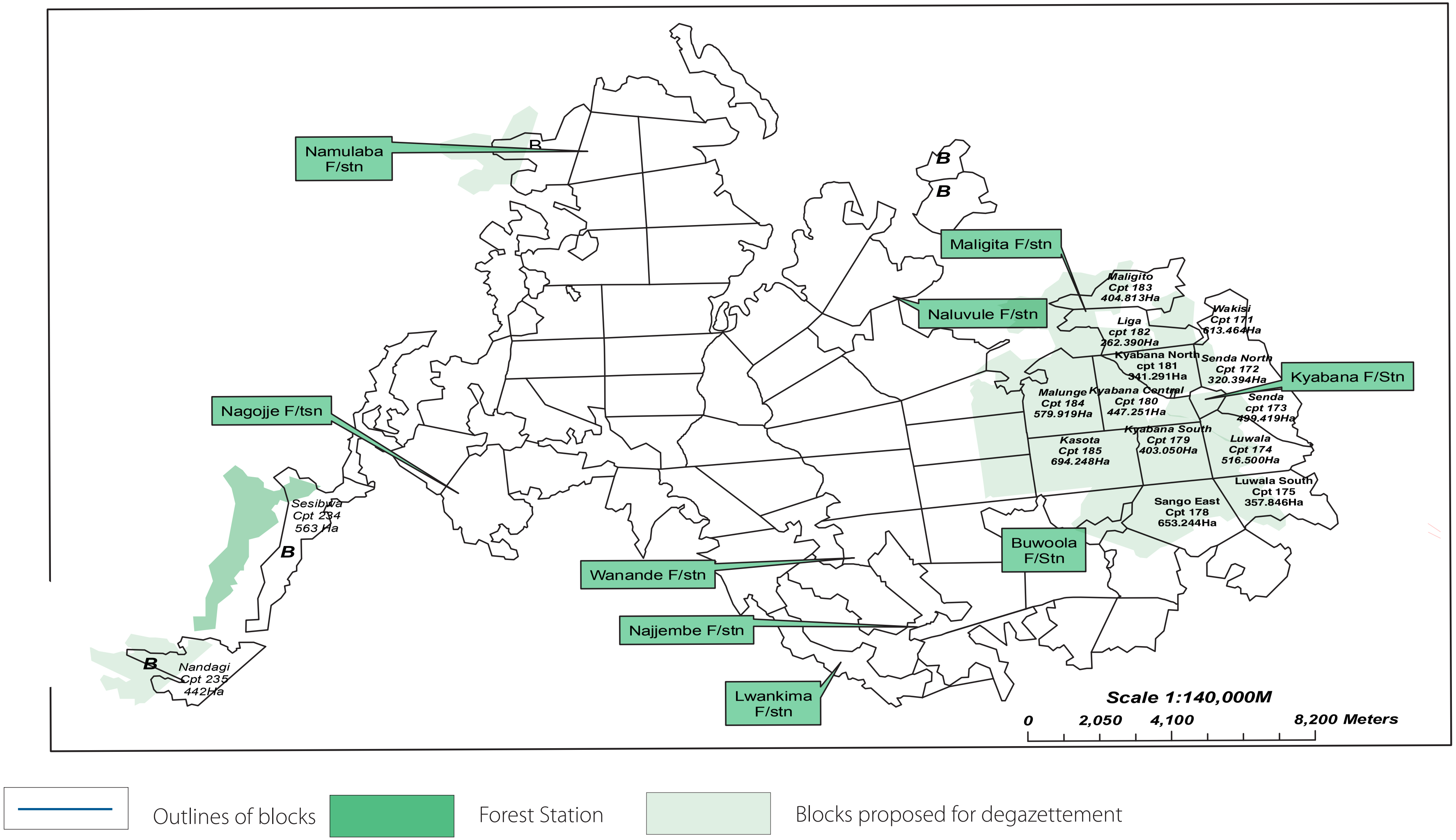
1.2. THE DEGAZETTEMENT PROPOSAL

The request and proposed degazettement covers an area of 7100 ha of the production zone of the reserve representing about 24 percent of the total area of the forest. From the perspective of forest management and in order not to split any compartments, SCOUL's request would involve the degazetting of 15 compartments, giving a total area of 7,186 hectares. The area requested by SCOUL for additional sugar production is therefore 7186 ha (Table 1). This size of area will therefore be used in the analysis for purposes of this study. Figure 1 shows a spatial description of the affected area.

Table 1: Mabira CFR Area Proposed for Degazettement

Compartment No.	Name	Size (ha)
171	Wakisi	617
172	Senda North	315
173	Senda	488
174	Luwala	515
175	Bugule	381
178	Sango East	667
179	Kyabana South	424
180	Kyabana Central	451
181	Kyabana North	365
182	Liga	403
183	Naligito	415
184	Mulange	611
185	Kasota	679
234	Ssezibwa South	586
235	Nandagi	479
Totals		7186

Figure 1: Map of Mabira CFR showing the Proposed sections for Degazettement



1.3 SCOPE OF THE ASSIGNMENT

The overall purpose of the study was to compare the economic merits of degazetting a section of Mabira CFR for sugar cane growing to those of maintaining it. This comparative study required the computation of the respective costs and benefits of the two alternative land uses with a view to determining the most preferable option. The benefits decision framework is summarised as follows:

If $\sum_{t=o}^{T} B_s \partial t \succ \sum_{t=o}^{T} B_c \partial t$, grow sugarcane; and if $\sum_{t=o}^{T} B_c \partial t \succ \sum_{t=o}^{T} B_s \partial t$, conserve

Where:

$\sum B_s \partial t$ – sum of present value of net benefit of sugarcane growing

$\sum B_c \partial t$ – sum of present value of net benefit of conservation

The conceptual scope of the study limited it to the most direct costs and benefits of land use change to sugar cane farming or the converse. Hence the primary analysis in this study dealt with sugar cane farming vis a vis forest conservation and applied farm gate or forest gate prices to all transactions. The estimates of all costs and benefits therefore related to sugar cane production and excluded the associated production of sugar, sugar by-products and the respective inputs.

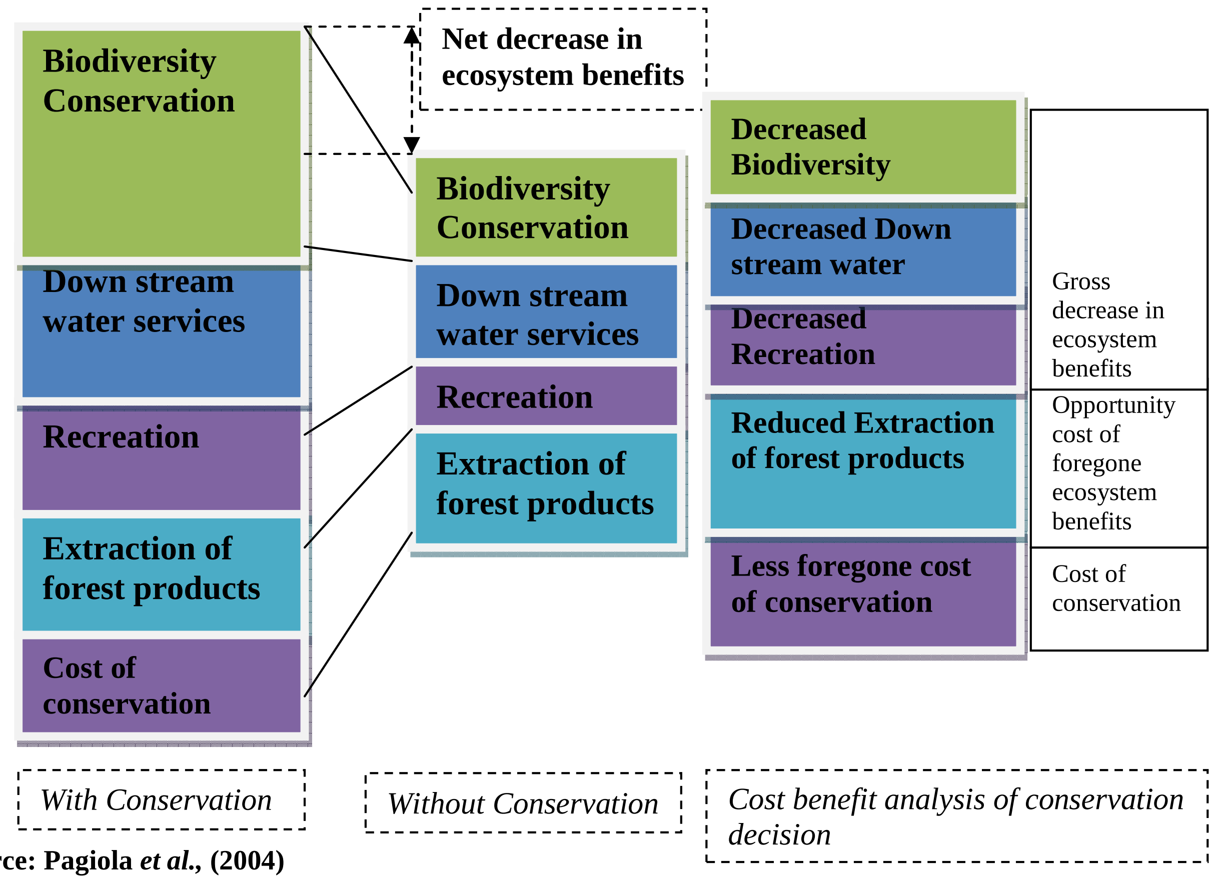
The study assessed a number of questions on the two components of the study viz? the sugar estate and the forest estate. The key questions on the first component included:

» What is the value of sugarcane estate of SCOUL?
» Is it possible for SCOUL (and the sugar industry as a whole) to achieve increased output through options, such as increasing productivity, and increasing the number of out-growers, other than using Mabira CFR?
» Are the other sugar companies in Uganda, other than SCOUL, able to meet the demand sought without having to convert part of Mabira CFR into permanent agriculture?
» Are there alternative pieces of land, to Mabira CFR, that could be used and the implications of using these alternative lands for SCOUL?

The key questions on the second component (the forest estate) included:

» What annual benefit flows are associated with the Central Forest Reserve;
» What are the potential consequences of the proposed ecosystem degradation;
» How will the annual flow of benefits change following the proposed degazettement?
» What is the opportunity cost of maintaining the forest estate?

Figure 2: Key Elements of the Conservation versus Degazettement Options of Part of Mabira Central Forest Reserve



Source: Pagiola *et al.*, (2004)

1.4. METHODOLOGY

This economic analysis was carried out in three phases including a detailed review of literature and media reports on the subject, assessment of standing stock and inventory information on the potential impact on the forest, key informant interviews, community consultations followed by data computations and interpretation. The study also involved detailed description of the biodiversity of Mabira Central Forest Reserve, economic evaluation of the agricultural potential of the area and detailed analysis of the sugar commodity market.

Description of the biodiversity of Mabira CFR relied on literature reviews. The agricultural economic evaluation relied on both budgeting techniques and cost benefit analysis, using the Net Present Value as the decision-making criteria. Assessment of the conservation value of the forest estate relied on both cost benefit analysis and the concept of total economic value (TEV). The detailed analytical frameworks are described in subsequent chapters.

2.0. BIOPHYSICAL CHARACTERISTICS OF MABIRA CFR

2.1. SIZE AND LOCATION

Mabira Central Forest Reserve covers an area of 306 square kilometers (km²) **(30,600ha) mostly** in Mukono and Buikwe Districts of Central Uganda. The forest lies in an altitudinal range of 1,070 to 1,340 metres above sea level. The dominant vegetation in the forest may therefore be broadly classified as medium altitude moist semi-deciduous forest. Mabira CFR is predominantly a secondary forest with the most distinctive vegetation types representing sub-climax communities following several decades of human influence. Three forest types are discernable including a young forest dominated by ***Maesopsis eminii (***about 25 percent); a successional forest represented by young mixed ***Celtis-Holoptelea*** tree species (about 60 percent) and riverine forests dominated by ***Baikiaea insignis (about 15 percent).*** Although the forest suffered extensive human interference in the seventies and early eighties, the forest remains a significant conservation forest system.

This report is aimed at providing a comprehensive account of the present state of knowledge of the flora and fauna of Mabira Forest Reserve in Mukono District. There has been a considerable amount of previous work in this forest and effort has been made to document all the information. The main body of the report provides fairly detailed accounts on the following taxa: plants; birds; mammals and butterflies of the reserve. Compared with other Ugandan forests, Mabira is relatively biodiverse, with total species diversity (an index of species richness per unit area) being average for all taxa except butterflies which were above average. In terms of the 'conservation value' of the species represented (based on knowledge of their world-wide distributions and occurrence in Ugandan forests), Mabira is above average for birds, and butterflies, and average for the remaining taxa. As a basis for further comparison with other sites, 81 species may be classified as restricted-range (recorded from no more than five Ugandan forests). Details of the biodiversity attributes of Mabira CFR are presented in ***Annex 1***.

Site description

Mabira Forest Reserve lies in the counties of Buikwe and Nakifuma in the administrative district of Mukono. It was established under the Buganda Agreement in 1900 and is situated between 32 52° - 33 07° E and 0 24° - 0 35° N. It is found 54 km east of Kampala and 26 km west of Jinja. Mabira Central Forest Reserve is the largest remaining forest reserve in Central Uganda (Roberts, 1994) and lies in an area of gently undulating land interrupted by flat-topped hills that are remnants of the ancient African peneplain (Howard, 1991). Although the reserve lies close to the shores of Lake Victoria it drains to the north eventually into Lake Kyoga and the Victoria Nile. The vegetation in the reserve may be classified as medium altitude moist semi-deciduous forest. The dominant tree vegetation is mostly sub-climax tree species, with clear signs of previous disturbance and human interference. The reserve has a number of community enclaves. The enclaves are however, not part of the gazetted area of the forest. Mabira Central Forest Reserve is covered by the Uganda Lands and Surveys Department map sheets 61/4, 62/3, 71/2 and 72/1 (series Y732) at 1:50,000.

2.2. GEOLOGY AND SOILS

Pallister (1971) indicated that the principal rock types underlying Mabira Forest Reserve are granitic gneisses and granites with overlying series of metasediments which include schist's, phyllites, quartzites and amphibolites. The gneisses and granites are generally fairly uniform and give rise to little variation in resistance to soil erosion other than along joints and fracture planes. Under humid conditions, granitic rocks are very liable to chemical decomposition and, in most parts of the area, the rocks are now weathered to a considerable depth. The overlying metasediments, by contrast, are heterogeneous and include hard resistant bands of quartzite and, to a lesser extent, amphibolite, alternating with soft, easily eroded schist's.

Soils

The soils in the forest reserve are strongly influenced by the local topography. The forest lies on the Buganda catena which comprises of red soils with incipient laterisation? on the slopes and black clay soils in the valley bottoms. There are four principal members of this catena which are described as follows, starting with those at the highest altitude:

a. Shallow Lithosols of the highest ridge crests consisting of grey and grey brown sandy loams overlying brashy, yellowish or reddish brown loam with laterite or quartzite fragments and boulders.
b. Red Earths (Red Latosols) which cover most of the land surface and are strikingly apparent in the large conical termitaria dotting a rather monotonously green landscape. The soil profile consists of up to 30 cm of brown sandy or clay loam overlying uniform orange-red clay to a depth of 3 m or more.
c. Grey Sandy Soils appearing at the base of the slopes of the catena these may be derived from hill-wash or river alluvium. Underlying the sandy topsoils are fine sandy clays of a very pale grey colour mottled to orange brown.
d. Grey clay usually water logged and occupied by papyrus stand at the base of the catena. Below this are sandy and even pebbly clays. Despite the waterlogged condition for most of the year, surface peat accumulation is rarely more than a few inches thick. The last two members of the catena are very acid in reaction (pH 3.8 – 4.8) and are deficient in all plant nutrients except sulphur and magnesium.

Due to the weathering, the soils are not so fertile and the fertility that is there is because of the forest litter that decomposes and releases nutrients. However, the cutting away of the forest will result into further soil degradation because of the removal of the forest cover and subsequent loss of litter. It will also lead to quicker leaching of nutrients and higher soil erosion levels.

2.3. PLANTS

Three hunded sixty five plant species are known to occur in Mabira forest as recorded by Howard & Davenport (1996) and Ssegawa (2006). Of the species recorded in this reserve, nine are uncommon and have been recorded from not more than five of the 65 main forest reserves in Uganda (Howard & Davenport, 1996). Trees and shrubs recorded in Mabira but not previously known in the floral region include ***Acacia hecatophylla, Aeglopsis eggelingii, Alangium chinense, Albizia glaberrima, Aningeria adolfi-friederici, Bequaertiodendron oblanceolatum, Cassipourea congensis, Celtis adolfi-fridericii, Chrysophyllum gorungosanum, Dombeya goetzenii, Drypetes bipindensis, Elaeis guineensis, Elaeophorbia drupfera, Ficus dicranostyla, Khaya*** anthotheca, ***Lannea barteri, Manilkara multinervis, Musanga cecropioides,Myrianthus holstii, Neoboutonia macrocalyx, Rawsonia lucida, Rhus ruspolii, Rinorea beniensis, Schrebera alata, Tapura fischeri*** and ***Warburgia ugandensis.*** Restricted-range trees and shrubs recorded from Mabira include ***Caesalpinia volkensii, Antrocaryon micraster, Chrysophyllum delevoyi, Elaeis guineensis, Lecaniodiscus fraxinfolius, Tricalysia bagshawei, Chrysophyllum perpulchrum, Ficus lingua*** and ***Picralima nitida.*** The Mahogany species namely, ***Entandrophrama cylindricum, Entandrophragma angolense*** and ***Khaya anthotheca*** are listed as globally threatened species (IUCN, 2000). Others include ***Hallea stipulosa, Lovoa***

swynnertonii and ***Milicia excelsa.*** The species that are known to occur in Mabira forest are given in *Table A1*.

2.4. BIRDS

Mabira Forest Reserve is an Important Bird Area (Byaruhanga ***et al*** 2001), globally recognized as an important site for conservation of biodiversity (key biodiversity area) using birds as indicators. Over 300 species of birds is known to occur in Mabira forest with one of the highest diversity of species in Uganda. It is the biggest block of forest in central Uganda which makes Mabira Forest a refugium of species that existed in central Uganda forests. Forty-eight per cent of these are forest dependent representing 45% of the Uganda total. Nahan's Francolin ***(Francolinus nahani)*** is a globally endangered species occurring only in Mabira in central Uganda. Other globally threatened species include Blue Swallow ***(Hirundo atrocaerrulea***, Grey Parrot (***Psittacus erithacus***) and Hooded Vulture (***Necrosyrtes monanchus*** listed as globally Vulnerable. Also listed are Papyrus Gonolek ***(Laniarius mufumbiri)*** a 'near-threatened' species.

Mabira Forest Reserve supports a rich avifauna of significant conservation value. Other regionally threatened species include Brown Snake-Eagle (***Circaetus cinereus***), Crowned Eagle (***Stephanoaetus coronatus***), White-headed Saw-wing (***Psalidoprocne albiceps***), Toro Olive Greenbul (***Phyllastrephus hypochloris***), and Green-tailed Bristlebill (***Bleda eximia***).

A number of species are known to occur in Mabira that are otherwise associated with different regions and altitudes. Their presence can possibly be explained by the fact that Mabira may have been connected to the refugium forest once forming part of the extensive forest that existed across East Africa, now isolated since its retreat. Tit Hylia ***(Philodornis rushiae)*** of the race ***denti*** is a West African species and is only known in East Africa from two specimens, both collected in Mabira (Britton, 1981). Purple-throated Cuckoo Shrike ***(Camphephaga quiscalina)*** is also known from West Africa where it is uncommon. It is known in East Africa in scattered locations where it is generally found in high altitude sites. In Uganda it is also known from lower altitude sites such as Mabira and Sango Bay Forest Reserves. Two species, Fine-banded Woodpecker ***(Campethera tulibergi)*** and Grey Apalis ***(Apalis cinerea)*** recorded in Mabira are normally restricted to high altitude areas.

Mabira is a particularly valuable forest for lowland forest species sharing many rare species with other lowland forests in Uganda such as Semliki National Park and Sango Bay Forest Reserve. Examples of these include White-bellied Kingfisher ***(Alcedo leucogaster),*** Blue-headed Crested -Flycatcher ***(Trochocercus nitens).*** Restricted-range birds recorded from Mabira include Little Bittern (***Ixobrychus minutus),*** Banded Snake Eagle (***Circaetus cinerascens),*** African Hawk Eagle (***Hieraaetus spilogaster),*** Gabar Goshawk (***Micronisus gabar),*** Nahan's Francolin(***Francolinus nahani***), Allen's Gallinule (***Porphyrio alleni),*** Caspian Plover(***Charadrius asiaticus***), European Cuckoo(***Cuculus canorus***), Madagascar Lesser Cuckoo(***Cuculus rochii),*** Cassin's Spinetail(Neafrapus cassini), White-bellied Kingfisher***(Alcedo leucogaster),*** African Dwarf Kingfisher (***Ispidina lecontei),*** Blue-cheeked Bee-eater ***(Merops persicus***), Eurasian Roller (***Coracias garrulous***), Little SpottedWoodpecker (***Campethera cailliautii),*** Bearded Woodpecker (***Dendropicos namaquus***), Blue Swallow***(Hirundo atrocaerulea),*** Banded Martin (***Riparia cincta),*** African Penduline Tit (***Anthoscopus caroli),*** Purple-throated Cuckoo-Shrike (***Campephaga quiscalina***), Leaflove (***Pyrrhurus scandens),*** Isabelline Wheatear (***Oenanthe isabellina),*** Black-capped Apalis (***Apalis nigriceps),*** White-winged Warbler (***Bradypterus carpalis),*** Carruthers' Cisticola (***Cisticola carruthersi***), Stout Cisticola (***Cisticola robustus***), Trilling Cisticola(***Cisticola woosnami),*** Grey Longbill (***Macrosphenus concolor***), Yellow Longbill (***Macrosphenus flavicans),*** Tit Hylia (***Pholidornis rushiae),*** Wood Warbler ***(Phylloscopus sibilatrix),*** Blue-headed Crested Flycatcher (***Trochocercus nitens),*** Plain-backed Pipit(***Anthus leucophrys),*** Papyrus Gonolek (***Laniarius mufumbiri***), Woodchat Shrike(***Lanius senator***), Wattled Starling*(Creatophora cinerea),* Red-chested Sunbird*(Cinnyris erythrocerca)*

2.5. MAMMALS

A total of fifty (50) large and small mammal species are known to occur in Mabira Forest Reserve. A high proportion of the species list are forest-dependent, and includes ***Deomys ferrugineus*** and ***Scutisorex somereni,*** closed forest-dependent specalists often regarded as two of the most sensitive indicators of forest disturbance. The Ugandan endemic shrew ***Crocidura selina,*** only previously recorded from Mabira Forest (Nicoll and Rathbun, 1990) has not been recorded since but has been recorded in other forests. Species with high conservation value include ***Crocidura maurisca*** and ***Casinycteris argynnis*** – a new record for Mabira forest. Others protected under the CITES include Red-tailed Monkey (***Cercopithecus ascanius***), Potto (***Perodictictus potto***), Galago (***Galago senegalensis***), Leopard (***Panthera pardus***), Grey Cheeked Mangabey (***Cercocebus abigena***) and Baboons (***Papio anubis)***.

2.6. AMPHIBIANS

Some of the common amphibian species are associated with permanent wetlands, rivers or water points. Species of genera ***Afrana***, ***Hyperolius***, ***Xenopus***, ***Hoplobatrachus*** and ***Afrixalus*** seem to select habitats with water all year round. The commonest species were members of family Hyperoliidae. Members of family Ranidae were also found to be common.

The most common species of family Hyperoliidae are generally associated with permanent water sources. Members of genera Xenopus, Afrana and Hoplobatrachus were also quite common. Members of these genera are commonly found near water, more so for the bullfrog, which only gets out of the water to feed. Afrana angolensis is a riverine species found mainly along rivers and this was encountered along rivers in Mabira Forest Reserve (***Table A4***). One member of family Arthroleptidae, ***Artholeptis adolfifriederici*** is a new record for Mabira Forest Reserve.

2.7. REPTILES

Mabira Central Forest Reserve has a variety of reptiles. More than 23 species of reptiles have been identified in the reserve. Reptiles are highly mobile and live in a range of habitats. They may be encountered in aquatic, bush, forest, rocky or riverine terrain. The tolerance of reptiles to a range of habitat types explains the large diversity of reptile species in the forest reserve.The key reptiles in the reserve however, include chameleons, geckos, forest and nile monitor lizards, skinks, snakes including tree and house snakes, pythons, cobras, mambas, puff adders and vipers. A list of the key reptile species in the forest reserve together with an indication of their respective conservation status is included in Table A5 in the annex.

2.8. BUTTERFLIES

A total of 199 species of butterflies is known to occur in Mabira forest. Nine (9) Papilioidae, twenty four (24) Pieridae, twenty five (25) Lycaenidae, one hundred and twenty eight (128) Nymphalidae aud thirteen (13) Hesperiidae. A relatively high proportion (73 percent) of the total were forest-dependent butterflies. Details of the number of species taken from each family, and each subfamily in the case of the Papilionidae, Pieridae and Nymphalidae, are provided in Table 2.

It can be seen that the reserve supports at least 16 percent of Uganda's Rhopaloceran fauna, including 24 percent of the country's Pieridae, 29 percent of the Nymphalidae and 38 percent of the subfamily Charaxinae (Howard & Davenport, 1996). Of the species registered, those of particular interest included ***Sallya natalensis*** a new record for Uganda (Howard & Davenport, 1996). This butterfly is a migratory insect so unusual distribution records are not too surprising, however, its previous known range was from Natal to parts of Kenya (Larsen, 1991). ***Charaxes boueti,*** meanwhile, a member of one of the more commonly studied subfamilies, represents a new record for this forest (Howard & Davenport, 1996): one of the few areas in the country which have been comparatively well investigated for their Rhopaloceran fauna.

At least two sub-species endemic to Uganda were registered, ***Tanuetheira timon orientius;*** Ugandan forests being the eastern limit of the species' range and ***Acraea lycoa entebbia,*** known only from central and eastern Uganda. ***Acraea agan ice ugandae,*** meanwhile, an uncommon butterfly is restricted to the northern shoreline of Lake Victoria (Howard & Davenport, 1996).

Other species of limited range include the skipper ***Ceratrichia mabirensis*** (Mabira being the Type Locality) with a patchy distribution, limited to parts of Uganda, Tanzania and western Kenya (Larsen, 1991), and ***Pseudathyma plutonica*** a scarce insect ranging from eastern Democratic Republic of Congo (DRC) to western Kenya. Moreover, ***Fseudacraea clarki,*** a comparatively large and conspicuous butterfly has records from Cameroon to Gabon and West Kenya, although Larsen (1991) maintains its absence from the latter. It is certainly not a common insect in East Africa.

Mabira Forest Reserve may be considered rich in terms of its butterfly fauna, supporting a high percentage of forest-dependent butterflies, as well as a number of uncommon and restricted-range species (Howard & Davenport, 1996). Despite a recent history of intensive human disturbance in this forest (as reflected by the fact that almost a quarter of the species recorded are associated with forest edge and woodland habitats), the butterfly fauna has shown marked resilience (Howard & Davenport, 1996). Two species of Nymphalidae ***Acraea rogersi*** and ***Bicyclus mesogena,*** both reliant on dense, undisturbed forest demonstrate the environmental flexibility of some invertebrate communities (Howard & Davenport, 1996).

Table 2: Species numbers recorded in Mabira from each family and from Papilionidae, Pieridae and Nymphalidae subfamilies

Family Subfamily	**Uganda Total**	**Forest Total**	**% Uganda Total**
Papilionidae	31	9	29
Papilioninae	31	9	29
Pieridae	100	24	24
Coliadinae	10	3	30
Pierinae	90	21	23
Lycaenidae	460	25	5
Nymphalidae	447	128	29
Danainae	13	7	54
Satyrinae	71	20	28
Charaxinae	65	25	38
Apaturinae	1	1	100
Nymphalinae	195	50	26
Acraeinae	101	24	24
Libytheinae	1	1	100
Hesperiidae	207	13	6
TOTAL	**1245**	**199**	16

Restricted-range butterflies recorded from Mabira include ***Belenois victoria*** Victoria White, ***Dixeia charina*** African Small White, ***Epitola catuna***, ***Lachnocnema bibulus*** Woolly Legs, ***Tanuetheira timon***, ***Cacyreus audeoudi*** Audeoud's Bush Blue, ***Amauris hecate*** Dusky Danaid, Charaxes port hos, ***Charaxes pythodoris*** Powder Blue Charaxes, ***Palla ussheri***, ***Apaturopsis clenchares*** Painted Empress, ***Euryphura albimargo***, ***Euryphura chalcis***, ***Pseudathyma plutonica***, ***Pseudacraea clarki***, ***Neptis trigonophora***, ***Sallya natalensis*** Natal Tree Nymph, ***Hypolimnas dubius*** Variable Diadem, ***Acraea aganice*** Wanderer, ***Acraea rogersi*** Rogers' Acraea, ***Acraea semivitrea, Acraea tellus, Celaenorrhinus bettoni, Celaenorrhinus proxima***, ***Gomalia elma*** African Mallow Skipper, ***Ceratrichia mabirensis,*** and ***Caenides dacena.*** The list of known butterflies of Mabira forest are given in *Table A6*.

3.0. ECONOMIC EVALUATION OF THE SUGAR SECTOR IN UGANDA

3.1. GLOBAL SUGAR PRODUCTION TRENDS

More than 130 countries produce sugar world wide. Of these, 66 percent process their sugar from sugarcane. The rest produce sugar from sugar beet. Sugarcane primarily grows in the tropical and sub-tropical zones of the southern hemisphere, while sugar beet is largely grown in the temperate zones of the northern hemisphere (ED&F Man, 2004). Prior to 1990, about 40 percent of sugar was made from beet but sugarcane production has grown more rapidly over the last two decades because of the lower costs associated with its production.

The top seven sugar producing countries in the world include Brazil, India, the European Union, China, Thailand, South Africa and Mauritius. The above seven countries produce up to sixty (60) percent of total global output (USDA, 2006). Projections indicate increased sugar production in 2006/07 due to higher production in Brazil, India, China and Thailand. Production in the EU was expected to decline by 5 million tonnes, from 21.8 million metric tonnes to 16.8 million metric tonnes (USDA, 2007).

Over seventy (70) percent of global sugar production is consumed in the country of origin, implying that only thirty (30) percent is traded in the world sugar market (ED&F Man, 2004). As indicated in ***Table 3***, world consumption of sugar was higher than production for 2005 and 2006 (***Table 3***). Africa, Asia, Greater Europe (outside EU) and North America were the regions with the largest sugar deficit (***Table 3***). In Africa, the deficit was 2.8 and 2.7 million tonnes in 2005 and 2006 respectively (FAO, 2006). More than 60 percent of the global consumption of sugar takes place in developing countries, with China and India leading the way. In addition, it is the developing countries particularly in Asia, which are expected to be the primary source of future demand growth (Sserunkuma and Kimera, 2006).

Table 3: World production and consumption of sugar (million tonnes, raw value)

World's Regions	Production		Consumption	
	2005	2006	2005	2006
World	145.2	149.7	147.2	149.9
Developing countries	101.9	106.9	99.5	102.0
Latin America and the Caribbean	50.5	49.9	26.5	27.1
Africa	5.3	5.6	8.1	8.3
Near East	7.7	7.7	11.1	11.5
Far East	38.1	43.4	53.6	55.1
Oceania	0.4	0.4	0.1	0.1
Developed countries	43.3	42.8	47.7	47.9
Europe, of which:	27.2	26.8	29.8	29.9
European Union (25)	22.1	21.3	18.1	18.1
Eastern Europe in Europe)	5.1	5.1	5.1	5.1
North America	7.4	7.1	10.4	10.5
Oceania	5.4	5.4	1.4	1.4
Others	3.3	3.6	6.0	6.1

Source: FAO (2006)

The demand for sugar has also been growing in the eastern Africa region. In order to achieve growth targets therefore, the sugar industry has been classified as a sensitive industry that requires effective safeguard measures (Serunkuma and Kimera, 2006). In Kenya, the area under sugarcane was 151,014 hectares by the end of 2006 and the average yield was 71.46 mts/ha. The amount of cane crushed was 4,850,333 mts. The amount of sugar produced by Kenyan sugar factories was 475,669 mts. In 2006, production further declined to 475 653 mts against a demand of 718,396 mts (Kenya Sugar Board in the East African Standard, 2007). In Tanzania, the annual sugar production was about 115,000 tonnes, while the demand of sugar is estimated at 300,000 tonnes. As such, Tanzania imports about 200,000 tonnes per annum to offset the shortfall (Tanzania Ministry of Agriculture, Food and Cooperatives, 2007).

3.2 HISTORY OF THE SUGAR INDUSTRY IN UGANDA

Sugarcane production in Uganda dates back to 1924 when the first sugar factory was established in Uganda and East Africa. The factory was then known as Uganda Sugar Factory Limited. The factory has since changed to the Sugar Corporation of Uganda Limited (SCOUL) (Serunkuma and Kimera, 2006). The Sugar Corporation of Uganda Limited was established by the late Najir Kalidas Mehta who came to Uganda from India in 1901. The second sugar factory opened at Kakira in 1930. It was started by the late Muljibhai Madhvani who also came to Uganda from India in 1908. Two other sugar establishments were made at Sango Bay in Rakai District and at Kinyara in Masindi District. Sugar production at Sango Bay started in 1972 but was shut down in 1973 following the expulsion of the Asian owners during the Idi Amin government. The National Sugar Works in Kinyara near Masindi (Kinyara Sugar Works) was initiated in the 1960s and implemented in the early 1970s.

Uganda has good physical attributes for the successful production of sugar. Peak production reached 152,000 mts in 1968, and by 1969, Uganda was able to export about 48,000 mts of sugar. In the 1950s and 1960s, with just SCOUL and Kakira Sugar Works, Uganda was one of the world leaders in the sugar industry with production at a tune of 140,000 mts of sugar per year. For example, about 20,000 mts of sugar/year were exported to the United States of America and regionally to neighbouring countries. Uganda's premier position in the sugar sector declined following the economic and political upheavals of the Amin and Obote II regimes. Sugar production actually plummeted to almost zero by 1983. Sugar estates were abandoned, machinery fell into disrepair,or were looted, and the physical and social infrastructure deteriorated (AfDB, 2002). The country became entirely dependent on imported sugar. The sector has however partly recovered following the return of Asians in the mid 1980s. In 1988, the Mehta Group repossessed and commissioned the rehabilitation of the SCOUL factory in Lugazi. Between 1985 and 1995 Kakira Sugar Works 1985 Ltd underwent rehabilitation and Kinyara Sugar Works was rehabilitated between 1986 and 1996[1].

The Economic Recovery Program initiated in 1987 and the Structural Adjustment Programme of the early 1990s promoted the rehabilitation of the agricultural sector, including the sugar industry. The rehabilitation in the sugar industry looked at the rehabilitation of sugarcane yields of the nucleus plantation; evaluation of current systems and methods of sugarcane production and set up methods and means to achieve production of sugarcane at minimum costs. It also examed advice on options for the diversification of the industry and the institutional and legislative requirements to improve management of the industry.

The sugar industry employs about 21,749 persons on a permanent, contract and casual labour basis. Of these eighty to ninety (80–90) percent are members of the National Union of Plantation Workers of Uganda (NUPAWU) (Uganda Land Coalition, 2006). In addition, the sugar industry engages approximately 40,000

1 Between 1985 and 1988, there was no sugar production as all factories were under rehabilitation

workers, when both direct and indirect employment are considered, including out-grower farmers (Fashoyin ***et al.,*** 2004). The total sugarcane production increased from 2002 to 2003 and 2003 to 2004 (*Table 4*) by nearly six percent and nine percent, respectively but declined by two and a half percent from 2004 to 2005 (FAO, 2007). By late 2005, Uganda had three operational sugar factories SCOUL, Kakira Sugar Works (1985) Ltd, and Kinyara Sugar Works Ltd. In the second half of 2006, a new company known as G.M. Sugar Limited, located at Nakibizzi in Mukono District, emerged as the fourth local sugar factory. Unlike the other three operators, this fourth factory does not have a nucleus sugarcane plantation. Instead G.M. Sugar Limited buys all its sugarcane from out-growers.

3.3 SUGAR PRODUCTION AND CONSUMPTION TRENDS IN UGANDA

Three issues influence productivity of the sugar sector in Uganda. They include yield per hectare, sugar recovery ratios and import export demand. Cane productivity in Ugnada may be ranked medium to low. Nucleus estate yields are normally higher than outgrower yields due to better agronomic practices. Typical nucleus estate yields range between 83.3 tonnes per hectare at Sugar Corporation of Uganda Limited (*Table 6)*, 89.9 mts per hectare at Kinyara Sugar Works to 108.9 tonnes per hectare at Kakira Sugar Works (Isingoma, 2004). Cane yields of 120 mts per hectare are however, achievable at nucleus estates (AfDB, 2002). The major factors influencing yield include rain and irrigation, the later being very underdeveloped.

Table 4: Uganda Sugar and Sugar Crops production between 2002 and 2005

	2002	2003	2004	2005
Production quantity (000 tonnes)	1,877.62	1,995.08	2,202.88	2,149.67
Increased sugarcane production (%)	--	5.89	9.43	-2.48
Import quantity (000 tonnes)	82.25	60.17	88.18	180.01
Export quantity (000 tonnes)	5.14	0.82	15.19	95.64
Food consumption quantity (000 tonnes)	1,229.01	1,329.09	1,428.97	1,554.54

Source: FAO (2007)

Table 6: Sugarcane yield in Uganda's sugar factory nucleus estate

	Cane yield (Tonnes/ha)	Average Age of Cane harvested (Months)	Cane Productivity (Tonnes/ ha /m)
Kakira Sugar Works	108.9	18.94	5.69
Kinyara Sugar Works	89.9	18.7	4.78
Sugar Corporation of Uganda Ltd	83.3	18.1	4.64

Source: (USCTA, 2003)

Though yields remain low, short-term projections indicate anticipated growth in cane production for the three sugar plantations as indicated below:

Table 7: Projected sugarcane production

Sugar factories	Projected Sugarcane production					
	2003		2004		2005	
	(tonnes)	%	(tones)	%	(tonnes)	%
Kakira Sugar Works	980,854	49	1,067,417	46	1,235,955	47
Kinyara Sugar Works	560,406	28	666,217	29	683,813	26
Sugar Corporation of Uganda Ltd	456,141	23	600,000	26	700,000	27
Total Projection	1,997,401	100	2,333,687	100	2,619,768	100

Adapted from: (USCTA, 2003)

The average sugar recovery ratios are also low. Kinyara has the highest standing at 9.6 percent compared to Kakira's 8.9 percent and SCOUL's 8.4 percent. Following a crop improvement campaign, Kinyara improved its cane to sugar ratio to 10 percent in the financial year 2004/05. The same campaign helped Kinyara to surpass its production target of 64,000 tonnes of sugar per year by 958 tonnes and to upgrade to a new production target of 93,000 tonnes per year for 2008. Although the outgrower contribution also increased to eight hundred farmers (800), sugar producers remained wary of cheap imported sugar, which makes competition a nightmare. They also complained of a poor road network and argued that it made the expansion of the outgrower scheme very difficult. Similar issues were raised at both Kakira Sugar Works and at the Sugar Corporation of Uganda Limited. Both factories however, suffered production short falls. The shortfalls were further exercebated by the low cane to sugar conversion ratios.

3.4. PERFORMANCE OF UGANDA'S SUGAR SECTOR

Kakira Sugar Works Limited is the largest sugar factory in Uganda in terms of yield and output. The company accounts for forty two (42) percent of overall national output and operates a nucleus estate of 12 000 hectares. The estate benefited from a contentious takeover of 1,200 hectares that were previously part of Butamira Central Forest Reserve[2]. The company also services up to 10,000 hectares of out-grower contract production.

A systematic expansion of the SCOUL nucleus plantation increased cultivable land by thirty three (33) percent from 9,000 to 12,000 hectares. In October 2006, RAI Holdings, a Kenyan consortium, paid Ush62 billion ($33.5 million) for a fifty one (51) percent stake in Kinyara Sugar Works Limited[3] (KSWL) (New Vision Newspaper, 2006). Kinyara Sugar Works factory produces more than 50,000 tonnes of sugar per year from over 500,000 mts of sugarcane. The company collaborates with over 800 outgrower farmers operating over 4,600 hectares of cane plantation. Among the three sugar factories, Kakira Sugar Works has the largest nucleus estate and cane output. SCOUL has the lowest output (*Table 5*).

The overall sugar production output from the three factories was 198,000 metric tones. This fell short of total annual demand currently put at 240,000 metric tones by over 40,000 metric tonnes (East African, 2007).

2 The land use in Butamira CFR changed to permanent agriculture. The move triggered a law suit by a civil society group. While the group won the case, it would appear this was a pyrrhic victory.

3 10 % of the shares in Kinyara Sugar Works were offer to the out-growers of Kinyara Sugar Works, another 10 % to the Bunyoro Kitara Kingdom and 30 percnet of the shares are to be traded to the public on the Kampala Stock Exchange

Table 5: Sugar Companies and Production in Uganda at a glance

Company	SCOUL	Kakira	Kinyara
Location	Lugazi; Mukono District	Kakira, Jinja Distict	Kinyara, Masindi District
Ownership	Mehta Family (76%) GoU (24%)	East African Holdings (100%)	RAI Holdings (51%), Bunyoro Kitara Kingdom (10%), Kinyara sugar works out-growers (10%), and public (29%)
Area	15,000 ha	22,000 ha	11,000 ha
Commissioned	1924	1930	1976
Sugarcane tonnage	480,000	900,000	500,000
Sugar tonnage	44,000	90,000	64,000
Products	Sugar, spirit, vegetables, and cut flowers		Sugar, molasses, spirit
Permanent & contract staff	6,000	2,300	3,900
Casual workers		4,200	
Out-growers	700+	3,600+	800
Out-grower area (ha)	3,000	10,000	4,600
Cane of out-growers	160,000 mts/year		200,000 tonnes/year
Primary schools	13		1
Secondary schools	1		1
Health care	Clinic & maternity with 20 beds		Clinic and maternity-primary health care only; 2 doctors, midwives and nurses plus ambulance
Company policy	Against child labour		
*Conversion sugar (%)	9.1	10	10.91

*Source: Sserunkuuma and Kimera (2006) *calculated from existing data*

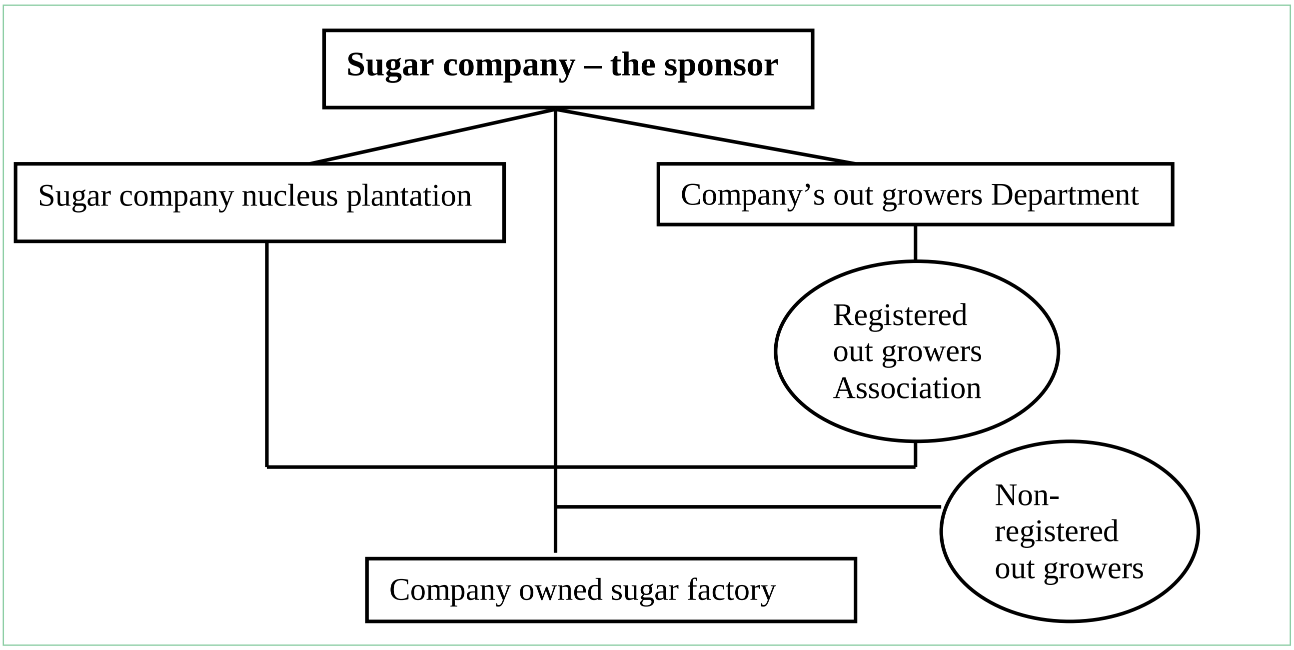
4.0. EVALUATION OF DECISION TO CONVERT MABIRA CFR FOR SUGAR CANE PRODUCTION

4.1 SUGAR PRODUCTION MODEL FOR UGANDA

Uganda's sugar industry employs a mixed production model consisting of a nucleus sugar cane plantation which is normally owned and managed by a sugar company and registered and non-registered out-grower farms. The nucleus estate is often fairly large and supplies more than 50% of sugarcane to the mill in order to provide some guarantee of throughput for the plant (*Figure 3*). The Sugar Company also owns a processing plant (Serunkuma and Kimera, 2006). For a farmer to become an out-grower he has to be registered at the out grower Department of the Company. The successful applicant receives a quota of the expected production and quality depending on the soil fertility.

The sugar companies secure sugarcane of a certain quantity and acceptable quality from out-growers by the provision of standard land preparation, seedlings, agrochemicals, supervising production and technical assistance to all out-growers. The supporting service costs are deducted from the total price to be paid to small farmers at the harvest time. *With the level of follow up on extension, farm practices and cane quality; it is envisaged that the sugar processing companies are able to establish production conditions on the registered out-grower farms that are identical to the conditions on their own nucleus plantation.*

Figure 3: Centralised and contract farming model in sugar companies in Uganda



Source: Uganda Land Coalition (2006)

A registered out-grower is a self-employed farmer usually a smallholder who owns or leases land, and produces and supplies sugarcane under contract to a plantation sugar company. The size of the small farmer's land varies from a minimum of 2 ha to larger farms with up to 400 hectares or even more. The company retains exclusive control over purchase and marketing of the out-grower–supplied sugar (Welch, 2004).

The out-growers however, retain the risk of growing, harvesting and transporting their quota of cane to the sugar mill as per production contract and under the company's supervision. The company engages to buy the estimated quota of cane agreed on, to provide technical advice, help with mechanical land preparation (bush clearing, ploughing and harrowing), planting (selection of seeds) and training and can, if required, provide financial aid in the form of loans. The company charges for all these services to the out-grower. It should also be noted that there is another category of out-growers, the non-registered small farmers whose aggregate supply of sugarcane to companies is growing. These farmers are, however, not guaranteed a market from the companies.

From the status of land ownership by the three leading sugar production firms; SCOUL's nucleus estate represents seventy five (75) percent of its total land compared to fifty nine (59) percent and 54.5 percent for Kinyara and Kakira, respectively. Kakira has the largest combined sugar estate totalling 22,000 hectares followed by SCOUL totalling 15,000 hectares and Kinyara totalling 11,000 hectares (*Table 8*).

The Sugar Corporation of Uganda Limited (SCOUL) therefore has the largest nucleus estate and the smallest area of outsourced cane (from 3,000 ha of small outgrowers). SCOUL also utilizes 1,000 hectares of land that is directly leased from private suppliers. Among the three estates, therefore, SCOUL obtains only twenty five (25) percent of its cane from outgrowers compared to forty and forty five percent for Kakira and Kinyara, respectively. Since they rely a lot more on the cane grown in the community, Kakira and Kinyara have to build strong links with local communities and authorities. The sugar companies depend on the stability of the land tenure system and the contracts they have with farmers. Kinyara has diversified sugarcane sources and has both large and small scale outgrowers, and large self funded groups. Kinyara may therefore have the most secure sugarcane estate. Both SCOUL and Kakira have little diverisification and carry the risk of their farmers defecting to other processors, or as in the case of Kakira forming their own sugar processing company. In addition, SCOUL still has 6.6 percent of its nucleus estate on private land, and as such relies on the land owner's willingeness to continue under the current arrangements. These conditions precipitate the desire for SCOUL to expand its nucleus estate into the forest reserve.

Table 8: Status of land ownership of Uganda's sugar factories

Classification of land owned	SCOUL		Kakira		Kinyara	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Nucleus estate	12,000	75	11,000	54.5	6,400	59
Government of Uganda lease			1,000	4.5		
Private land leases	1000	6.6				
Outsourcing	3,000	25	10,000	45.5	4,600	41
Large private estates			-		800	7.2
Small out-growers	3,000	25	10,000	45.5	2,400	21.8
Large self-funded					1,400	12.7
Total	15,000	100	22,000	100	11,000	100

Source: Adapted from Uganda land coalition (2005); Welch (2004)

4.2. THE VALUE OF THE SUGAR SECTOR IN UGANDA

The value aspects of Uganda's sugar estate may be classified into three categories including the following:

i. reproducible tangible assets including plantations and the improvements made on them;
ii. non-reproducible tangible assets by type where land is categorised into: urban land, cultivated land and other lands (parks and private gardens); and
iii. assets not owned such as leased land on which the sugarcane is produced (UN, 1991)

4.2.1. Value of Reproducible Tangible Assets (sugarcane)

The gross profit from sugarcane production for the sugar factories cannot be individually disaggregated from value of the sugar and other by-products derived from the sugarcane. On the other hand, sugarcane value can be derived (for Kakira and SCOUL) from the value at which the sugar estates buy factory delivered sugarcane from out-growers (*Table 9*). The outgrowers receive a price ranging between Ushs20,200 per metric tone to Ushs 25,000 per metric tone of sugarcane (Welch, 2004).

Box 1: Out-growers production and earnings with SCOUL

Consider the case of a farmer in Kasokoso village, Kawolo sub-county Mukono District:

» Sugarcane takes 18 months to mature, for the first crop;
» Kiwanuka got a Ushs 200,000 loan, bought sugarcane stems and planted three acres;
» At that time, a tonne of sugarcane cost Ushs 17,000;
» Kintu got Ushs 2.5 million from selling sugarcane to SCOUL;
» The price of sugarcane rose to Ushs 20,200 per tonne;
» The farmer hoped to get Ushs 8 million from his harvest in February 2006;
» The contracted out-growers are assured of the market for their sugarcane at SCOUL;
» The farmers get sugarcane stems, technical skills and tractors to plough our fields, on credit;
» SCOUL can meet the transportation costs depending on the distance from the factory;
» The farmer's life has improved; he has renovated his house and bought three cows. He also plans to buy more land. The farmer (Mr. Kintu) is now also a field supervisor at SCOUL.

Source: New Vision (2006)

The total value of sugarcane produced by SCOUL is Ushs 12,120 million equivalent to US$ 7.128 million (*Table 9*). For Kakira Sugar Works the value of sugarcane is Ushs 20,200 million (equivalent to US$ 11.88 million). Estimates of the average revenue per hectare, for Busoga Sugar Cane Out-growers Association, was US$ 490 per ha (Uganda Land Coalition, 2005), which was only slightly higher than the estimates for farmers in Kasokoso village, Kawolo Sub-county Mukono District (New Vision, 2006).

Estimates of the present value of a 5 ratoon (annual) of sugar cane gave a present value of Ushs 2,822,861 per ha (US$ 1,660 per ha) and Ushs 3,207,162 per ha (US$ 1,887 per ha) for the sugarcane estate at SCOUL and Kakira respectively (*Table 9*). Therefore, a 7,186 ha estate can, at the maximum, produce cane with a present value of Ushs 20,285.08 million (US$ 12.3 million) at SCOUL and Ushs 23,046.67 million (US$ 13.6 million) for the equivalent of Kakira sugar works.

Table 9: Value of sugarcane for SCOUL out-growers in Mukono district, 2006

Description of cost items	SCOUL	Kakira
Area	15,000	22,000
Sugarcane (kg)	600,000	1,000,000
Price of sugarcane (Ushs/tonne)	20,200 (US$ 11.88)	
Per hectare value of sugarcane based on out-grower prices ('000 Ushs/ha)	808	918
Per hectare value of sugarcane based on out-grower sugar prices (US$/ha)	475.2	540
Present value of the sugarcane at on out-grower sugar prices ('000 Ushs/ha), based on a 5 annual ratoon, at a 22% Bank Interest rate	2,822,861.53	3,207,161.99
Present value of the sugarcane at on out-grower sugar prices (US$/ha) based on a 4 to 5 annual ratoon, at a 22% Bank Interest rate	1,711.88	1,886.57
Value of a 7,186 ha estate of sugar cane out-grower sugar prices ('million Ushs), based on a 5 annual ratoon, at a 22% Bank Interest rate	20,285.08	23,046.67
Value of a 7,186 ha estate of sugar cane out-grower sugar prices (US$ million) based on a 4 to 5 annual ratoon, at a 22% Bank Interest rate	12.30	13.56

Source: Adapted from (New Vision, 2006; Uganda Land Commission, 2005)

4.2.2. Value of non-reproducible assets of sugar factory (Land at the Company owned nucleus sugarcane estate)

In valuing non-reproducible tangible assets of the nucleus estate land is valued as cultivated land located at the different sites. In Mukono District and the areas neighbouring Mabira Central Forest reserve and SCOUL sugar estate the land rates obtained from brokers ranged between Ushs 500,000 to 1,000,000 per acre equivalent to Ushs 1,250,000/ha and 2,500,000/ha. Therefore, if it was a private land estate equivalent to 7,186 ha Mabira CFR, without any other ecosystem values it would fetch a value of Ushs 8,0982.5 – 17,965 million (US$ 10.57 million to US$ 21.135 million) on the open land market (*Table 10*). Economic sense would suggest that SCOUL would not vie to buy such land if someone, i.e. the Government, were giving it for free. If then the government goes ahead and gives this land it would in effect be providing an equivalent subsidy (US$ 10.57 – 21.14), on the basis of the land rates in the area alone, to one of the three main sugar factories in the country, thereby creating an un-level playing field in the market place. Similar overtures might have to be extended to the other sugarcane estates as well.

Table 10: Value of land based on open market prices

	Value of one unit of land area	Value of equivalent land on the open market (7,186 ha)
Land rates (range) (Ushs/acre)	500,000 – 1,000,000	
Land value (million Ushs/ha)	1,250,000 - 2,500,000	8,982.5 - 17,965
US$	735.3 – 1,470.6	5,283,823.5 - 10,567,647

4.3. COST OF PRODUCTION AND THE DETERMINANTS OF THE COMPETITIVENESS OF THE SUGAR SECTOR IN UGANDA

Brazil has the lowest sugar production costs, approximately US$ 150/ mts of sugar. In Africa, Southern African Development Community countries such as Zimbabwe (US$ 160/mts), Zambia (US$ 180/ mts), and South Africa (US$ 220/mts) have the lowest sugar production costs (Malzbender, 2003). Yet Zambia is a landlocked country like Uganda. Additional, by-products reduce input costs: for example, bagasse is burned to achieve energy self-sufficiency in mills and filter press mud from mills is spread on fields to reduce inorganic fertiliser use. There is potential to generate additional value from current production. Uganda has one of the highest sugar production costs in the Eastern and Southern African region (UNCTAD, 2005). The county's average sugar production cost (*Table 10*) is more that two times higher than the average production cost of Zambia, three-times as high as the sugar production cost in Sudan. Indeed, only Tanzania, Uganda's neighbour to the south, has a comparable but slightly lower sugar production cost. As such, one would expect that Uganda's sugar industry still has options for improvements in productivity and production leading to a reduction in the average sugar production costs.

The higher costs for the sugar factories in Uganda are attributed to: (i) high operational costs; and (ii) the high costs of out-growers cane if the distance goes beyond 20-30km;

Table 11: Sugar production costs in selected Least Developing Countries

Country	Estimation of costs US$/ tonne	Average sugar production cost as a percentage of Uganda's production cost
Ethiopia	375	56.8
Bangladesh	550	83.3
Tanzania	600	91.0
Uganda	660	--
Madagascar	550	83.3

Source: adapted from UNCTAD (2005)

However, the cost of producing sugar in Uganda is already much higher than regional producers. In addition, the Ugandan sugar industry maintains a production cycle which subsidises out-grower sugarcane farmers and a fixed sugarcane rate.

Provision of extension services aimed at ensuring that a good quality cane is available to the factory is a necessary input on the part of sugar factories. However, there are no direct incentives for farmers to expand on their areas or for other farmers, engaged in production of other crops, to switch from these crops if they can earn better prices producing sugar cane.

However, the SCOUL has stated that the production costs are quite high (***Box 3.3***). Similarly, when the price rose in 2006 (New Vision, 4th October, 2005), the General Manager Kakira Sugar Works attributed the higher price to a power shortage, which lead to increased investment in the factories to keep them running.

Box 2: SCOUL sets terms to abandon Mabira CFR

The Sugar Corporation of Uganda Limited will consider dropping its bid for a chunk of Mabira Forest only if the alternative land on offer is fertile, within 20-30 Kilometres of its factory and has no squatters. Speaking on Monday to officials from the National Association of Professional Environmentalists (Nape), SCOUL Chief Executive S.C Khanna said the company would take up the two land offers- one by the Mengo establishment and the other by the Anglican Church in Mukono-only if such land met the company's expectations.

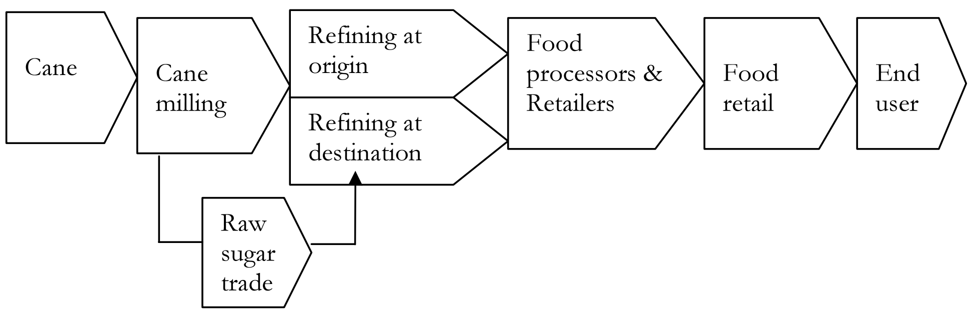
"Tell us where that land is. If it is fertile land and free from squatters then we can see what to do. But it is not a matter of any land," Mr Khanna said at SCOUL's head offices at Lugazi. Mr Khanna spoke out for the first time in weeks while meeting Nape officials headed by Mr. Frank Muramuzi. Mr Khanna said that if the land Mengo was offering is beyond the radius of 30 kilometres, they would not buy or take it. "If the cost of transporting the sugarcane exceeds the cost of producing the sugar, then our company cannot survive.

The Monitor Newspaper (2007)

The main value chain for sugar worldwide consists of cane production, milling, refining, and other value-addition activities such as food processing, food retail until the sugar reaches the end user (*Figure 3*). In Uganda the chain is largely restricted to the first three chain processes. The sugar used in the beverage industry and other food industries, including hotels is largely imported (UBOS, 2006).

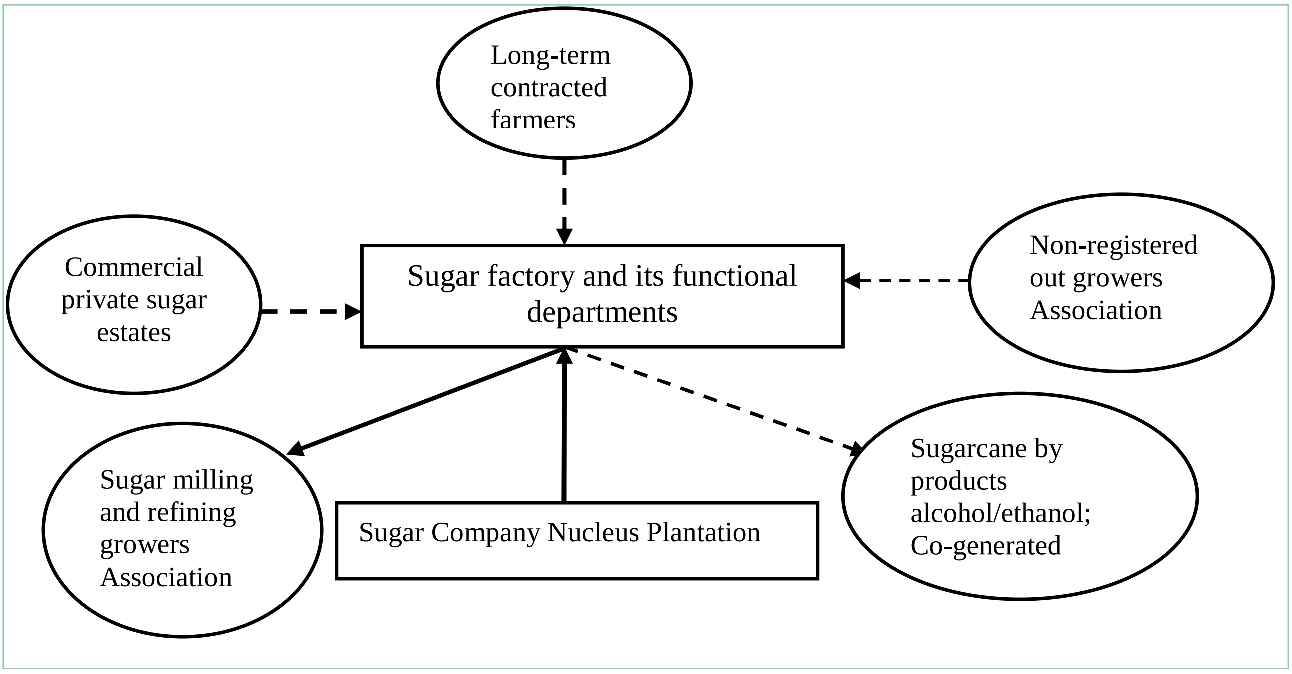
If increased competition arises in the industry there is likely to also be increased specialisation where the sugar companies manage their nucleus estate and then buy the additional sugarcane they need from commercial private estates and long-term contracted smallholder out-growers. The sugar factories can then buy the cane on the basis of the cane quality, the farmers would incur the transport costs, and in exceptional cases the actual cost of transport would be deducted from the price negotiated with the sugar factories.

Figure 4: value chain for sugar cane to sugar



Source: (IIED, 2004)

Figure 5: Framework of specialisation for sugar industries



The cost structure for Kinyara Sugar Works indicates that the main sources of costs for out-growers come from land developments, transport and labour (*Table 11*). Labour and transports costs increase after the first year while the land development costs decreased after the first year. The cost structure in Kinyara was used as a proxy for the likely costs of production for out-growers throughout Uganda's sugar industry.

However, from *Table 12*, the gross costs of production for the SCOUL out-grower are 45% of the gross revenue equivalent to Ushs 784,260/ha. Of which family labour contributed 35% of the gross production costs, which is in line with the average labour costs for Kinyara Sugar Works over the three year period (*Table 12*). The net profits for the out-grower are Ushs 954,974/ ha over an average 18 month period leading to an income of Ushs 636,649/ year.

Table 11: Cost structure for a Kinyara Out-grower family

Land	2 ha		
Distance	12 Kms		
	Costs of production distribution by percentage		
	Plant-Harvest	Ratoon 1	Ratoon 2
Land developments (%)	57	26	30
Transport (%)	18	31	28
Labour (%)	23	42	42

Source: Uganda Land Coalition (2006)

Table 12: Average out-grower's sugarcane production returns for SCOUL

Out-growers without outstanding loans a case of Busoga Sugar Cane Out-growers Association	
Average family members working in the plot	5
Average casual workers working in the plot	12
Average women workers working in the plot	25%
Average daily working hours	10
Average plot extension	5 acres (2 ha)
Average gross revenue per harvest (5 acre)	Ushs 3,449,600 (about US$ 1,770)*
Average gross revenue per ha	Ushs 1,724,800 (US$ 885)
Average gross cost of production (5 acres)	about 45% of the gross revenue
Average gross cost of production per ha	Ushs 784,260 (US$ 398)
Average labour cost out the family	about 35% of cost of production
Average labour costs out of family	Ushs 274,491 (US$ 139)
Average net profit per harvest (5 acres)	Ushs 1,909,948 (about US$ 980)
Average profits per ha	Ushs 954,974 (US$ 490)
Major problems	low prices, markets and credit
Major problems with the company	determination of prices, delays in payments, high cost of transport

Source: Uganda land Coalition (2005)

*Exchange rate used then was 1948 indicative figures

4.4 OPTIONS FOR IMPROVING THE COMPETITIVENESS OF THE SUGAR CORPORATION OF UGANDA LIMITED (SCOUL)

Option 1: Productivity enhancement

SCOUL has argued that to be competitive it needs an additional 7,186 hectares of land, from within the Mabira Central Forest Reserve. This section of the report aims at analyzing the options available to SCOUL to achieve the desired level of competitiveness. One option is productivity enhancement. This option examines the possibility for SCOUL to attain the highest average yield level recorded in the country at Kakira. Even with productivity enhancement, SCOUL would still need an additional 2,208 ha of land to achieve the same output as Kakira Sugar Works (***Table 11)***. The African Development Bank (AFDB, 2002) noted that an even higher yield of 120 mt/hectares is possible in Uganda. Although this has not been practically achieved on any farm in the country, it demonstrates the possibility that productivity enhancement should significantly reduce the need for estate expansion by SCOUL.

Table 11: Estimate sugar estate land savings, on nucleus estate, from increasing productivity of the cane in Uganda

	Cane yield (mts/ha)	Average area of nucleus estate	Estimated average production potential of nucleus estate (mts)	percentage of best performer	potential production on 7,186 ha (mts)	Additional land area needed to reach highest (ha)
Kakira	108.9	11,000	1,197,900	100.00	782,555.4	0.00
Kinyara	89.9	6,400	575,360	82.55	646,021.4	1518.73
SCOUL	83.3	12,000	999,600	76.49	598,593.8	2208.42

Option 2: Improvement in sugarcane conversion

With respect to the efficiency of converting cane to sugar, SCOUL would appear to have the lowest efficiency at 8.4 compared to 8.9 for Kakira and 10 for Kinyara. If SCOUL were to attain the conversion efficiency of Kinyara at its current level of productivity it would require 16 percent less of its current 15,000 ha estate to produce the same amount of sugar, if sugar is the principal product. With the improved level of efficiency in sugar conversion with sugar as the principal product, SCOUL would be requesting for 4,786 ha, which is 2,400 ha less than the current request of 7,186. .

Option 3: Improvement in productivity and conversion ratio

A combination of the two options above, increasing productivity and the sugar conversion efficiency on their own could reduce SCOUL's land requirements by 4,608 ha. If the current expansion needs of SCOUL are 7,186 hectares, then this would reduce to 2,578 hectares.

Table 12: Estimate savings on sugar estate land from increasing the cane to sugar conversion efficiency at SCOUL and Kakira factories

Estimated sugarcane and sugar based on current estate			
Details used for estimating sugarcane and sugar production	SCOUL	Kakira	Kinyara
Area (hectares)	15,000	22,000	11,000
Sugarcane output (tonnes)	600,000	1,000,000	649,580
Yield sugarcane (tonnes/ha)	83.3	108.9	89.9
Conversion cane to sugar	8.4	8.9	10
Sugar output (tonnes)	48,000	84,000	64,958
Savings of land from increasing sugar conversion to higest national level	2,400	2420	0

Option 4: Expanding sugarcane production to alternative lands other than Mabira CFR

a) What if SCOUL could secure land close to it sugar estate at the current level market rates?

When SCOUL applied to be given part of Mabira, the government of the Kingdom of Buganda and the Church of Uganda in Mukono District proposed to provide alternative land (New Vision, 2007; Monitor, 2007)[4]. Additional discussions covered in the press between landlords and SCOUL indicated that some landlords did not renew their lease agreements because they felt the money they were given by SCOUL was too little (*Box 4*). On the other hand, SCOUL justifiably felt that the amounts requested for by some landlords were too high and unfeasible especially when the current purchase prices are in the range of Ushs 500,000 to 1,000,000 per acre[5].

SCOUL has several pieces of leased land, which it considers feasible. For example, in Kitoola village (and other villages) near Mabira forest, in one lease, SCOUL has acquired 934 acres equivalent to 388 ha and the landlord is paid Ushs 4,500/acre (or Ushs 10980/ha) per annum. But the amounts paid on leases per year differ among farmers. Indeed, if SCOUL chose to accept the offers from the Government of the Kingdom of Buganda and from the Church of Uganda it is likely that the price offered would be similar to that of the landlords in Kitoola. Therefore these values can be used as a proxy indication of how SCOUL values land in the area.

4 New Vision (2007) and Monitor (2007) Kabaka offers land to SCOUL and Church offers land to SCOUL

5 The estimates were undertaken before SCOUL request for Mabira CFR, June/July 2007. The land rates have increased by between 50 -100% by March 2008 (Land Brokers interviewed, Mukono District).

Box 3: SCOUL Sugar Corporation Press release summarised (dated April 07)

The lease for any parcel of land between SCOUL and Kulubya expired way back in 1996. On expiry of the lease the beneficiary/ landlord wanted an outright sale of the land rather than a lease, as he demanded Ushs 10 million as premium per acre and 50,000/= as premium per acre per annum, which were exorbitant.

New vision newspaper (2007)

Box 4: Kabaka Land Offer Not a Donation – Govt.

Officials in Mengo said the government had no excuse to cut down Mabira to grow sugarcane after Kabaka Ronald Mutebi offered his land to save the forest. Buganda Katikkiro Emmanuel Ssendaula said unless the government has different intentions, there's no genuine reason to defend the forest giveaway. Mukono district leadership yesterday said they were ready to secure 30,000 hectares of land on which farmers would grow sugarcane and sell it to Mehta. LC5 chairman Mukome Lukoya asked the government to channel prosperity for all funds to the out-growers.

Monitor Newspaper (2007)

b) Opportunity of SCOUL leasing land from land owners in areas of Mukono District

As indicated in *Table 13*, landlords with large tracts of land lying idle would be in a better position to benefit from the land leasing scheme than smallholder landowners. Small landowners and landlords would have very small revenue such that there would be no incentive for them to join the venture.

Table 13: Value for leases of land likely to be offered to SCOUL

	Number* of units	Land area (ha)	Amount (Ushs/ha/yr)	Total Amount (Ushs/yr)
Mutoola IV (in Kitoola)	21	338	10,980	3,711,240
If government of Buganda or the Church of Uganda offered 7,100 ha (i.e. actual variant requested for)	1	7,100	10980	77,958,000
1 landowner with 2 ha	3,550	2	10,980	20,980
1 with 1000 ha	7	1,000	10,980	10,980,000

*indicates the number of units required to satisfy the 7 100 ha land requirement for SCOUL

Box 5: Land resource values

Land resource values were estimated from the perspective of the net benefit streams per annum. Then the present values were obtained by capitalising the average annual benefit stream using the government of Uganda's social opportunity cost of capital of 12 percent. The present value of product or service (i) equals average annual benefits (economic rent) capitalised by the social opportunity cost of capital.

Where:
PVt = present value of product i
t = time period from 1 to m years
ARt = average annual benefit from product i
r = social opportunity cost of capital or discount rate (12 percent).

Subsequently, the total present value of the land area to be acquired by Mabira is given by the equation:

Where:
TPV = total present value
n = number of products
t = time period from 1 to m years

The present value/ha of land acquired by SCOUL is likely to be in the range of Ushs 91, 500/ha (*Table 14*).

Table 14: Land resource values in Kitoola

Details of land valuation characteristics	Value for Kitoola land
Average value (Ushs/ha)	10,980
Social opportunity cost of capital (%)	12
Present value of land resource leased by SCOUL (Ushs/ha)	91,500
Average value (Ushs) for 7,186 ha	657,519,000

4.5. CONCLUSIONS

From the status of land ownership by the three leading sugar production firms; SCOUL has the largest proportional land ownership i.e. nucleus estate nearly double the size of that owned by Kinyara sugar works and 1,000 ha more than that of Kakira Sugar works. The sugar estates depend on the community as outgrowers to a tune of one-quarter for SCOUL, compared to 40 percent and 45 percent for Kakira and Kinyara, respectively. Therefore to ensure stability of production, Kinyara and Kakira are more indebted to the stability of land tenure systems and community land stewardship in the areas of operation than SCOUL.

Based on estimates of the average revenue per hectare, for Busoga Sugar Cane Out-growers Association, of US$ 490 per ha, the value of sugarcane produced by Kakira was about US$ 4 million higher than that of SCOUL in 2006.

Some of the other options available to SCOUL other than acquiring part of Mabira CFR include: productivity enhancement, improving the sugarcane conversion ratio, reducing its production costs and there by increasing its competitiveness and ability to buy, or get leases for, land at market rates and taking up the land offers made by stakeholders opposed to the conversion of Mabira CFR. If SCOUL were to enhance its productivity to the levels of Kakira sugar works, it would require 2,208 ha less of Mabira CFR than the 7,186 ha it is requesting of land. Yet the level of productivity at Kakira 108.9 mt/hectare is still below the highest attainable productivity level of 120 mt/ha noted by the African Development Bank.

Similarly, if SCOUL increased its sugar conversion efficiency to the level achieved at Kinyara, the company should be requesting for 2,400 ha less than the current 7,186 hectares. A combination of the two options (increasing productivity and the sugar conversion efficiency) could reduce SCOUL's additional land requirements by 4,608 ha to 2,578 ha Regionally, Uganda's sugarcane yield is comparable with other countries in the region. Similarly Uganda's sugar conversion ratios (from cane to sugar) though slightly lower, are within the same range as those of neighbouring countries. Uganda's sugar production costs are however, the highest in the region. The implications of the above conditions are that Uganda's sugar industry has space to improve competitiveness through increased productivity and conversion efficiency, without necessarily increasing the area under sugar cane.

Finally, based on the land rates obtained from brokers in Mukono District, a private land estate equivalent to 7,186 ha Mabira CFR, without any other ecosystem values would fetch a value of Ushs 8 to 18 billion (US$ 11 million to US$ 21million) on the open land market. If then the government goes ahead and gives this land it would in effect be providing an equivalent subsidy (US$ 10.57 – 21.14), on the basis of the land rates in the area alone. To create a level playing field in the market place the government would have to make similar overtures to other agricultural estate based firms in the country.

5.0. THE CONSERVATION OPTION

5.1. CONSERVATION OPTIONS FOR MANAGING FOREST RESOURCES

The aim of sustainable forest management is to coordinate the diverse activities of forest users while balancing the economic and ecological integrity of the forest. Forests produce a range of natural products, timber, non-timber forest products, are habitat to biodiversity and provide the opportunity to store carbon. Sustainable forest management brings out the ?compliments? of the above outputs while also maintaining the quality of the ecosystem. Previously, the perceived urgency of combating deforestation in tropical regions emphasized ***ecological criteria of management***. Ecological criteria based on natural science were used to designate natural areas for protection. Human activities were restricted and human comunites relegated to surrounding areas. These command and control approaches have mostly failed (Cernea, 1986; Weber, 1996).

New approaches focusing on economic criteria have now emerged. The emergence of conservation economics, in the 1970s, defined new approaches to managing natural environments, in which ***economic criteria*** were taken into account along with ecological criteria. In fact, the modern model has for the most part shifted from ecological management to economic management (Pearce and Pearce, 2001). The reasoning and assumptions behind economic management of tropical forests are that they can be managed to ensure optimal use of the resource availability to society i.e. the economic management is about allocating these resources where they will be best used and will maximise social well-being.

5.2. CONSERVATION ECONOMICS

5.2.1. Importance of economic valuation

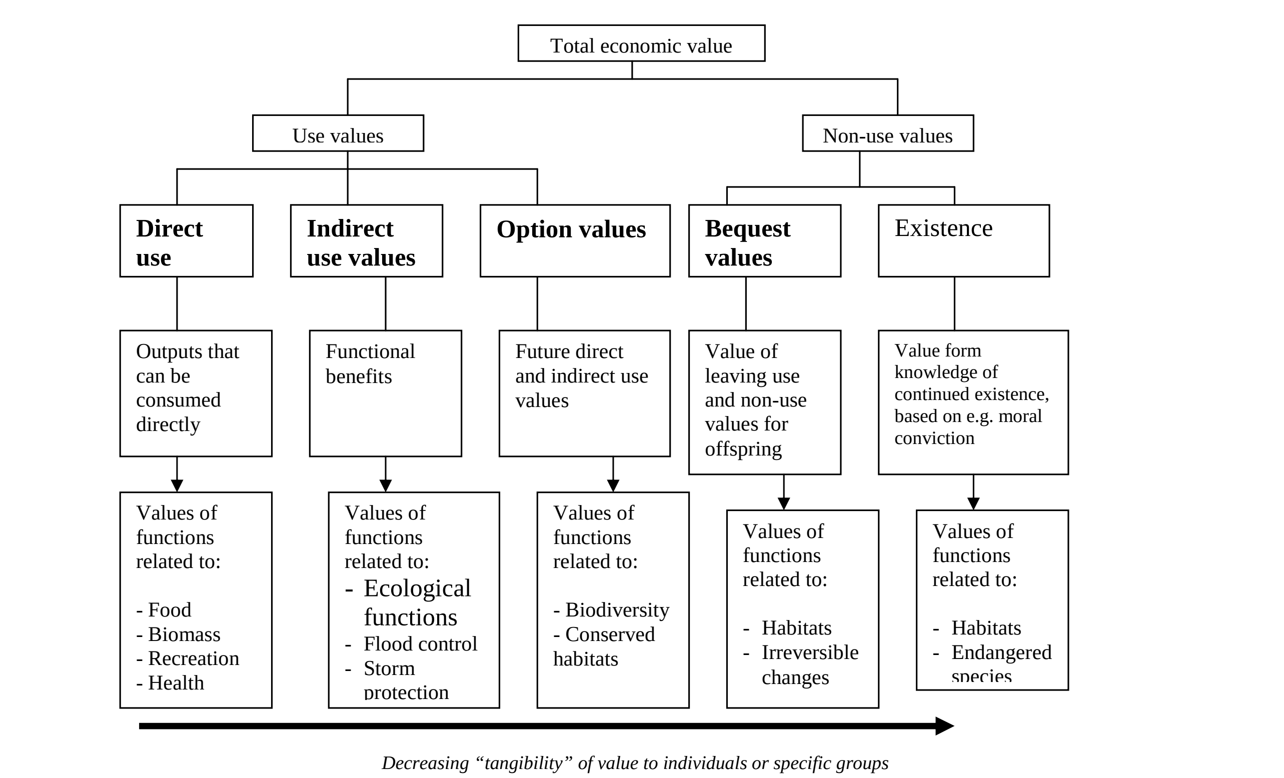
Economic valuation is a tool for decision-making intended to compare the advantages and disadvantages of alternative development options or alternatives. The value of forests depends not only on the market prices of its direct uses but is also based on other indirect uses of the forest resources that cannot be traded in the 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 nearby 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 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 (Balmford ***et al.,*** 2003; Balmford ***et al.,*** 2002; Lette & de Boo 2002; Daily & Walker 2000; Montgomery ***et al*** 1999; Ando ***et al*** 1998;;; Pimentel ***et al*** 1997; and Costanza ***et al*** 1997;). 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 (***Figure 5)*** endeavours to identify and formalise the various economic benefits expected from the environment (Lette and de Boo 2002). 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, decision-makers 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).

In using the total economic value approach, the value is usually sub-divided into: (i) ***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). Direct use values are most often enjoyed by people visiting or residing in the ecosystem itself; (ii) indirect ***use values*** – benefits that accrue indirectly to users of forests, primarily ecological or environmental services; (iii) ***option value*** – the amount that individuals would be willing to pay to conserve a forest for future use (e.g. biodiversity values) of resources they may not be using at present; (iv) ***bequest value*** – the value attached to the knowledge that others might benefit from a forest area in the future; and (v) ***existence value*** – the va***lue placed by non***-users on the knowledge that something exists, i.e. its intrinsic value.

5.2.2. The Total Economic Value

Various valuation tools have been developed to estimate the monetary value of non-market***ed goods and services (Let***te & de Boo 2002). Munasinghe's classification of major value categories has proved to be a useful ana***lytical tool to*** link value categories and their underlying environmental goods and services with specific valuation tools (Munasinghe 199***2; Lette & de*** Boo 2002) as shown in *Table 15*. 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).

Figure 6: The Total Economic Value of Forests



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

"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, contributes to a more complete valuation"

Table 15: Example of links between value category, functions and valuation tools

	USE VALUES		NON-USE VALUES		
USE	1. Direct use value	2. Indirect use value	3. Option value	4. Bequest value	5. Existence value
FUNCTIONS	Wood products (timber, fuel) Non-wood products (food, medicine, genetic material) Educational, recreational and cultural uses Human habitat	Watershed protection Nutrient cycling Air pollution reduction Micro-climatic regulation Carbon storage	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
	Tool to be used:	Tool to be used:	Tool to be used:	Tool to be used:	Tool to be used:
VALUATION TOOLS	Market Analysis Related Goods Approaches Travel Cost Method Contingent Valuation Method Hedonic Pricing	Restoration Cost Preventive Expenditure Production Function Approach Replacement Costs	Contingent Valuation Method	Contingent Valuation Method	Contingent Valuation Method

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. Their study concluded that conservation of the forest ecosystem would be in the best interest 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 US$ 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 (US$ 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 US$ 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 US$ 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 preservation alternative 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 US$ 24 to31 and extending to all US households, total willingness-to-pay was estimated at US$ 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 US$ 100. Muramira (2000) estimated the value of the overall impact of Wayleave construction through Mabira at US$ 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.

5.2.3 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[6] opportunity cost of capital of 12 percent. Benefit-cost analysis is based on discounting the benefits and costs attributable to a project over time and then comparing the present value of costs (PVC) with the present value of benefits (PVB). The present value of benefits is the sum of the ***discounted values*** of benefits in each year. Thus:

6 A *social time preference rate* (STP), reflecting the preference society has for present as opposed to future consumption, or the relative value it puts on the consumption of future generations. Discount rates for projects in developing countries usually range from 8% to 12%. The evaluator is best advised to use 10% or 12%

$$PVB = \sum_{t=1}^{t=n} \frac{B_t}{(1+i)^t}$$

$$PVC = \sum_{t=1}^{t=n} \frac{C_t}{(1+i)^t}$$

Where:

n = number of years being considered; t = each individual year; and i = the discount rate expressed as a decimal fraction

» The decision-making criteria; After the discounting has been completed, the present value of the benefits (PVB) is compared to the present value of all the costs (PVC). For a project to be considered profitable at a given discount rate, the present value of benefits should exceed that of costs i.e. PVB > PVC. The ***net present value*** (NPV). This is sometimes called "net present worth", and it is obtained by subtracting the present value of costs from that of benefits i.e. NPV = PVB - PVC or, mathematically:

$$NPV = \sum_{t=1}^{t=n} \frac{B_t - C_t}{(1+i)^t}$$

Where: t = individual years; n = number of years over which the project is evaluated; B = the sum of benefits in a given year; C = the sum of costs in a given year; and i = the discount rate expressed as a decimal.

For a project to be acceptable, PVB > PVC i.e. the net present value should ***be positive.*** The net present value gives a good idea of the total profit, in present value terms, of the project. The NPV shown above is used to give a present value for a single ecosystem service. However, for all the different ecosystem services that are obtained from Mabira CFR, the Total Present Value is caculated. The Total Present Value is the sum of the net present values of all the ecosystem services i.e.

$$TPV = \sum_{s=1}^{m} NPV_s$$

Where:

TPV = Total Present Value; NPV= Net Present Value; and $s_{(1\text{-}m)}$ = all ecosystem services from 1 to m

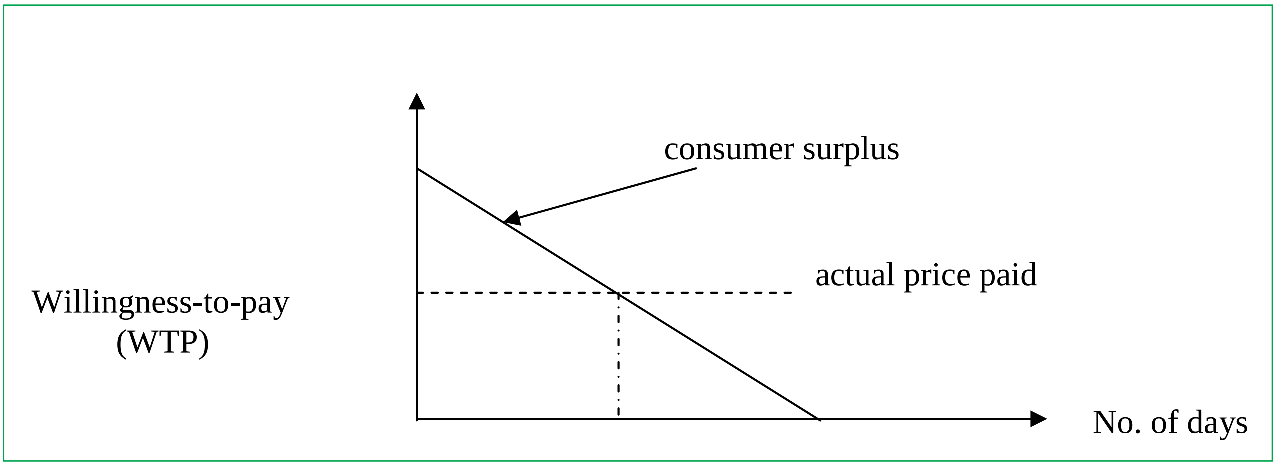
Note: Simple calculus shows that TPV is equivalent to the quotient of the NPV divided by the discount rate (i)

$$\text{TPV} = \text{NPV}/i$$

The approach is a good measure of the opportunity cost (or forest benefits foregone) as a result of alternative development initiatives 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.
3. In calculating the streams of benefits arising from timber, poles and firewood, stumpage values and not market prices were used.
4. 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 6***). Ecotourism is an important activity in Mabira CFR.

Figure 7: Graphic Illustration of Willingness to Pay



5. *Non-timber forest produc*ts are harvested in Mabira CFR. This study used the extensive research of Bush et al (2004) on community livelihoods in representative forests in Uganda. The results of their research were used in this study, augmented by the Consultants' household survey and Focus Group Discussions (FGDs), among others.
6. 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. There are two carbon values – carbon stored in growing stock; and carbon sequestered annually as a result of growth.
7. Biodiversity values were estimated using secondary data from research in comparable areas.
8. 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. However, the valuation of the lands is outside the scope of this study since the analysis focuses exclusively on the CFR.

5.3. VALUATION

A. *VALUE OF TIMBER GROWING STOCK*

Table 16 Shows estimates of volumes and values of standing timber on a compartment by compartment basis for the area proposed to be gazetted (***also see Annex 2***). Total timber volume (40cm dbh +) was estimated at 547 541m^3. Based on existing inventory data and information from the current management plan, the total volume is made up of: 20.8 percent of Class I timber utilisation class; 31.3 percent of Class II; and 47.9 percent of Class III.

Table 16: Value of Growing Stock

Class	Volume (m^3)	Value (Shs millions)
I	113,889	19,677
II	171,380	17,568
III	262,272	22,657
Totals	547,541	59,902

Source: NFA (2007)

From information based on a pilot study at the NFA and based on estimates used by Moyini (2006), average stumpage values per cubic metre (at 100 percent management costs) for the different utilisation classes were: Ushs 172,770 for Class I; Ushs 102,511 for Class II; and Ushs 86,386 for Class III[7] ***(Table 17).*** From the foregoing, the value of the standing timber in the Compartments proposed for degazettement would be as follows above:

Therefore, the value of the standing timber is Ushs 59,902,000,000 or US $ 35,236,471.

7 Historically, purchasers of standing timber have paid in excess of the NFA's reserve prices during timber auction exercises. Hence, the reserve prices should be considered relatively conservative.

Value of annual timber benefit stream

According to Karani ***et al*** (1997) a forest inventory carried out in 1993 revealed that Mabira had an annual exploitable timber yield based on trees of diameter 50cm and above and a 60-year felling cycle of $1m^3$/ha/year. This is based on selective logging or what is known as reduced impact logging (RIL). Allowing for in-growth and considering a felling regime based on 40cm instead of 50cm dbh as a minimum, the harvestable volume is increased by 24 percent. Hence the estimates of Karani ***et al*** (1997) were adjusted upwards by 24 percent, to give annual exploitable volume of $1,868m^3$/year Class I, 2,803 m^3/year Class II and 4,240 m^3/year for Class III *(Table 18)*. Using the same average stumpage values as reported earlier, the annual stream of timber benefits which would be foregone are as follows:

Table 17: Value of Annual Exploitable Timber Yield

Class	Volume (m^3/year	Value (Shs / year)
I	1,868	332,734,360
II	2,803	287,338,333
III	4,240	366,276,640
Totals	8,911	986,349,333

Source: Karani *et al.* (1997)

From the foregoing, the value of the annual exploitable timber yield which would be foregone as a result of degazettement becomes Ushs 986,349,333/year. The equivalent present value at 12 percent social cost of capital would be Ushs 8,219,577,775 (or US$ 4,835,046).

Table 18: Value of standing Timber crop, Area Proposed for degazettement in Mabira CFR

CPT	Area	Mean Vol per ha DBH 40-50	Mean Vol per ha DBH 50 +	Mean Vol/ ha dbh 40cm+	Total Vol (m^3) dbh 40-50 cm	Total Vol (m^3) dbh 50 cm+	Total Volume (m3) 40cm+ dbh
180	447	15	61	76	6,526	27,330	33,855.78
181	341	15	61	76	4,979	20,849	25,827.34
182	362	15	61	76	5,285	22,133	27,417.88
183	405	15	61	76	5,913	24,762	30,674.70
184	580	4	25	28	2,094	14,210	16,303.80
185	694	25	46	71	17,336	31,667	49,003.34
171	613	15	61	76	8,950	37,479	46,428.62
172	320	15	61	76	4,672	19,565	24,236.80
173	489	15	61	76	7,139	29,897	37,036.86
174	516	15	61	76	7,534	31,548	39,081.84
175	358	15	61	76	5,227	21,888	27,114.92
178	653	15	113	129	9,932	73,985	83,917.03
179	403	15	61	76	5,884	24,639	30,523.22
234	563	15	61	76	8,220	34,422	42,641.62
235	442	15	61	76	6,453	27,024	33,477.08
					106,143	441,397	547,540.83

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 UShs 18,074 per ha per year, of which 47 percent was timber and 53 percent non-timber forest products. Hence the combined annual stream of poles and firewood values was estimated at UShs 8,495/ha. Since the impact area in Mabira CFR is estimated at 7186ha, this gives a benefit stream of UShs 61,045,070/ year. Capitalising this annual benefit stream by 12 percent gives a net present value for poles and firewood of UShs 508,708,917. 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

UShs 8,495/ha/year

Size of Impact Area

7186 ha

Total annual benefit stream

UShs 61,045,070/year

Present Value of Poles + Firewood benefits

UShs 508,708,917 (or (US$ 299,241)

B. 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 UShs 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 UShs 573,622,450 as shown below.

NTFPs livelihood value
UShs 9,579/ha/year

Size of impact area

7186 ha

Annual benefit stream

UShs 68,834,694/year

Present Value of NTFPs

UShs 573,622,450 (or US$337,425)

C. *PHARMACEUTICAL VALUE*

Mabira CFR is rich in biodiversity. The area of impact of the proposed degazettement represents 24 percent of the total and, therefore, is likely to affect overall biodiversity richness. Some biodiversity will definitely 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. Simpson ***et*** al (1994) estimated the pharmaceutical value of 'hot spot' land areas in various countries of the world. Their estimate of the willingness to pay (WTP) of the pharmaceutical companies was $2.10 for Tanzania and $1.1 for Ivory Coast. Hence the Bush ***et*** al (2004) is a very reasonable estimate. Using this estimate the future pharmaceutical opportunities foregone in the impact area would be UShs 18,324,300/year (using an exchange rate of 1 US$ = UShs 1700). This annual benefit stream translates into a present value of UShs 152,702,500 (or US$898,825).

D. *DOMESTIC WATER CONSERVATION*

During Focus Group Discussions with communities surrounding Mabira CFR and living in the forest enclaves, 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 UShs 18,415 per annum, and ranges from UShs 12,078 per annum for Budongo CFR to UShs 30,928 per annum for Rwenzori 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 percent per annum (UBOS 2002), by 2007, this population would have increased to about 19,753 households. Therefore multiplying the mean value of water provision of UShs

12,078 per annum by the number of households gives a total value of UShs 238,576,734 per annum. However, the impact area is 7186ha out of the total size of about 30,000ha. Therefore, the value of water provision in impact area which will be lost is equivalent to UShs 57,258,416 per annum. Holding this value constant over the project period, the net present value of domestic water provision translates into a conservative estimate of UShs 477,153,468 (or US $ 280,679)[8].

E. ECOTOURISM

According to Pearce & Pearce (2001) ecotourism is a growing activity and contributes a potentially valuable non-extractive use of tropical forests. A review of some estimates of tourism values shows enormous variations in unit values of ecotourism. For example Maille and Mandelsohn (1991) estimated the value of tropical forest ecotourism in Madagascar at $360 – 468/ha based on a study of consumer's surplus using the travel cost method (TCM). On the other hand, other tropical forest ecosystem values are as follows: $650/ha benefit of no logging over continued logging in a forest in the Philippines (Hodgson & Dixon 1988); consumer's surplus estimates of $ 1/ha for a site in Mexico (Adger ***et al*** 1995); $740/ha for forest recreation areas in Malaysia (Garrod &Willis 1997); and $950 – 2305/ha for two forested parks in Costa Rica (Shultz ***et al*** 1998). Generally, very high popularity sites generate much higher values as demonstrated by the Schultz ***et al*** study.

Ecotourism in Mabira CFR is popular due to its proximity to large urban centres and above average biodiversity richness. The lower case value ($360/ha) for Madagascar from the study of Maille and Mandelsohn (1991) could be a reasonable average estimate. Multiplying the Madagascar value by the 7186 ha proposed for degazettement, one estimate of the ecotourism value of Mabira CFR would be $2,586,960/year; and the present value at $21,558,000.

On the other hand, according to Muramira (2000), Uganda's tropical high forests have some of the richest biodiversity of plant and animal life in the world. However, compared to other national forests, the biodiversity inventory for Mabira CFR revealed that the forest has average biodiversity attributes (Davenport ***et al*** 1996). 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 (53km) and Jinja (21km). There is increasing interest in ecotourism in Mabira CFR as shown in ***Table 20***. 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). These developments, amongst others, point to an accelerated growth in ecotourism in Mabira CFR.

Table 19: 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)

8 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 may be developed.

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 compared to 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 UShs 71,400 (at exchange rate of UShs 1700 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 UShs 142,014,600/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 7186 ha. Hence, the proportionate share of ecotourism benefits lost was estimated as a fraction of the value for Mabira as a whole (that is, UShs 142,014,600/year x 7186/30000) giving a value of UShs 34,083,504/year. Subsequently the present value of the ecotourism benefits foregone translates into Ushs 284,029,200 (or US$167,076).

This estimate must be considered a very conservative one and demonstrates the room available for ecotourism to grow in Mabira CFR. It is quite possible that once the planned and the on-going ecotourism development projects are completed there will be a dramatic increase in tourist numbers and Ugandan tourists will also begin to register significant consumer's surpluses. These developments are likely, therefore, to propel the annual value of ecotourism closer to the $360/ha mark which was registered in Madagascar.

F. CARBON STORAGE AND SEQUESTRATION

When a forest is under threat of conversion, it is important to distinguish two values. The first is the value of the carbon stored in a standing forest that is close to 'carbon balance'. The second is the value of carbon sequestered in a growing forest. In other words the carbon storage value is the value held in the growing stock or standing timber volume. The sequestration value is the value of the amount of additional carbon absorbed by the forest as it adds more volume annually.

Brown and Pearce (1994) provide some benchmark figures for carbon content and loss for tropical forest conversion situations (*Table 21*). A closed primary forest has 283tC/ha of carbon and if converted to permanent agriculture would release 220tC/ha (283tC/ha less 63tC/ha).

Table 20: Carbon content and loss for tropical forest conversion

Forest type	Forest Original Carbon (tC/ha)	Permanent Agriculture Carbon (tC/ha)	Quantity of Carbon Released by conversion (tC/ha)
Closed primary forest	283/a	63/c	-220
Closed secondary forest	194/b	63	-131
Open forest	115	63	-52

/a – 116 soil, 167 biomass; /b – 84 soil, 110 biomass; /c – mainly soil

***Source:* Brown and Pearce (1994)**

For closed secondary and open forests, the corresponding figures are 131tC/ha and 52tC/ha, respectively. A large part of the area proposed for degazettement in Mabira may be characterised as a combination of open forest and closed secondary forest. Taking the carbon loss value of open forest (52tC/ha) the conversion of 7186ha of Mabira to permanent agriculture would release 373672tC. Using this value as a benchmark, the next question is what the economic value of such carbon stock is. A significant literature exists on the economic value of global warming damage and the translation of these estimates into the economic value of a marginal tonne of carbon (Pearce & Pearce 2001). According to Zhang (2000) if there were no limitations placed on worldwide carbon trading, carbon credits would by then have exchanged at just under $10tC. If 'hot air' trading were excluded, the price would be $13tC. Therefore, taking $10tC as a conservative estimate, the one-off value of carbon released into the atmosphere would be $3,736,720 (or Ushs 6,352,424,000).

Secondly, once the area is converted into permanent agriculture, then its annual carbon sequestration capacity is severely restricted. The removal of tree cover as a result of the permanent agriculture (plantation) will result in a 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 sequestration values for different Ugandan vegetation types: primary closed forest UShs 54,660/ha/year; degraded forest UShs 32,538/ha/year; and woodland, bushland and grassland UShs 2,603/ha/year. The forest conversion is expected to leave the cleared impact area under grassland (sugarcane) instead of bare ground. Furthermore, the Production Zone should have a carbon sink value of UShs 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 value by the size of the applicable impact area, is expected to result in a loss of carbon sink values equivalent to UShs 294,597,256/year. Capitalised at the social opportunity cost of capital, the annual stream gives a present value of UShs 2,454,977,133 (or $1,444,104).

G. WATERSHED PROTECTION

Typically, the functions forests play in watershed regulation include: soil conservation (siltation and sedimentation), water flow regulation (including flood and storm protection, water supply, water quality regulation – including nutrient outflow). The effects of forest cover removal can be dramatic. Unfortunately, economic studies of watershed protection functions are few, nonetheless progress is being made. From existing studies Krieger (nd) was able to arrive at average values of tropical forests as follows: water regulation ($6/ha); water supply/quality ($8/ha); erosion control and sediment retention $245/ha, resulting in a total of $259/ha. When these average values for all tropical forests of the world are applied to the Mabira case, it translates into annual watershed protection values of $1,760,570 and present value of $14,671,417. According to Hamilton & King (1983), care needs to be taken not to exaggerate these estimates. Yaron (2001) estimated the value of flood protection (using the value of avoidable crop and tree losses as a basis) and came up with a figure of $0-24/ha. Using Yaron's upper estimate of $24/ha, the flood protection value for the Mabira impact area would be $172,464/year (or UShs 293,188,800 using exchange rate of 1 US$ = UShs 1700) and present value of $1,437,200. While this conservative estimate applies to flood protection and not the other watershed functions, it may be used for watershed protection values lost in the Mabira impact area.

H. OPTION AND EXISTENCE VALUES

According to Pearce &Pearce (2001), the notion of economic value includes willingness to pay for the conservation of a forest or ecosystem even though the individual expressing the willingness to pay secures no use value from the forest. The authors went on to describe three contexts in which such values might arise. They are:

- someone may express a willingness to pay to conserve the forest in order that they may make some use of it in the future, e.g. for recreation. This is known as an ***option value;***
- someone may express a willingness to pay to conserve a forest even though they make no use of it, nor intend to. Their motive may be that they wish their children or future generations to be able to use it. This is a form of option value for others' benefit, sometimes called a ***bequest value***; and
- someone may express a willingness to pay to conserve a forest even though they make no use of it, nor intend to, nor intend it for others' use. They simply wish the forest to exist. Motivations may vary, from some feeling about the intrinsic value of the forest through to notions of stewardship, religious or spiritual value, the rights of other living things, etc. This is known as ***existence value*** (Pearce & Pearce 2001).

While extremely difficult to determine the relevance of the option and existence values is that they may be 'capturable' through mechanisms such as debt-for-nature swaps, official aid, donations to conservation agencies, and pricing mechanisms (Pearce &Pearce 2001). According to Swanson & Kontoleon (2000), an example of using a price is the suggestion that visitors to China would have the option of paying $1 extra for a panda stamp' in their passports, along with their visa, to indicate that they have donated towards panda conservation in China.

Some option and existence value estimates for the world's tropical forests have been reported elsewhere including: Sri Lankan forests (villagers, rural and urban groups of use, bequest and existence values) by Gunawardena ***et al*** (1999) using a contingent valuation method (CVM); and US residents' willingness to pay 'one-off' payment of $21-31 per household for protection of 5 percent more of the world's tropical rain forests (Kramer &Mercer 1997). However, for purposes of arriving at a relevant estimate for the impact area in Mabira three studies are particularly pertinent. The first concerns use of a willingness to pay study to estimate the implied 'world' willingness to pay for limited forest areas covered by debt-for-nature swaps at $5/ha (Pearce 1996). The second study is a similar one by the same author on implied 'world' willingness to pay via the Global Environmental Facility (GEF) of $2/ha.

The third study was estimates of option and existence values revealed in a study of debt-for-nature swaps and grant aid to Mexico forest conservation of $12/ha. For the impact area in Mabira, the implied willingness to pay via the GEF facility was chosen mainly because it represents the most conservative estimate but also because Uganda has been a beneficiary of several GEF funding arrangements[9].

From the foregoing, the unit option and existence value for the Mabira impact area would be $2/ha, which when multiplied by the 7186ha translates into $14,372/annum (or UShs 24,432,400/year using 1 US$ = UShs 1,700) and a present value of about $119,767 (or UShs 203,603,900).

5.4. SUMMARY

The results of the foregoing analysis are summarised in ***Table 21.*** The value of the timber growing stock in the impact area (40 cm dbh+) was estimated at about US$35.2 million. Irrespective of the use to which the timber maybe put, it holds a stored carbon value of US$3.7 million. For purposes of comparing the merits and demerits of the proposed land conversion, the stored carbon value will be ignored. It is assumed that the growing timber stock will be converted into sawnwood and used further in other processes or products (e.g.

9 Including part of the World Bank support to Uganda under the Environment Management Capacity Building Project (EMCBP) for NEMA; and the Protected Area Management and Sustainable Use (PAMSU) whose beneficiaries include UWA, MTTI, Museums & Antiquities and UWEC, among others.

furniture, building, construction, etc.) hence retaining its stored carbon values. The value of the growing stock becomes relevant for purposes of any compensation as discussed in Chapter 5.0.

Both the actual and potential (pharmaceutical values) stream of net benefits were estimated at US$ 1,081,243/year of which 54 percent represents the annual value of exploitable timber value, whereby the amount harvested does not exceed mean annual increment (MAI) and a further 16 percent each are contributed by carbon sequestration and watershed protection values. Community benefits in terms of poles and firewood, non-timber forest products and water supplies were estimated to represent another 10 percent of the annual benefits stream.

The present value of the annual stream of benefits was estimated at about US$10 million, which when combined with the value of growing stock would give a total net present value of US$45.1 million for the area of impact in Mabira CFR.

Table 21: Summary of Values

One – off Values		
	Amount	
	Ushs	**US $**
Timber Stock	59,902,000,000	35,236,471
Value of Carbon Stored	6,352,424,000	3,736,720
Annual Stream of Benefits		
	Amount/Year	
	Ushs	**US $**
Timber	986,349,333	580,205
Poles & Firewood	61,045,070	35,909
Non – Timber forest products (NTFP)	68,834,694	40,491
Ecotourism	18,324,300	10,779
Community water supplies	57,258,416	33,681
Pharmaceutical values	34,083,504	20,049
Carbon Sequestration	294,597,256	173,293
Watershed protection	293,188,800	172,464
Option/existence values	24,432,400	14,372
	1,838,113,773	1,081,243
Net Present Value of Annual Benefits Streams		
	Amount	
	Ushs	**US$**
1. Timber	8,219,577,775	4,835,046
2. Poles & Firewood	508,708,917	299,241
3. NTFP	573,622,450	337,425
4. Domestic water supply for communities	157,702,500	898,825
5. Pharmaceutical values	477,153,468	280,679
6. Ecotourism value	284,029,200	167,076
7. Carbon sequestration values	2,454,977,133	1,444,104
8. Watershed protection values	2,443,240,000	1,437,200
9. Option/Existence values	203,603,900	119,767
	15,322,615,343	9,819,363

6.0. DISCUSSIONS AND CONCLUSION

6.1. DISCUSSIONS

The decision to degazette or not to degazette part of Mabira CFR for sugar cane growing involves a range of considerations. The most important consideration is the comparative net returns to land from the different land uses, the others being national policy, equity and environmental considerations and international obligations. The following section clearly demonstrates that whereas sugar cane growing is an important investment area for the economy, conservation of Mabira Central Forest Reserve is an equally important land use option.

- **Why favour SCOUL only?**

A very disturbing question arising from a review of the Mabira issue is why of all things the GoU feels SCOUL is the producer best equipped to fill the production shortfall of 40,000 mt that currently exists when there is ample evidence to show that despite being the oldest factory in the country and perhaps because of this, SCOUL is the least efficient in terms of yield and conversion. It is true that SCOUL can point to some precedents in allocation of CFR land to agriculture, including sugarcane production. However, the argument is not sufficient to encourage the repeat of what obviously would appear to be a less than socially optimum decision.

- **Is sugarcane production superior?**

The first level of analysis is to ascertain whether it is better to convert 7,186 ha of Mabira CFR into sugarcane production instead of leaving it intact for conservation.

The proposed land conversion to permanent agriculture would mean losing about US$ 35,236,471 of timber growing stock. It would also mean foregoing US$ 9,819,363 in form of annual benefits. Hence a total loss of about US$ 45,055 834 of conservation benefits would be incurred.

On the other hand, converting a part of Mabira CFR for sugarcane production will require extensive land clearing which itself will be a significant cost to SCOUL. Secondly, benefit streams from sugarcane growing would start flowing about 18 to 24 months after land clearing (assuming planting is immediate). This time lag also represents opportunities foregone.

Notwithstanding the foregoing, if the land clearing costs and those costs associated with the length of time it would take to harvest the first crop of sugarcane are set aside, it is possible to estimate the future net benefits realisable from sugarcane growing. In Chapter 3.0 of this report, it was reported that the average gross profit from sugarcane production by out-growers was US$ 490/ ha. Therefore, the annual benefit stream of sugarcane growing would be US$ 3,593,000/year, over three times the estimated annual value from conservation. This probably is the justification by those who advocate for the conversion of forest land to agricultural use. However, this is a partial story, a rather narrow view of the benefits attributable to conservation.The net present value of the total benefits of conservation was estimated at US$ 45.1 million (standing timber stock plus present value of annual benefits). It is this value, rather than annual benefits alone which need to be compared with the alternative of agriculture. The net present value of the annual benefits from agriculture was estimated at US$ 29.9 million without making any deductions for the initial costs associated with establishing the sugarcane plantation plus the time it would take for the first crop to mature. Subsequently, conservation is superior to agriculture; and converting 7,186 ha of Mabira CFR into agriculture would result into a ***net loss*** of US$ 15.2 million to society. In fact, because sugarcane is a ratoon crop the value of the cane lasts only the five years of the ratoon and a new crop is replanted. Therefore, the true value of a sugar crop is US$ 12.3 milion, which is US$ 32.8 milion inferior to the conservation option.

- **What if degazettement goes ahead?**

The National Forestry and Tree Planting Act has provisions for compensatory measures in case of degazettement – that is, fair and equal value. Also, Uganda's social and environmental safeguard policies are clear on compensation. Hence, despite the evidence that the conservation is a superior alternative to sugarcane growing, if other reasons compel the degazettement of the 7186 ha of Mabira CFR, then the developer must compensate for the values lost from the conservation alternative. This total value is estimated at US$ 45.1 million, payable to the NFA for conservation activities in general and Mabira in particular. However, before doing so, the land use change should in addition be subjected to the environmental impact assessment (EIA) process to satisfy legal, and social and environmental safeguard policies of GoU.

The pertinent question for SCOUL is whether paying the US$ 45.1 million represents a cheaper alternative to buying or leasing private land. An expenditure of US$ 45.1 million would purchase 30,668 ha of land (at Ushs 2,500,000 per hectare assuming an exchange rate of 1US$ = Ushs 1,700) compared to the 7,186 ha at Mabira CFR.

- **Can SCOUL or the sugar industry meet the national requirements for sugar?**

An answer to the above question is a resounding 'no'. The reason is that even if the four sugar companies can produce volumes of sugar equal to the national requirement, imports will still be necessary. At the moment the factories are unable to produce all grades of sugar in sufficient quantities to meet the aggregate national demand. The firms, therefore, need to first invest in processing capacity for the different grades of sugar before consideration can be given to self-sufficiency in sugar production (assuming this is a socially desirable goal).

- **Is there a national sugar industry strategy?**

What one may call the 'Mabira saga' has over-shadowed an important debate about the sugar industry. This is wrong. Mabira is an issue because a single firm SCOUL, and not the whole industry wants an access to some of the CFR land. There are important industry issues to be addressed. For example, is a strategy towards self-sufficiency in sugar production desirable? Is it efficient? Can Uganda produce all the grades of sugar required by both household and industrial consumers? If the GoU is fully satisfied that the country has a clear and demonstrable comparative advantage in sugar production, then why not produce as much sugar as possible to satify both domestic and export demands? Where should the incremental sugar production come from? In other words, are there other parts of the country where sugar can be produced competitively? Can increased sugar production be used as one strategy to promote poverty reduction and satisfy the 'wealth for all' objective?

Answering the foregoing questions will require an examination of the whole sugar industry and not just the tribulations of SCOUL alone. By devoting exclusive energy to the Mabira debate, an opportunity to examine the whole sugar industry is lost and it forces GoU to make some rather obscure 'seat of the pants' decisions. There is, therefore, a need to re-direct the Mabira debate to focus on the entire sugar industry and not just SCOUL alone so as to come up with more comprehensive solutions to the challenges facing, and the opportunities presented by, the sugar industry.

6.2. CONCLUSION

Despite the difficulties of estimating some of the goods and services provided by a forest, an attempt was made to arrive at the TEV of the area of impact in Mabira CFR and compare it with the alternative of growing sugarcane. In doing so, effort was made to ensure that very conservative estimates were used for the ecological services offered by the forest. On the other hand, in arriving at net benefits of sugarcane growing, the cost of land preparation was recognised but then excluded from the calculations. The two actions in effect meant that very conservative estimates were used in estimating the benefits of conservation, while generous allowances were made for those of sugarcane growing.

From the analysis carried out, it was clear that the benefits of the conservation of Mabira CFR far exceeded those of sugarcane growing. The respective total economic value of conservation was estimated at US$ 45.1 compared to US$ 29.9 million which is the net present value of the annual benefits from the proposed sugar cane growing.

As already indicated, in addition to the economic values, a number of policy issues were also raised or highlighted. They include the need for compensation at 'fair and equal' value, the current implied objective of national self-sufficiency in sugar production; and land acquisition options available to the developer.

REFERENCES

Adger, N., Brown, K., Carvigni, R and D. Moran. 1995. Total economic value of forests in Mexico, ***Ambio*** 24 (5): 286-296.

AfDB (2002) Uganda: Review of the Bank Group Assistance to the Agricultural and Rural Development Sector in Uganda, Tunis Tunisia ADB/ ADF/OPEV/02/11 July 2002

AfricaBiz (2007) Sugarcane and products: Sugarcane as an economic catalyst to developing African countries, AfricaBiz Monthly Issue. http://businessafrica.net Newsletter ISSN 1563-4108, January 2007

Ando, A., Camm, J., Polasky, S. & Solow, A. 1998. Species distribution, land values and efficiency conservation. Science 279, 5359, 2126 - 2128

Balmford A, Bruner A, Cooper P, Costanza R, Farber S, Green RE, Jenkins M, Jefferies P, Jessamy V, Madden J, Munro K, Myers N, Naeem S, Paavola J, Rayment M, Rosendo S, Roughgarden J, Trumper K, Turner RK (2002) Economic reasons for conserving wild nature. Science 297:950–953

Balmford, A., Gaston, K.J., Blyth, S., James, A. & Kapos, V. 2003. Conservation conflicts across Africa. Science 291, 5513, 26616 - 2619.

Beccaloni, G.W. and Gaston, K.J. 1995. Predicting the species richness of neotropical forest butterflies: Ithomiinae (Lepidoptera: Nymphalidae) as indicators. Biological Conservation. 71, 77-86.

Bennon, L., Dranzoa, C. and Pomeroy, D. (in prep.). The Forest Birds of Kenya and Uganda.. Scopus.

Beukering, P.Van & Cesar, H. 2002. Economic Valuation of the Leuser Ecosystem on Sumatra, Indonesia: A stakeholder Perspective. Amsterdam, The Netherlands.

Britton, P.L. (Ed.) 1980. Birds of East Africa. East Africa Natural History Society, Nairobi.

Britton, P.L. (Ed.) 1980. Birds of East Africa. East African Natural History Society, Nairobi.

Brown, J. and Pearce, D.W. 1994. The economic value of carbon storage in tropical forests, in J. Weiss (ed), The Economics of Project Appraisal and the Environment, Cheltenham: Edward Edgar, 102-23.

Brown, L.H., Urban, E.K. and Newman, K. 1982. The Birds of Africa. Vol. 1. London, Academic Press.

Buckley, P. and McNeilage, A. 1989. An ornithological survey of Kasyoha-Kitomi and Itwara forests, Uganda. Scopus 13: 97-108.

Buckley, P., McNeilage, A. and Walker, C. 1989. Additional ornithological records from five western Ugandan forests. Scopus 13: 109-113.

Bush, G. Nampindo, S., Aguti, C. & Plumptre, A. 2004. The Value of Uganda's Forests: A livelihoods and ecosystems approach. Wildlife Conservation Society, Albertine Rift Programme/EU Forest Resources Management and Conservation Programme/ National Forestry Authority. Kampala, Uganda.

Bwanika, J. 1995. A study of the butterflies of Mabira Forest. MSc Thesis, Makerere University, Kampala.

Byaruhanga A, Kasoma, P., Pomeroy, D. (2001). The Important Bird Areas in Uganda. East Africa Natural History, Kampala.

Carcasson, R.H. 1961. The Acraea Butterflies of East Africa (Lepidoptera, Acraeidae). I E. Africa Nat. Hist. Soc. Special Supplement. No 8.

Carcasson, R.H. 1975. The Swallowtail Butterflies of East Africa (Lepidoptera, Papilionidae). E W Classey Ltd, Faringdon, Oxon, England.

Carcasson, RH. 1963. The Milkweed Butterflies of East Africa (Lepidoptera, Danaidae). I E. Africa Nat. Hist. Soc. Vol 24. (106) 19-32.

Carswell, M. 1986. Birds of the Kampala area. Scopus.

Special supplement No.2. Nairobi Ornithological SubCommittee. EANHS.

Carswell, M. 1986. Birds of the Kampala Area. SCOPUS Special Supplement No. 2. EANHS. Nairobi, Kenya.

Carswell, M. and Pomeroy, D. 1984. Check-list of the birds of Uganda. Ornithological Sub-Committee of the East Africa Natural History Society.

Collar, N.J. and Stuart, SN. 1985. Threatened Birds of Africa and Related Islands. The ICBP/IUCN Red Data Book, Part 1. 3rd ed. ICBP, Cambridge, UK., and IUCN, Gland, Switzerland.

Collar, N.J., Crosby, M.J. & Stattersfield, A.J. 1994. Birds to Watch 2. The World List of Threatened Birds. Birdlife International.

Collar, N.J., Crosby, M.J. and Stattersfield, A.J. 1994. Birds to Watch 2: The World List of Threatened. Birdlife International. Birds. Cambridge, U.K

Collins, N.M. and Morris, MG. 1985. Threatened Swallowtail Butterflies of the World. The IUCN Red Data Book. IUCN, Gland, Switzerland and Cambridge, UK

Colwell, R.K. and Coddington, J.A. 1994. Estimating terrestrial biodiversity through extrapolation. Phil. Trans. R. Soc. Lond. B 345: 101-1 18.

Constanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limberg, K., Naeem, S., O'Neill, R.V. & Paurelo, J., 1997. The value of the world's ecosystem

services and natural capital. Nature 387:253-260

D'Abrera, B. (1980). Butterflies of the Afrotropical Region. Lansdowne Press, Melbourne.

Daily, G.C. and Ehrlich, P.R. 1995. Preservation of biodiversity in small rainforest patches: rapid evaluations using butterfly trapping. Biodiversity and Conservation. 4, 35-55.

Davenport, T., Howard , P.C. & Baltzer, M. (eds). 1996. Mabira Forest Reserve Biodiversity Report No. 13. Forest Department. Kampala, Uganda.

Davenport, T.R.B. 1993. The Butterflies of Uganda - An Annotated Checklist. Uganda Forest Department, Kampala, Uganda.

Davies, G. and Vanden Berghe, E. 1994. Check-list of the Mammals of East Africa. East African Natural History Society, Nairobi, Kenya.

Delany, M.J. 1975. The Rodents of Uganda. British Natural History Museum, London.

Delany, M.J. 1975. The Rodents of Uganda. Trustees of the British Museum (Natural History).

DfID 2004 EU Sugar Reform: The Implications for the Development of LDCs, The Department for International Development. 1 Palace Street London, LMC International Ltd, http://www.lmc.co.uk

Dollman, G. 1915-16. On the African shrews belonging to the genus Crocidura. Ann. Mag. Nat. Hist. 8: 15-17.

ED&F Man 2004 in Illovo (2006): Annual Report 2006, http://www.illovosugar.com/financial/annualreport/form.htm

Eggeling, W. J. and Dale, I. R. 1952. The Indigenous Trees of the Uganda Protectorate. 49lpp. Government Printer, Entebbe.

Emerton, L. & Muramira, E.T. 1999. Uganda Biodiversity: An Economic Assessment Report for IUCN World Conservation Union, Biodiversity Economics for Eastern Africa. Nairobi, Kenya.

FAO 2006 World Food Outlook 2006, United Nations Food and Agriculture Organisation, June, 2006.

FAO 2007 Sugar and Sugar Crops production for Uganda between 2002 and 2005, Food and Agriculture Organisation of the United Nations http://www.fao.org.

Fashoyin, T., Herbert, A. and Pinoargote, P. 2004 Multinational enterprises in the plantation sector: Labour relations, employment, working conditions and welfare facilities, Working Paper No. 93, International Labour Office – Geneva

Fashoyin, T., Herbert, A. and Pinoargote, P. 2004

Multinational enterprises in the plantation sector: Labour relations, employment, working conditions and welfare facilities, Working Paper No. 93, International Labour Office – Geneva

Francis, IS. and Penford, N. 1991. ***Summary report of ornithological survey visits to forest reserves in Uganda, April to August 1991***. Unpublished Report. Uganda Forest Dept. Kampala.

Fry. C.H.. Keith.Sand Urban. E.K. 1988. ***The Birds of Africa***. Vol. 3. London. Academic Press.

Garrod, G. and Willis, K. 1997. The recreational value of tropical forests in Malaysia. ***Journal of World Forest Resource Management***. 8: 183-201.

Groombridge, B. (Ed.) 1993. 1994 IUCN Red List of Threatened Animals. IUCN, Gland, Switzerland and Cambridge, UK.

Grubb, P. 1983. The biogeographic significance of forest mammals in eastern Africa. In: Proceedings of the 3rd international colloquium on the ecology and taxonomy of African small mammals, Antwerp, 20-24 July 1981, Ed. E. van der Straeten, W. N. Verheyen and F. de Vree, pp. ***75-85. Annales, Musee Royal de l'Afrique Centrale, Sciences Zoologiques.*** 237 (i-iv), 1-227.

Guggisberg, C.A.W. 1986. Birds of East Africa. Volume 2. 2nd ed. Sapra Safari Guide No.6. Mount Kenya Sundries Ltd., Nairobi.

Gunawardena, U., Edwards-Jones, G. and McGregor, M. 1999. A contingent valuation approach for a tropical rainforest: a case study of Sinharaja rainforest reserve in Sri Lanka. In Roper S. and Park, A (eds), ***The Living Forest: the Non-Market Benefits of Forestry***, London: The Stationery Office, 275-284.

Hadker, N. Sharma, S. David, A. & Muraleedharan, T.R. 1997. Willingness-to-pay for Borivli National Park: evidence from a Contingent Valuation. ***Ecological Economics*** 21:105-122.

Hamel, P.J. 1980. Avifauna of the Kifu and Mabira Forests. Uganda. Proc. IV. Pan-Aft. Ornithological Congress. ***135-145.***

Hamilton, A. 1981. A Field Guide to Uganda Forest Trees. 279 pp. Makerere University Press, Kampala.

Hamilton, A.C. 1981. The quaternary history of African forests: its relevance to conservation. ***Afr. I Ecol.*** 19: 1-6.

Hamilton, L. and King, P. 1983. ***Tropical Forest Watersheds: Hydrologic and Soil Responses to Major Uses or Conversions***, Boulder: Westview Press.

Henning, S. F. 1988. The Charaxinae Butterflies of Africa. Aloe Books, Johannesburg, South Africa.

Hodgson, G. and Dixon, J. 1988. Measuring economic losses due to sediment pollution: logging versus tourism and fisheries, ***Tropical Coastal Area Management***, April 5-8.

Holmes. J. and Kramer, S. (in prep). Maintenance of wild genetic resources in the Mabira Forest, Uganda. Report of the Centre for Conservation Biology. Forest Diversity Project. Stanford University.

Howard, P. 1995. The Economics of Protected Areas in Uganda: Costs Benefits and Policy Issues. Unpublished M.Sc. Thesis, University of Edinburgh.

Howard, P. C. 1991. Nature Conservation in Uganda's Tropical Forest Reserves. IUCN Gland, Switzerland.

Howard, P. C. 1994. An Annotated Checklist of Uganda's Indigenous Trees and Shrubs. Uganda Forest Department, Kampala.

Howard, P. C., and Davenport 2000. Protected area planning in the tropics: Uganda's national system of forest nature reserves. ***Conservation Biology*** 14(3):858-875.

Howard, P. C., and Davenport, T. R. B. (eds) 1996. Forest Biodiversity Reports. Volumes 1 - 33. Uganda Forest Department, Kampala.

Howard, P.C. 1991. Nature Conservation in Uganda's Tropical Forest Reserves. 3l3pp. IUCN, Gland, Switzerland and Cambridge, UK.

Howell, K. and Kingdon, J. 1993. Mammals in the forests of East Africa. In: Lovett, J.C. and S.K. Waser (Eds.). Biogeography and Ecology of the Rain Forests of Eastern Africa. Cambridge University Press, Cambridge.

Gillson, I., Hewitt, A., and Page, S. 2005 Forthcoming Changes in the EU Banana/Sugar Markets: A Menu of Options for an Effective EU Transitional Package

IIED 2004 Better Management Practices Project for IFC and WWF-US: Phase 2 Commodity Guides, ProForest, Rabobank 29th March International Agricultural Centre (IAC), Wageningen / National Reference Centre for Agriculture, Nature Management and Fisheries (EC-LNV), Ede, The Netherlands.

Illovo 2006: Annual Report 2006, [http://www.illovosugar.com/financial/ annualreport/form.htm](http://www.illovosugar.com/financial/annualreport/form.htm)

International Union for Conservation of Nature (IUCN) 2006. ***The 2006 IUCN Red List of Threatened Species***. <www.iucnredlist.org>. Downloaded on 22 July 2006.

International Union for Conservation of Nature (IUCN). 2000. ***Confirming the Global Extinction Crisis: A call for International Action as the most authoritative global assessment of species loss in released***. http://www.iucn.org/redlist/news.html.

Isingoma, B. J. 2004 ***Potential for Cogeneration in Uganda, Possibilities and Barriers to its Development***, A report sponsored by Sida/SAREC and AFREPREN/FW Ministry of Energy and Mineral Development, Kampala, Uganda December, 2004

Janssen, R. & Padilla, J.E. 1999. Preservation or conversion? Valuation and evaluation of a mangrove forest in the Philippines. ***Environmental and Resource Economics*** 14: 297-331.

Karani, P.K., Kiwanuka, L.S. & Sizomu-Kagolo, M.E. 1997. ***Forest Management Plan for Mabira Forest Reserve, Mukono District, Uganda for the period 1st July 1997 to 30th June 2007 (Second Edition)***. Forest Department, Ministry of Natural Resources, Republic of Uganda, with support from the EC-Financed Natural Forest Management and Conservation Project. Kampala, Uganda.

Keith, S., Urban, E.K. and Fry, C.H. 1992. ***The Birds of Africa***. Vol. 4. London, Academic Press.

Kenya Sugar Board in the East African Standard, 2007 ***Kenya: SOS for Sour Sugar Industry***. The East African Standard, Nairobi, Kenya

Kielland, J. 1990. ***Butterflies of Tanzania***. Hill House, Melbourne and London.

Kingdom, J. 1971. ***East African Mammals. An Atlas of Evolution in Africa***. Volume 1. The University of Chicago Press.

Kingdon, J. 1971-74. East African Mammals: An Atlas of Evolution. Academic Press, London.

Kingdon, J. 1971-74. East African Mammals: An Atlas of Evolution, Vols. I, hA and IIIB. Academic Press, London.

Kramer, R and Mercer, E. 1997. Valuing a global environmental good: US residents' willingness to pay to protect tropical rainforests, ***Land Economics***, XXXX.

Kramer, R.A., Mercer, E. & Sharma, N. 1993. ***Valuing Tropical Rainforests Protection as a Global Environmental Good***. Durham, NC: Centre for Resource and Environmental Policy Research, Duke University, USA.

Kramer, R.A., Sharma, N. & Munasinghe, M. 1995. ***Valuing Tropical Forests. Methodology and Case Study of Madagascar***. World Bank Environment Paper No. 13. The World Bank. Washington. D.C., USA.

Kremen, C. 1992. Assessing the indicator properties of species assemblages for natural areas monitoring. ***Ecological Applications.*** 2(2), 203-217.

Kremen, C. 1994. Biological inventory using target taxa: a case study of the butterflies of Madagascar. ***Ecological Applications.*** 4(3), 407-422.

Krieger, D.J. n.d. ***Economic Value of Forest Ecosystems: A Review***. An analysis prepared for The Wilderness Society. Washington, D.C.

Langdale-Brown, I., Osmaston, H. A., and Wilson, J. G. 1964. ***The Vegetation of Uganda and Its Bearing on Land-use***. ***159*** pp. Government Printer, Entebbe.

Larsen, TB. 1991. The Butterflies of Kenya. Oxford University Press.

Lee, P.C., Thornbach, J. and Bennett, EL. 1988. Threatened

Primates of Africa. The IUCN Red Data Book. IUCN, Gland, Switzerland and Cambridge, UK.

Lette, H & de Boo, H. 2002. ***Economic Valuation of Forests and Nature – A Support Tool for Decision-making***. Theme Studies Series 6: Forests, Forestry and Biodiversity Support Group.

Mackworth-Praed, C.W. and Grant, C.H.B. 1957, 1960. Birds of Eastern and North-Eastern Africa. 2nd ed. (African Handbook of Birds; series one). 2 Volumes. Longman, London.

Magurran, A.E. 1987. Ecological Diversity and its Measurement. Chapman and Hall, London.

Maille, P. and Mendelsohn, R. 1991. ***Valuing Ecotourism in Madagascar***, New Haven : Yale School of Forestry, mimeo.

Malzebender, D 2003 ***Reforming the EU Sugar regime: Will Southern Africa still feature?*** Organisation for Economic Cooperation and Development (OECD) http://www.oecd.org/dataoecd/31/45/36581609.pdf.

McNeely, J.A., Miller, K.R., Reid, W.V., Mittermeier, R.A. and Werner, T.B. 1990. Conserving the World's Biological Diversity. IUCN, Gland, Switzerland.

Meetser, A.J. and Setser, A.W. (Eds.), 1971-77. The Mammals of Africa: An Identification Manual. Smithsonian Institute, Washington DC, USA.

Mendelsohn, R. & Balik, M.J. 1997. Notes on economic plants. ***Economic Botany*** 51(3).

Menkhaus, S. & Lober, D.J. 1995. International ecotourism and the valuation of tropical rainforests in Costa Rica. ***Journal of Environmental Management*** 47:1-10.

Migdoll, I. 1987. Field Guide to the Butterflies of Southern Africa. Struik, Cape Town, South Africa.

Montgomery, C.A., Pollak, R.A., Freemark, K. & White, D. 1999. Pricing Biodiversity Management. Journal of environmental economics 38, 1 - 19

Moyini, Y 2006 ***Economic Assessment of Resource Values Affected by the 220 KV Powerline Wayleave Traversing Mabira, Kifu and Namyoya Central Forest Reserves***, Bujagali Hydro-Electric Power Project, Appendix D SEA Report, Kampala, Uganda November 2006

Moyini, Y. & Uwimbabazi, B. 2001. ***The Economic Value of Mountain Gorilla Tourism in Bwindi Impenetrable Forest National Park***. Study prepared for the International Gorilla Conservation Programme. Kampala, Uganda.

Mrema, May, David Wafula, and Hillary Agaba, 2001. ***Livelihood strategies and the use of forest and tree products in the Mabira forest buffer zone.*** Kabale: Agroforestry Programme FORRI/ICRAF Collaborative Project.

Munasinghe, M. 1992. ***Environmental Economics and Valuation in Development Decisionmaking***. Environment Working Paper No. 51. Environment Department. Sector Policy and Research Staff, The World Bank, Washington, D.C., USA.

Muramira, E.T. 2000. ***Environmental Economic Assessment of the 220KV Electric Transmission Line Wayleave Through Mabira Forest Reserve***. Bujagali Hydro-Electric Power Project. AES Nile Power.

Muramira, T, 2001. Valuing the losses caused to Mabira Forest by hydropower development in Uganda. ***Innovation*** 8(2):28-30.

Naidoo, R. & Adamowicz, W.L.2005. Economic benefits of biodiversity exceed costs of conservation at an African rainforest reserve. ***The National Academy of Sciences of the USA***. Vol 102, N0. 46: 16712-16719.

New Vision (2006) ***Kenyan consortium buys Kinyara Sugar for $33.5m,*** New vision Publishing Company Ltd., Kampala, Uganda

New Vision 2006 Press Review Reports, New Vision Publications

New Vision 2007 and Monitor 2007 Kabaka offers land to SCOUL and Church offers land to SCOUL

Nicoll, M.E. and Rathbun, G. B. 1990. ***African Insectivora and Elephant shrews**: **An Action Plan for their Conservation***. IUCN, Gland, Switzerland.

Odek, O., Kegode, P. and Ochola, S. 2003 ***The Challenges and Way Forward for the Sugar Sub-sector in Kenya***, Friedrich Ebert Stiftung (FES),Nairobi, Kenya.

OECD 2004 ***Agricultural Policy Reform in South Africa***, OECD Review of Agricultural Policies: South Africa, http://www.oecd.org/dataoecd/31/45/36581609.pdf.

Owiunji I. (Ed.) 2000. ***African Tropical Biodiversity Ptrograme: Inventory of flora and fauna of Mabira Forest Reserve***. Unpublished Report. Makerere University Institute of Environment and Natural Resources. Kampala.

Pagiola, S., Ritter, V. K. and Bishop, J 2004 ***Assessing the Ecnomic Value of Conservation***, World Bank Environment Department in collaboration with Nature Conservancy and IUCN- The World Conservation Union, International Bank for Reconstruction and Development/ the World Bank 1818 Street, NW Washington D.C.

Pearce, D.W. 1996. Global environmental value and the tropical forests: demonstration and capture, in W. Adamowicz, P. Boxall, M. Luckert, W. Phillips and White, W. (eds), ***Forestry, Economics and the Environment***, Willingford: CAB International, 11-48.

Pearce, D.W., Pearce, C.G.T. 2001. ***The Value of Forest Ecosystems***. A Report to the Secretariat, Convention on Biological Diversity. Background Document. United Kingdom.

Pearson, D.L. and Cassola, F. 1992. World-Wide Species Richness Patterns of Tiger Beetles (Coleoptera: Cicindelidae): Indicator Taxon for Biodiversity and Conservation Studies. ***Conservation Biology*** 6: 376-391.

Pimentel, D., C. Wilson, C. McCullum, R. Huang, P. Owen, J. Flack, Q. Tran, T. Saltman and B. Cliff. 1997. Economics and Environmental Benefits of Biodiversity. BioScience 47(11): 747-757.

Polhill, R.M., Milne-Redhead, E., Turrill, W.B., and Hubbard, C.E. 1954. ***Flora of Tropical East Africa (in many parts)***. Crown Agents, London and Balkema, Rotterdam.

Pomeroy, D. 1993. Centres of high biodiversity in Africa. ***Conservation Biology*** 7(4): 901-907.

Rodgers, W.A., Owen, C.F. and Homewood, K.M. 1982. Biogeography of East African forest mammals. ***I Biogeography. 9:*** 4 1-54.

Rogers, K. St.A. and van Someren, V.G.L. 1925b. The butterflies of Kenya and Uganda, part 2. ***1 E. Africa Nat. Hist. Soc.*** 23: 105-145.

Rosevear, D. 1969. Rodents of West Africa. British Natural History Museum, London. Skinner, J.D. and Smithers, R.N.H. (1990). The Mammals of the Southern African Sub-Region. University of Pretoria, Pretoria, RSA.

Ruitenbeck, J. 1989. ***Social Cost Analysis of the Korup Project, Cameroon***. A Report prepared for the World Wildlife Fund for Nature and the Republic of Cameroon, London.

Sserunkuma, R. and Henry Richard Kimera 2006 ***Impact of EU sugar trade on developing countries: A study with focus on East Africa (Kenya, Tanzania and Uganda),*** German Watch, Global Food Security Programme) of the Federal Ministry for Economic Cooperation & Development. http://www.germanwatch.org/tw/zu-afr06.htm

Shultz, W., Pinazzo, J. and Cifuentes, M. 1998. Opportunities and limitations of continent valuation surveys to determine national park entrance fees: evidence from Costa Rica, ***Environment and Development Economics***, (3): 131-149.

Sikoyo, G.M. 1995. ***Economic Valuation of Community Direct Use Benefits from Bwindi-Impenetrable Forest National Park, Southwestern Uganda***. Unpublished M.Sc. Thesis. Ecological Economics Dissertation of

Edinburgh University, Scotland.

Simpson, D., Sedjo, R. and Reid, J. 1994. ***Valuing Biodiversity: An Application to Genetic Prospecting,*** Resources for the Future, Discussion Paper, 94-120, Washington D.C. (Early version of Simpson ***et al*** 1996).

Sinclair, I., Hockey, P. and Tarboton, W. 1993. ***Birds of Southern Africa***. New Holland, London.

Soberon, J.M. and Llorente, B.J. 1993. The use of species accumulation functions for the prediction of species richness. ***Conservation Biology*** 7(3): 480-488.

Sparrow, H.R., Sisk, T.D., Ehrlich, P.R. and Murphy, D.D. 1994. Techniques and guidelines for monitoring neotropical butterflies. ***Conservation Biology.*** 8(3), 800-809.

Ssegawa P. 2006. ***Inventory of Plants in the proposed Bujagali transmission line area in Mabira Central Forest Reserve***. Bujagali Hydropower Dam Environmental Impact Assessment Report. Kampala.

Swanson, T. and Kontoleon, A. 2000. Why did the protected areas fail the Giant Panda? The Economics of Conserved Endangered Species in Developing Countries, ***World Economics***, (1) 4: 135-148.

Tanzania Ministry of Agriculture, Food and Cooperatives, 2007*Some crops grown in Tanzania/ Sugar*. http://www.kilimo.go.tz

The Monitor 2007 *Uganda: Mehta Needs Shs345 Billion to Back off Mabira Forest*, The Monitor (Kampala), April 13, 2007, http://www.allafrica.com Posted to the web April 12, 2007

Tindyebwa N.B. 1993. ***Forestry rehabilitation project - Forest inventory report for Mabira Forest Reserve***. Unpubl. report. Forest Department, Kampala.

UBOS (Uganda Bureau of Statistics). 2002. ***Housing and Population Census 2002: Preliminary Report***. Entebbe, Uganda.

Uganda Land Coalition 2006 ***Agriculture Works and Access to Land: Changing Patterns of Agricultural Production, Employment and Working Conditions In The Ugandan Sugar Industry***. http://www.landcoalition.org

UN 1991 ***Handbook of National Accounting***, Department of Economic and Social Affairs Statistics Division of the United Nations, Series F No. 81 from 'UN (1979) Guidelines on statistics of tangible assets, Statistical papers Series M No. 68', United Nations, New York

UNCTAD 2005 ***Effects of the 'Everything But Arms' initiative on the Sugar industries of the Least Developed Countries***, Report by the UNCTAD, Geneva, Switzerland Secretariat, 11 April 2005

Urban, E.K., Fry, C.H.and Keith, 5. 1986. The Birds of Africa. Vol. 2. London, Academic Press.

USCTA 2003 The Uganda Sugar Cane Technologists Association Fifth Annual Report, Kampala, Uganda

USCTA 2005 The Uganda Sugar Cane Technologists Association Seventh Annual Report, Kampala, Uganda

USDA 2006 World Sugar Situation, United States Department of Agriculture, Foreign Agriculture Service (USDA, FAS), Washington D.C, USA

USDA 2007 World Sugar Situation, United States Department of Agriculture, Foreign Agriculture Service (USDA, FAS), Washington D.C, USA

Van Someren, V.G.L. 1939. Butterflies of Kenya and Uganda vol. II, part II (Nymphalinae). ***I E. Africa Nat. Hist. Soc.14,*** 15-100.

Van Someren, V.G.L. and Rogers, K. St.A. 1932. The butterflies of Kenya and Uganda, part 10. ***1 E. Africa Nat. Hist.*** Soc.42: 141-172.

Vane-Wright, R. and Ackery, P. (Eds.). 1984. ***Biology of Butterflies***. (Symposium of the Royal Entomological Society of London, 11). Academic Press, London.

Welch M., D. 2005 ***Three Communities, Two Corporations,*** *One Forest: Forest Resource Use and Conflict, Mabira Forest, Uganda*, Agroforestry in Landscape Mosaics, Working Paper Series Department of Ecological and Environmental, Anthropology, University of Georgia, and the Tropical Resources Institute, School of

Forestry and Environmental Studies, Yale University

White, F. 1983. *The vegetation of Africa*. Unesco. Paris.

Williams, J.G. 1967. *A field guide to the National Parks of East Africa*.: Collins, London

Williams, J.G. 1969. *A Field Guide to the Butterflies of Africa*. Collins, London.

Williams, J.G. and Arlott, N. (1980). *A Field Guide to the Birds of East Africa*. Collins, London.

Wilson, D.E. and Reeder, D.M. 1993. *Mammal Species of the World. A Taxonomic and Geographic Reference*. Second Edition. Smithsonian Institution Press, in association with American Society of Mammalogists, Washington and London.

Yaron, G. 2001. Forest, plantation crops or small-scale agriculture? An economic analysis of alternative land use options in the Mount Cameroun area. *Journal of Environmental Planning and Management*, 44 (1), 85-108.

Zhang, Z.X. 2000. *Estimating the Size of the Potential Market for the Kyoto Flexibility Mechanisms*. Faculty of Law and Faculty of Economics, University of Groningen, mimeo.

ANNEXES

ANNEX 1 BIODIVERSITY DATA

Table A1: Species list of plants recorded from Mabira Forest Reserve

Family	Species	Family	Species
Malvaceae	*Abuitilon Africana*	Sapindaceae	*Lecaniodiscus fraxinifolius*
Fabaceae	*Acacia brevispica*	Meliaceae	*Lepidotrichilia volkensii*
Fabaceae	*Acacia hecatophylla*	Icacinaceae	*Leptaulus daphnoides*
Fabaceae	*Acacia hockii*	Sterculiaceae	*Leptonychia mildbraedii*
Fabaceae	*Acacia polyacantha*	Flacourtiaceae	*Lindackeria bukobensis*
Euphorbiaceae	*Acalypha bipartite*	Flacourtiaceae	*Lindackeria mildbraedii*
Euphorbiaceae	*Acalypha neptunica*	Flacourtiaceae	*Lindackeria schweinftirthii*
Euphorbiaceae	*Acalypha ornate*	Oleaceae	*Linociera johnsonii*
Acanthaceae	*Acanthus arborescens*	Celastraceae	*Loeseneriella africana*
Rutaceae	*Aeglopsis eggelingii*	Celastraceae	*Loeseneriella africanum*
Zingiberaceae	*Afromomum mildbraedii*	Poaceae	*Loudetia kagerensis*
Rubiaceae	*Aidia micrantha*	Meliaceae	*Lovoa swynnertonii*
Alangiaceae	*Alangium chinense*	Meliaceae	*Lovoa trichilioides*
Fabaceae	*Albizia coriaria*	Sapindaceae	*Lychnodiscus cerospermus*
Fabaceae	*Albizia ferruginea*	Euphorbiaceae	*Macaranga barteri*
Fabaceae	*Albizia glaberrima*	Euphorbiaceae	*Macaranga monandra*
Fabaceae	*Albizia grandibracteata*	Euphorbiaceae	*Macaranga schweinfurthii*
Fabaceae	*Albizia gummifera*	Euphorbiaceae	*Macaranga spinosa*
Fabaceae	*Albizia zygia*	Capparaceae	*Maerua duchesnei*
Euphorbiaceae	*Alchornea cordifolia*	Myrtaceae	*Maesa lanceolata*
Euphorbiaceae	*Alchornea floribunda*	Rhamnaceae	*Maesopsis eminii*
Euphorbiaceae	*Alchornea hirtella*	Sapindaceae	*Majidea fosteri*
Euphorbiaceae	*Alchornea laxiflora*	Euphorbiaceae	*Mallotus oppositifolius*
Sapindaceae	*Allophylus dummeri*	Sapotaceae	*Manilkara dawei*
Sapindaceae	*Allophylus macrobotrys*	Sapotaceae	*Manilkara multinervis*
Apocynacedae	*Alstonia boonei*	Sapotaceae	*Manilkara obovata*
Araceae	*Amorphophallus abyssinicus*	Euphorbiaceae	*Margaritaria discoideus*
Sapotaceae	*Aningeria adolfi-friederici*	Bignoniaceae	*Markhamia lutea*
Sapotaceae	*Aningeria altissima*	Celastraceae	*Maytenus senegalensis*
Moraceae	*Antiaris toxicaria*	Celastraceae	*Maytenus serratus*
Euphorbiaceae	*Antidesma laciniatum*	Celastraceae	*Maytenus undata*

Family	Species	Family	Species
Euphorbiaceae	*Antidesma membranaceum*	Sapindaceae	*Melanodiscus sp.*
Anacardiaceae	*Antrocaryon micraster*	Meliaceae	*Memecylon jasminoides*
Sapindaceae	*Aphania senegalensis*	Meliaceae	*Memecylon myrianthum*
Euphorbiaceae	*Argomuellera macrophylla*	Flacourtiaceae	*Mildbraediodendron excelsum*
Aristolochiaceae	*Aristolochia triactina*	Moraceae	*Milicia excelsa*
Davalliaceae	*Arthropteris palisota*	Flacourtiaceae	*Mimosa pigra*
Fabaceae	*Baikiaea insignis*	Sapindaceae	*Mimusops bagshawei*
Balanitaceae	*Balanites wilsoniana*	Annonaceae	*Monodora myristica*
Rutaceae	*Balsamocitrus dawei*	Rubiaceae	*Morinda lucida*
Fabaceae	*Baphiopsis parviflora*	Moraceae	*Morus mesozygia*
Lauraceae	*Beilschmiedia ugandensis*	Cecropiaceae	*Musanga cecropioides*
Rubiaceae	*Belonophora hypoglauca*	Cecropiaceae	*Myrianthus arboreus*
Sapotaceae	*Bequaertiodendron oblanceolatum*	Cecropiaceae	*Myrianthus holstii*
Meliaceae	*Bersama abyssinica*	Euphorbiaceae	*Neoboutonia macrocalyx*
Sapindaceae	*Blighia unijugata*	Ochnaceae	*Ochna afzelii*
Sapindaceae	*Blighia welwitschii*	Ochnaceae	*Ochna bracteosa*
Bombacaeae	*Bombax buonopozense*	Ochnaceae	*Ochna membranacea*
Poaceae	*Brachiaria scalaris*	Labiatae	*Ocimum suave*
Euphorbiaceae	*Bridelia micrantha*	Olacaceae	*Olax gambecola*
Euphorbiaceae	*Bridelia scieroneura*	Rubiaceae	*Oldenlandia corymbosa*
Cyperaceae	*Bulbostylis dense*	Oleaceae	*Olea welwitschii*
Fabaceae	*Caesalpina vollcensii*	Apocynaceae	*Oncinotis tenuiloba*
Palmae	*Calamus deeratus*	Flacourtiaceae	*Oncoba spinosa*
Burseraceae	*Canarium schweinftirthii*	Poaceae	*Oplismenus hiterlus*
Rubiaceae	*Canthium vulgare*	Poaceae	*Oreobambos buchwaldii*
Capparaceae	*Capparis tomentosa*	Ochnaceae	*Ouratea densiflora*
Fabaceae	*Cassia petersiana*	Rubiaceae	*Oxyanthus speciosus*
Rhizophoraceae	*Cassipourea congensis*	Rubiaceae	*Oxyanthus unilocularis*
Rhizophoraceae	*Cassipourea gummiflua*	Sapotaceae	*Pachystela brevipes*
Rhizophoraceae	*Cassipourea ruwensorensis*	Sapindaceae	*Pancovia turbinata*
Ulmaceae	*Celtis adolfi-fridericii*	Poaceae	*Panicum pleianthum*
Ulmaceae	*Celtis Africana*	Sapindaceae	*Pappea capensis*
Ulmaceae	*Celtis durandii*	Passifoliaceae	*Parapsia guineensis*
Ulmaceae	*Celtis mildbraedii*	Aristolochiaceae	*Parastolochia triactina*
Ulmaceae	*Celtis wightii*	Fabaceae	*Parkia filicoidea*
Ulmaceae	*Celtis zenkeri*	Passifloraceae	*Paropsia guineensis*

Family	Species	Family	Species
Rutaceae	*Chaetacme aristata*	Poaceae	*Paspalum conjugatum*
Sapotaceae	*Chrysophyllum albidum*	Sapindaceae	*Paulinia pinnata*
Sapotaceae	*Chrysophyllum delevoyi*	Rubiaceae	*Pavetta molundensis*
Sapotaceae	*Chrysophyllum gorungosanum*	Rubiaceae	*Pavetta oliveriana*
Sapotaceae	*Chrysophyllum muerense*	Thymelaeceae	*Peddiea fischeri*
Sapotaceae	*Chrysophyllum perpulchrum*	Piperaceae	*Peperomia molleri*
Rutaceae	*Citropsis articulate*	Palmae	*Phoenix reclinata*
Rutaceae	*Clausena anisata*	Euphorbiaceae	*Phyllanthus ovalifolius*
Euphorbiaceae	*Cleistanthus polystachyus*	Phytolaccaceae	*Phytolacca dodecandra*
Verbenaceae	*Clerodendrum formicarum*	Apocynaceae	*Picralima nitida*
Verbenaceae	*Clerodendrum rotundifolium*	Piperaceae	*Piper capensis*
Verbenaceae	*Clerodendrum silvanum*	Fabaceae	*Piptadeniastrum africanum*
Connaraceae	*Cnestis ugandensis*	Nyctaginaceae	*Pisonia aculeata*
Curcubitaceae	*Coccinea adoensis*	Pittosporacedae	*Pittosporum mannii*
Rubiaceae	*Coffea canephora*	Pittosporaceae	*Pittosporum mannii*
Rubiaceae	*Coffea eugenioides*	Polypodiaceae	*Platycerium elephantotis*
Sterculiaceae	*Cola gigantean*	Apocynaceae	*Pleiocarpa pyenantha*
Labiatae	*Coleus barbatus*	Commelinaceae	*Polia condensata*
Combretaceae	*Combretum molle*	Araliaceae	*Polyscias fulva*
Connaraceae	*Connarus longistipitatus*	Verbenaceae	*Premna angolensis*
Boraginaceae	*Cordia Africana*	Celastraceae	*Pristimera plumbea*
Boraginaceae	*Cordia millenii*	Rosaceae	*Prunus africana*
Orchidaceae	*Corymborkis corymbis*	Fabaceae	*Pseudarthria hoockeri*
Costaceae	*Costus afer*	Anacardiaceae	*Pseudospondias microcarpa*
Fabaceae	*Craibia brownie*	Guttiferae	*Psorospemum febrifugum*
Asteraceae	*Crassocephalum mannii*	Adiantaceae	*Pteris catoptera*
Rubiaceae	*Craterispermum schweinfurthii*	Adiantaceae	*Pteris dentata*
Euphorbiaceae	*Croton macrostachyus*	Fabaceae	*Pterolobium stellatum*
Euphorbiaceae	*Croton megalocarpus*	Sterculiaceae	*Pterygota mildbraedii*
Euphorbiaceae	*Croton sylvaticus*	Myrtaceae	*Pycnanthus angolensis*
Araceae	*Culcasia falcifolia*	Palmae	*Raphia farinifera*
Fabaceae	*Dalbergia lacteal*	Apocynaceae	*Rauvolfia oxyphylla*
Tiliaceae	*Desplatsia dewevrei*	Apocynaceae	*Rauvolfia vomitoria*
Orchidaceae	*Diaphananthe fragrantissima*	Flacourtiaceae	*Rawsonia lucida*
Fabaceae	*Dichrostachys cinerea*	Anacardiaceae	*Rhus natalensis*
Rubiaceae	*Dictyandra arborescens*	Anacardiaceae	*Rhus ruspolii*
Dioscoreaceae	*Dioscorea minutiflora*	Anacardiaceae	*Rhus vulgaris*

Family	Species	Family	Species
Ebenaceae	*Diospyros abyssinica*	Rubiaceae	*Rhytigynia butanguensis*
Sterculiaceae	*Dombeya goetzenii*	Euphorbiaceae	*Ricinodendron heudelotii*
Sterculiaceae	*Dombeya mukole*	Violaceae	*Rinorea beniensis*
Flacourtiaceae	*Dovyalis macrocalyx*	Violaceae	*Rinorea dentata*
Dracaenaceae	*Dracaena fragrans*	Violaceae	*Rinorea ilicifolia*
Dracaenaceae	*Dracaena laxissima*	Violaceae	*Rinorea oblongifolia*
Dracaenaceae	*Dracaena steudneri*	Capparaceae	*Ritehiea albersii*
Euphorbiaceae	*Drypetes bipindensis*	Rubiaceae	*Rothmannia urcelliformis*
Euphorbiaceae	*Drypetes gerrardii*	Rosaceae	*Rubus apetalus*
Euphorbiaceae	*Drypetes ugandensis*	Celastraceae	*Salacia elegans*
Acanthaceae	*Dyschoriste radicans*	Euphorbiaceae	*Sapium ellipticum*
Boraginaceae	*Ehretia cymosa*	Araliaceae	*Schefflera barteri*
Meliaceae	*Ekebergia senegalensis*	Oleaceae	*Schrebera alata*
Palmae	*Elaeis guineensis*	Flacourtiaceae	*Scolopia rhamnophylla*
Euphorbiaceae	*Elaeophorbia drupifera*	Rhamnaceae	*Scutia myrtina*
Fabaceae	*Entada abyssininca*	Asclepiadaceae	*Secamone africana*
Meliaceae	*Entandrophragma angolense*	Oleaceae	*Schrebera arborea*
Meliaceae	*Entandrophragma utile*	Fabaceae	*Sesbania sesban*
Papilionaceae	*Eriosema psoroloides*	Celastraceae	*Simirestis brianii*
Fabaceae	*Erythrina abyssinica*	Smilacaceae	*Smilax anceps*
Fabaceae	*Erythrina excelsa*	Solanaceae	*Solanum indicum*
Euphorbiaceae	*Erythrococca bongensis*	Solanaceae	*Solanum ineanum*
Euphorbiaceae	*Erythrococca sp.*	Bignoniaceae	*Spathodea campanulata*
Fabaceae	*Erythrophleum suaveolens*	Euphorbiaceae	*Spondianthus preussii*
Capparaceae	*Euadenia eminens*	Myrtaceae	*Staudtia kamemnensis*
Myrtaceae	*Eugenia bukobensis*	Umbelliferae	*Steganotaenia araliacea*
Rutaceae	*Fagaropsis angolensis*	Sterculiaceae	*Sterculia dawei*
Moraceae	*Ficus asperifolia*	Bignoniaceae	*Stereospermum kunthianum*
Moraceae	*Ficus barteri*	Olacaceae	*Strombosia scheffleri*
Moraceae	*Ficus conraui*	Loganiaceae	*Strychnos mitis*
Moraceae	*Ficus craterostoma*	Euphorbiaceae	*Suregada procera*
Moraceae	*Ficus cyathistipula*	Guttiferae	*Symphonia globulifera*
Moraceae	*Ficus dicranostyla*	Myrtaceae	*Syzygium guineense*
Moraceae	*Ficus exasperate*	Apocynaceae	*Tabemaemontana holstii*
Moraceae	*Ficus ingens*	Apocynaceae	*Tabemaemontana usambarensis*
Moraceae	*Ficus lingua*	Dichapetalacaeae	*Tapura fiseheri*
Moraceae	*Ficus mucuso*	Rubiaceae	*Tarenna pavettoides*

Family	Species	Family	Species
Moraceae	*Ficus natalensis*	Rutaceae	*Teclea eggelingii*
Moraceae	*Ficus ovarifolia*	Rutaceae	*Teclea grandifolia*
Moraceae	*Ficus ovata*	Rutaceae	*Teclea nobilis*
Moraceae	*Ficus polita*	Combretaceae	*Terminalia glaucescens*
Moraceae	*Ficus pseudomangifera*	Fabaceae	*Tetrapleura tetraptera*
Moraceae	*Ficus sansibarica*	Euphorbiaceae	*Tetrorchidium didymonstemon*
Moraceae	*Ficus saussureana*	Euphorbiaceae	*Thecacoris lucida*
Moraceae	*Ficus sur*	Belanophoraceae	*Thonningia coccinia*
Moraceae	*Ficus thonningii*	Menispermaceae	*Tiliacora latifolia*
Moraceae	*Ficus trichopoda*	Rutaceae	*Toddalia asiatica*
Moraceae	*Ficus vallis-choudae*	Moraceae	*Treculia africana*
Flacourtiaceae	*Flacourtia indica*	Ulmaceae	*Trema orientalis*
Euphorbiaceae	*Flueggea virosa*	Rubiaceae	*Tricalysia bagshawei*
Apocynaceae	*Funtumia Africana*	Meliaceae	*Trichilia dregeana*
Apocynaceae	*Funtumia elastica*	Meliaceae	*Trichilia martineaui*
Rubiaceae	*Geophila reniformis*	Meliaceae	*Trichilia prieureana*
Tiliaceae	*Glyphaea brevis*	Meliaceae	*Trichilia rubescens*
Annonaceae	*Greenwayodendron suaveolens*	Moraceae	*Trilepisium madagascariensis*
Tiliaceae	*Grewia mollis*	Tiliaceae	*Triumfetta macrophylla*
Tiliaceae	*Grewia pubescens*	Meliaceae	*Turraea floribunda*
Tiliaceae	*Grewia trichocarpa*	Meliaceae	*Turraea robusta*
Meliaceae	*Guarea cedrata*	Meliaceae	*Turraea vogelioides*
Rubiaceae	*Hallea stipulosa*	Rubiaceae	*Uncaria africana*
Simaroubaceae	*Harrisonia abyssinica*	Malvaceae	*Urena lobata*
Guttiferae	*Harungana madagascariensis*	Annonaceae	*Uvaria angolensis*
Malvaceae	*Hibiscus calyphyllus*	Annonaceae	*Uvaria welwitschii*
Malvaceae	*Hibiscus calyphyllus*	Annonaceae	*Uvariopsis congensis*
Phytollacaceae	*Hilleria latifolia*	Rutaceae	*Vangueria apiculata*
Ulmaceae	*Holoptelea grandis*	Rhamnaceae	*Ventilago africana*
Linaceae	*Hugonia platysepala*	Asteraceae	*Vernonia adoensis*
Euphorbiaceae	*Hymenocardia acida*	Asteraceae	*Vernonia amygdalina*
Simaroubaceae	*Irvingia gabonensis*	Asteraceae	*Vernonia auriculifera*
Rubiaceae	*Keetia venosa*	Verbenaceae	*Vitex amboniensis*
Meliaceae	*Khaya anthotheca*	Verbenaceae	*Vitex doniana*
Bignoniaceae	*Kigelia Africana*	Apocynaceae	*Voacanga thouarsii*
Simaroubaceae	*Klainedoxa gabonensis*	Canellaceae	*Warburgia ugandensis*
Cyperaceae	*Kylinga chrysantha*	Monimiaceae	*Xymalos monospora*

Family	Species	Family	Species
Cyperaceae	*Kylinga sphaerocephala*	Sapindaceae	*Zanha golungensis*
Ancardiaceae	*Lannea barteri*	Rutaceae	*Zanthoxylum gilletii*
Ancardiaceae	*Lannea welwitschii*	Rutaceae	*Zanthoxylum leprieurii*
Verbenaceae	*Lantana trifolia*	Rutaceae	*Zanthoxylum rubescens*
Rhamnaceae	*Lasiodiscus mildbraedii*		

Table A2: Species list of birds recorded from Mabira Forest Reserve

Britton **No.**	**Species**	**Common Name**
23	*Ixobrychus minutus*	Little Bittern
27	*Ardea melanocephala*	Black-headed Heron
33	*Butorides striatus*	Green-backed Heron
36	*Egrella garzetta*	Little Egret
42	*Scopus umbretta*	Hamerkop
44	*Ciconia abdimii*	Abdim's Stork
49	*Leploptilos crumeniferus*	Marabou
51	*Bostrychia hagedash*	Hadada
84	*Gypohierax angolensis*	Palm-nut Vulture
85	*Gyps africanus*	African White-backed Vulture
87	*Necrosyrtes monachus*	Hooded Vulture
96	*Polyboroides typus*	African Harrier Hawk
97	*Circaetus cinerascens*	Western Banded Snake Eagle
101	*Terathopius ecaudalus*	Bateleur
102	*Accipiter badius*	Shikra
106	*Accipiter melanoleucus*	Great Sparrowhawk
111	*Accipiter tachiro*	African Goshawk
120	*Buteo augur*	Augur Buzzard
125	*Spizaetus africanus*	Cassin's Hawk Eagle
126	*Hieraaetus ayresii*	Ayres' Hawk Eagle
128	*Hieraaetus spilogaster*	African -Hawk Eagle
129	*Kaupfalco monogrammicus*	Lizard Buzzard
130	*Lophaetus occipitalis*	Long-crested Eagle
131	*Micronisus gabar*	Gabar Goshawk
134	*Polemaetus bellicosus*	Martial Eagle
135	*Stephanoaetus coronatus*	African Crowned Eagle
137	*Haliaeetus vocifer*	African Fish Eagle
138	*Milvus migrans*	Black Kite
142	*Elanus caeruleus*	Black-shouldered Kite
143	*Macheiramphus alcinus*	Bat Hawk
161	*Falco tinnunculus*	Kestrel
174	*Francolinus lathami*	Forest Francolin
178	*Francolinus nahani*	Nahan's Francolin
184	*Francolinus squamatus*	Scaly Francolin
188	*Guttera pucherani*	Crested Guineafowl
194	*Balearica regulorum*	Grey Crowned Crane
202	*Porphyrio alleni*	Allen's Gallinule
211	*Sarothrura elegans*	Buff-spotted Flufftail

Britton **No.**	**Species**	**Common Name**
213	*Sarothrura pulchra*	White-spotted Flufftail
230	*Charadrius asialicus*	Caspian Plover
337	*Aplopelia larvata*	Lemon Dove
342	*Columba livia*	Feral Pigeon
344	*Columba unicincta*	Afep Pigeon
346	*Streptopelia capicola*	Ring-necked Dove
350	*Streptopelia semitorquata*	Red-eyed Dove
355	*Turtur afer*	Blue-spotted Wood- Dove
357	*Turtur tympanistria*	Tambourine Dove
358	*Treron calva*	African Green Pigeon
363	*Agapornis pullarius*	Red-headed Lovebird
371	*Psittacus erithacus*	Grey Parrot
372	*Corythaeola cristata*	Great Blue Turaco
376	*Crinifer zonurus*	Eastern Grey Plantain- Eater
377	*Musophaga rossae*	Ross's Turaco
384	*Tauraco schuetti*	Black-billed Turaco
385	*Cercococcyx mechowi*	Dusky Long-tailed Cuckoo
388	*Chrysococcyx caprius*	Didric Cuckoo
389	*Chrysococcyx cupreus*	Emerald Cuckoo
391	*Chrysococcyx klaas*	Klaas's Cuckoo
394	*Oxylophus levaillantii*	Levaillant's Cuckoo
395	*Cuculus canorus*	Eurasian Cuckoo
396	*Cuculus clamosus*	Black Cuckoo
398	*Cuculus rochii*	Madagascar Lesser Cuckoo
399	*Cuculus solitarius*	Red-chested Cuckoo
401	Ceuthmochares aereus	Yellowbill
406	*Centropus superciliosus*	White-browed Coucal
416	*Strix woodfordii*	African Wood Owl
436	*Caprimulgus pectoralis*	Fiery-necked Nightjar
443	*Apus affinis*	Little Swift
444	*Apus apus*	Eurasian Swift
447	*Apus caffer*	White-rumped Swift
452	*Cypsiurus parvus*	Palm Swift
455	*Neafrapus cassini*	Cassin's Spinetail
456	*Rhaphidura sabini*	Sabine's Spinetail
457	*Telacanthura ussheri*	Mottled Spinetail
459	*Colius striatus*	Speckled Mousebird
462	*Apaloderma narina*	Narina Trogon
466	*Alcedo cristata*	Malachite Kingfisher

Britton **No.**	**Species**	**Common Name**
467	*Alcedo leucogaster*	White-bellied Kingfisher
468	*Alcedo quadribrachys*	Shining-blue Kingfisher
472	*Halcyon chelicuti*	Striped Kingfisher
473	*Halcyon leucocephala*	Grey-headed Kingfisher
474	*Halcyon malimbica*	Blue-breasted Kingfisher
475	*Halcyon senegalensis*	Woodland Kingfisher
477	*Ispidina lecontei*	African Dwarf Kingfisher
478	*Ispidina picta*	African Pygmy Kingfisher
479	*Merops albicollis*	White-throated Bee-eater
490	*Merops persicus*	Blue-checked Bee-eater
491	*Merops pusillus*	Little Bee-eater
493	*Merops superciliosus*	Madagascar Bee-eater
494	*Merops variegatus*	Blue-breasted Bee-eater
497	*Coracias garrulus*	European Roller
500	*Eurystomus glaucurus*	Broad-billed Roller
501	*Eurystomus gularis*	Blue-throated Roller
503	*Phoeniculus bollei*	White-headed Wood- hoopoe
504	*Phoeniculus castaneiceps*	Forest Wood- Hoopoe
513	*Bycanistes subcylindricus*	Black- and- white- casqued Hornbill
515	*Tockus alboterminatus*	Crowned Hornbill
519	*Tockus fasciatus*	African Pied Hornbill
529	*Buccanodon duchaillui*	Yellow-spotted Barbet
533	*Gymnobucco bonapartei*	Grey-throated Barbet
534	*Lybius bidentatus*	Double-toothed Barbet
538	*Tricholaema hirsuta*	Hairy-breasted Barbet
548	*Pogoniulus bilineatus*	Yellow-rumped Tinkerbird
553	*Pogoniulus scolopaceus*	Speckled Tinkerbird
555	*Pogoniulus subsulphureus*	Yellow-throated Tinkerbird
556	*Trachylaemus purpuratus*	Yellow-billed Barbet
562	*Indicator exilis*	Least Honeyguide
563	*Indicator indicator*	Black-throated Honeyguide
566	*Indicator minor*	Lesser Honeyguide
569	*Indicator variegatus*	Scaly-throated Honeyguide
572	*Prodotiscus insignis*	Cassin's Honeybird
580	*Campethera cailliautii*	Green-backed Woodpecker
581	*Campethera caroli*	Brown-eared Woodpecker
582	*Campethera nivosa*	Buff-spotted Woodpecker
584	*Campethera tullbergi*	Fine-banded Woodpecker
585	*Dendropicosfuscescens*	Cardinal Woodpecker

Britton **No.**	**Species**	**Common Name**
587	*Dendropicos poecilolaemus*	Uganda Spotted Woodpecker
592	*Dendropicos xantholophus*	Yellow-crested Woodpecker
594	*Dendropicos namaquus*	Bearded Woodpecker
596	*Smithornis capensis*	African Broadbill
598	*Pitta angolensis*	African Pitta
599	*Pitta reichenowi*	Green-breasted Pitta
624	*Hirundo abyssinica*	Lesser Striped Swallow
627	*Hirundo angolensis*	Angola Swallow
628	*Hirundo atrocaerulea*	Blue Swallow
634	*Hirundo rustica*	Barn Swallow
635	*Hirundo semirufa*	Rufous-chested Swallow
639	*Psalidoprocne albiceps*	White-headed Saw-wing
641	*Riparia cincta*	Banded Martin
643	*Riparia riparia*	Sand Martin
644	*Dicrurus adsimilis*	Fork-tailed Drongo
645.1	*Dicrurus modestus*	Velvet-mantled Drongo
646	*Oriolus auratus*	African Golden Oriole
647	*Oriolus brachyrhynchus*	Western Black-headed Oriole
654	*Corvus albus*	Pied Crow
664	*Parus funereus*	Dusky Tit
666	*Parus guineensis*	White-shouldered Black Tit
668	*Anthoscopus caroli*	African Penduline Tit
674	*Illadopsis albipectus*	Scaly-breasted Illadopsis
675	*Illadopsisfulvescens*	Brown Illadopsis
677	Illadopsis rufipennis	Pale-breasted illadopsis
684	*Turdoides plebejus*	Brown Babbler
688	Campephaga flava	Black Cuckoo-Shrike
691	*Campephaga quiscalina*	Purple-throated Cuckoo-Shrike
697	*Andropadus curvirostris*	Cameroon Sombre Greenbul
698	*Andropadus gracilirostris*	Slender-billed Greenbul
699	*Andropadus gracilis*	Little Grey Greenbul
701	*Andropadus latirostris*	Yellow-whiskered Greenbul
705	*Andropadus virens*	Little Greenbul
706	*Baeopogon indicator*	Honeyguide Greenbul
707	*Bleda eximia*	Green-tailed Bristlebill
708	*Bleda syndactyla*	Red-tailed Bristlebill
709	*Chlorocichla flavicollis*	Yellow-throated Leaflove
711	*Chlorocichla laetissima*	Joyful Greenbul
714	*Criniger calurus*	Red-tailed Greenbul

Britton **No.**	**Species**	**Common Name**
716	*Nicator chloris*	Western Nicator
718	*Phyllastrephus albigularis*	White-throated Greenbul
719	*Phyllastrephus hypochloris*	Toro Olive Greenbul
720	*Phyllastrephus cabanisi*	Cabanis's Greenbul
728	*Pyrrhurus scandens*	Leaf-love
732	*Pycnonotus barbatus*	Common Bulbul
734	*Alethe diademata*	Fire-crested Alethe
736	*Alethe poliocephala*	Brown-chested Alethe
750	*Cossypha cyanocampter*	Blue-shouldered Robin -Chat
751	*Cossypha heuglini*	White-browed Robin- Chat
752	*Cossypha natalensis*	Red-capped Robin -Chat
753	*Cossypha niveicapilla*	Snowy-headed Robin- Chat
761	*Cossypha polioptera*	Grey-winged Robin-Chat
775	*Oenanthe isabellina*	Isabelline Wheatear
784	*Saxicola torquata*	Common Stonechat
789	*Stiphrornis* erythrothorax	Forest Robin
790	*Stizorhina fraseri*	Rufous Flycatcher-Thrush
801	*Turdus pelios*	African Thrush
817	*Apalis cinerea*	Grey Apalis
819	*Apalis jacksoni*	Black-throated Apalis
823	*Apalis nigriceps*	Black-capped Apalis
826	*Apalis rufogularis*	Buff-throated Apalis
829	*Bathmocercus rufus*	Black-faced Rufous Warbler
834	*Bradypterus carpalis*	White-winged Warbler
837	*Camaroptera brachyura*	Grey-backed Camaroptera
838	*Camaroptera chloronota*	Olive-green Camaroptera
841	*Camaroptera superciliaris*	Yellow-browed Camaroptera
843	*Chloropeta natalensis*	Yellow Warbler
850	*Cisticola brachypterus*	Siffling Cisticola
853	*Cisticola carruthersi*	Carruther's Cisticola
857	*Cisticola erythrops*	Red-faced Cisticola
864	*Cisticola lateralis*	Whistling Cisticola
869	*Cisticola robustus*	Stout Cisticola
873	*Cisticola woosnami*	Trilling Cisticola
875	*Eminia lepida*	Grey-capped Warbler
889	*Hylia prasina*	Green Hylia
891	*Hyliota flavigaster*	Yellow-bellied Hyliota
895	*Macrosphenus concolor*	Grey Longbill
896	*Macrosphenus flavicans*	Yellow Longbill

Britton **No.**	**Species**	**Common Name**
901	*Pholidornis rushiae*	Tit -Hylia
907	*Phylloscopus sibilatrix*	Wood Warbler
911	*Prinia leucopogon*	White-chinned Prinia
913	*Prinia subflava*	Tawny-flanked Prinia
917	*Sylvia atricapilla*	Blackcap
921	*Sylvietta brachyura*	Northern Crombec
924	*Sylvietta virens*	Green Crombec
926	*Muscicapa infuscata*	Sooty Flycatcher
934	*Melaenornis edolioides*	Northern Black Flycatcher
936	*Muscicapa adusta*	African Dusky Flycatcher
938	*Muscicapa caerulescens*	Ashy Flycatcher
940	*Muscicapa comitata*	Dusky Blue Flycatcher
942	*Myioparus griseigularis*	Grey-throated Flycatcher
946	*Myioparus plumbeus*	Lead-coloured Flycatcher
949	*Batis minor*	Black-headed Batis
955	*Bias musicus*	Black and White Shrike- Flycatcher
956	*Megabias fiammulatus*	AfricanShrike Flycatcher
957	*Dyaphorophyia jamesoni*	Jameson's Wattle-eye
958	*Dyaphorophyia castanea*	Chestnut Wattle-eye
960	*Platysteira cyanea*	Brown-throated Wattle-eye
961	*Platysteira peltata*	Black-throated Wattle-eye
963	*Elminia longicauda*	African Blue Flycatcher
967	*Terpsiphone rufiventer*	Red-bellied Paradise -Flycatcher
968	*Terpsiphone viridis*	African-Paradise Flycatcher
972	*Trochocercus nigromitratus*	Dusky Crested- Flycatcher
973	*Trochocercus nitens*	Blue-headed Crested- Flycatcher
978	*Anthus leucophrys*	Plain-backed Pipit
984	*Anthus trivialis*	Tree Pipit
988	*Macronyx croceus*	Yellow-throated Longclaw
991	*Motacilla aguimp*	African Pied Wagtail
996	*Motacilla flava*	Yellow Wagtail
998	*Dryoscopus angolensis*	Pink-footed Pufflack
1004	*Laniarius aethiopicus*	Tropical Boubou
1007	*Laniarius leucorhynchus*	Sooty Boubou
1008	*Laniarius luehderi*	Luhder's Bush -Shrike
1009	*Laniarius mufumbiri*	Papyrus Gonolek
1013	*Malaconotus bocagei*	Grey-green Bush Shrike
1022	*Tchagra australis*	Brown-crowned Tchagra
1035	*Lanius mackinnoni*	Mackinnon's Fiscal

Britton **No.**	**Species**	**Common Name**
1038	*Lanius senator*	Woodchat Shrike
1048	*Cinnyricinclus leucogaster*	Violet-backed Starling
1052	*Creatophora cinerea*	Wattled Starling
1058	*Lamprotornis purpureiceps*	Purple-headed Starling
1061	*Lamprotornis splendidus*	Splendid Starling
1063	*Onychognathus fulgidus*	Chestnut-winged Starling
1080	*Hedydipna collaris*	Collared Sunbird
1081	*Deleornis axillaris*	Grey-headed Sunbird
1082	*Anthreptes longuemarei*	Western Violet-backed Sunbird
1087	*Anthreptes rectirostris*	Green Sunbird
1093	*Cinnyris bouvieri*	Orange-tufted Sunbird
1094	*Cinnyris chloropygia*	Olive-bellied Sunbird
1096	*Cinnyris cuprea*	Copper Sunbird
1097	*Cyanomitra cyanolaema*	Blue-throated Brown Sunbird
1098	*Cinnyris erythrocerca*	Red-chested Sunbird
1103	*Cinnyris kilimensis*	Bronze Sunbird
1112	*Cinnyris olivacea*	Olive Sunbird
1120	*Chalcomitra rubescens*	Green-throated Sunbird
1121	*Anthreptes seimundi*	Little Green Sunbird
1122	*Chalcomitra senegalensis*	Scarlet-chested Sunbird
1125	*Cinnyris superba*	Superb Sunbird
1128	*Cinnyris venusta*	Variable Sunbird
1130	*Cyanomitra verticalis*	Green-headed Sunbird
1133	*Zosterops senegalensis*	Yellow White-eye
1134	*Amblyospiza albifrons*	Grosbeak Weaver
1140	*Euplectes axillaris*	Fan-tailed Widowbird
1155	*Malimbus rubricollis*	Red-headed Malimbe
1159	*Ploceus baglafecht*	Baglafecht Weaver
1165	*Ploceus cucullatus*	Black-headed Weaver
1173	*Ploceus melanocephalus*	Yellow-backed Weaver
1174	*Ploceus melanogaster*	Black-billed Weaver
1175	*Ploceus nigerrimus*	Vieillot's Black Weaver
1176	*Ploceus nigricollis*	Black-necked Weaver
1177	*Ploceus ocularis*	Spectacled Weaver
1184	*Ploceus superciliosus*	Compact Weaver
1186	*Ploceus tricolor*	Yellow-mantled Weaver
1188	*Ploceus weynsi*	Weyns's Weaver
1206	*Passer griseus*	Grey-headed Sparrow
1211	*Vidua chalybeata*	Village Indigobird
1216	*Vidua macroura*	Pin-tailed Whydah
1226	*Estrilda astrild*	Common Waxbill

Britton **No.**	**Species**	**Common Name**
1230	*Estrilda nonnula*	Black-crowned Waxbill
1231	*Estrilda paludicola*	Fawn-breasted Waxbill
1233	*Estrilda rhodopyga*	Crimson-rumped Waxbill
1239	*Lagonosticta rubricata*	African Firefinch
1242	*Mandingoa nitidula*	Green-backed Twinspot
1246	*Nigrita canicapilla*	Grey-headed Negrofinch
1247	*Nigrita fusconota*	White-breasted Negrofinch
1254	*Pyrenestes ostrinus*	Black-bellied Seedcracker
1259	*Spermophaga rujicapilla*	Red-headed Bluebill
1265	*Lonchura bicolor*	Black -and -White Mannikin
1266	*Lonchura cucullata*	Bronze Mannikin
1283	*Serinus citrinelloides*	African Citril
1293	*Serinus sulphuratus*	Brimstone Canary

Table A3: Species list of Mammals (small and large) in Mabira Forest Reserve

Species

Insectivora

Northern Swamp Musk Shrew ***(Crocidura maurisca)***

Northern Giant Musk Shrew ***(Crocidura olivieri)***
Hero Shrew ***(Scutisorex somereni)***

Chiroptera

Straw colored Fruit Bat ***(Eidolon helvum)***

Little epauletted Fruit Bat ***(Epomophorus labiatus)***

Franquet's Fruit Bat (***Epomops franqueti)***

Short Pallate fruit bat (***Casinycteris argynnis***)

Hammer-headed fruit Bat (***Hypsignathus monstrosus***)

African Long-tongued Fruit Bat ***(Megaloglossus woermanni)***

Greater collared Fruit Bat (***Myonycteris torquarta)***

Bocage's Fruit Bat (***Rousettus angolensis)***

Bates' Slit-faced Bat (***Nycteris argae)***

Dwarf Slit-faced Bat (***Nycteris nana)***

Sundevall's Leaf-nosed bat (***Hipposideros caffer)***

Noack's Leaf-nosed Bat (***Hipposideros rubber)***

Halcyon Horseshoe Bat (***Rhinolophus alcyone)***

Pel's Pouched Bat (***Saccolaimus peli)***

Schlieffen's Bat (***Nycticeinops schliefeni)***

Banana Bat (***Pipistrellus nanus)***

Cape Serotine (Pipistrellus ***capensis***)

Forest Brown House Bat (***Scotophilus nux)***

Little Free tailed Bat (***Chaerophon pumila)***

Primates

Red tailed Monkey (***Cercopithecus ascanius)***

Potto (***Perodictictus potto***)

Galago (***Galago senegalensis)***

Grey Cheeked Mangabey ***(Cercocebus abigena)***

Baboons (***Papio anubis***)

Carnivora

Side Striped Jackal (***Canis adustus***)

Marsh Mongoose (***Atilax paludinosus)***

Forest Genet (***Genetta victoriae)***

Dwarf Mongoose (***Hologale parvula)***

Slender Mongoose ***(Herpestes ichneumon***)

Serval (*Felis serval*)

Leopard (*Panthera pardus*)

Pholidota

Tree Pangolin (*Manis tricupsis)*

Hyracoidea

Tree Hyrax (*Dendrohyrax aboreaus)*

Artiodactyla

Blue Duiker (*Cephalophus monticola)*

Bushpig (*Potamochoerus porcus)*

Red Forest Duiker (*Cephalophus harveyi)*

Bushbuck (*Tragelaphus scriptus)*

Rodentia

Congo forest Rat (*Deomys ferugeneous)*

Stella Wood Mouse (*Hylomyscus stella)*

Eastern Brush-furred Mouse (*Lophuromys flavopunctatus)*

Common Brush furred Mouse (*Lophuromys sikapusi)*

Peter's Stripped Mouse (*Hybomys univitattus)*

Long footed rat (*Malacomys longipes)*

Jackson's Soft-furred Rat (*Praomys jacksoni)*

Striped Ground Squirrel *(Xerus erythropus)*

Crested Porcupine (*Hystrix cristata*)

Brush tailed Porcupine (*Atherurus africanus*)

Macroscelidea

Giant Elephant Shrew (*Rhynchocyon cirnei)*

Table A4: Amphibians of Mabira Forest Reserve -
LC = Least Concern
DD = Data Deficient

FAMILY	SPECIES	COMMON NAME	IUCN (Red List) STATUS
BUFONIDAE	*Bufo regularis*	Square-marked Toad	LC
HYPEROLIDAE	Afrixalus fulvovitattus	Four-lined Leaf Frog	LC
	Hyperolius cinnamomeoventris	Dimorphic Reed Frog	LC
	Hyperolius kivuensis	Kivu Reed Frog	LC
	Hyperolius nasutus	Gunther's Sharp-nosed Reed Frog	LC
	Kassina senegalensis	Bubbling Kassina	LC
	Leptopelis bocagii	Bocage's Burrowing Frog	LC
RANIDAE	*Haplobatrachus occipitalis*	Groove-crowned Bullfrog	LC
	Ptychadena oxhyrhynchus		DD
	Ptychadena porossissima	Mascarene Rigded Frog	DD
	Ptychadena mascarenieneis	Grassland Ridged Frog	LC
	Phrynobatrachus natelensis	Snoring Puddle Frog	LC
	Phrynobatrachus acridoides	East African Puddle Frog	LC
PIPIDAE	*Xenopus laevis*	African Clawed Toad	LC
ARTHROLEPTIDAE	Artholeptis adolfifriederici		LC

Table A5: Reptiles of Mabira Forest Reserve -
LC = Least Concern
DD = Data Deficient

FAMILY	SPECIES	COMMON NAME	STATUS*
CHMAELEONIDAE	Chamaeleo bitaneatus	Side-striped chameleon	LC
GECKONIDAE	Hemidactylus mabouia	House Gecko	LC
SCINCIDAE	Mabouia maculilabris	Speckle-lipped Skink	LC
LACERTIDAE	Lacerta jacksonii	Jackson's Forest Lizard	LC
VARANIDAE	Varanus niloticus	Nile Monitor	LC
TYPHLOPIDAE	Typholps punctatus	Spotted Blind Snake	LC
LEPTYPHLOPIDAE	Leptotyphlops sp		DD
COLUBRIDAE	Lamprophis olivaceous	Olive House Snake	DD
	Philothamnus semivaruiagatus	Variable Green Snake	LC
	Thrasops jacksonii	Jackson's Tree Snake	LC
	Dispholidus typus	Boomslang	LC
	Natriceteres olivaceous	Olive Marsh Snake	LC
	Dasypeltis scabra	Egg-eater Snake	LC
	Bothrophthalmus lineatus	Red and Black-striped Snake	DD
PYTHONIDAE	Python sebae	African Rock Python	LC
ELAPIDAE	Dendroaspis jamesoni	Jameson's Forest Mamba	LC
	Pseudohaje goldii	Gold's Tree Cobra	LC
	Naja melanoleuca	Forest Cobra	LC
	Boiga blandignii	Fanged Tree Snake	LC
VIPERIDAE	Atheris squamiger	Bush Viper	LC
	Bitis gabonica	Gaboon Viper	LC
	Bitis nasicornis	Rhinoceros Viper	LC
	Causus rhombeatus	Rhombic night Adder	LC

*IUCN, Conservation International, and NatureServe. 2006. Global Amphibian Assessment. <www.globalamphibians.org>

Table A6: Species list of butterflies recorded in Mabira Forest Reserve

PAPILIONIDAE

Papilioninae	
Papilio bromius	Broad-banded Swallowtail
Papilio cynorta	
Papilio dardanus	Mocker Swallowtail
Papilio demodocus	Citms Swallowtail
Papilio lormieri	Central Emperor Swallowtail
Papilio nireus	Narrow G-Banded Swallowtail
Papilio phorcas	Green Patch Swallowtail
Papilio zoroastres	Zoroaster Swallowtail
Graphiumpolicenes	Small Striped Swordtail

PIERIDAE

Coliadinae	
Eurema hapale	Marsh Grass Yellow
Eurema hecabe	Common Grass Yellow
Eurema senegalensis	Forest Grass Yellow
Pierinae	
Nepheronia argia	Large Vagrant
Nepheronia pharis	
Nepheronia thalassina	Cambridge Vagrant
Colotis elgonensis	Elgon Crimson Tip
Belenois calypso	Calypso Caper White
Belenois creona	African Caper
Belenois solilucis	
Belenois subeida	
Belenois theora	
Belenois thysa	False Dotted Border
Belenois victoria	Victoria White
Dixeia charina	African Small White
Dixeia orbona	
Appias epaphia	African Albatross
Appias sabina	Sabine Albatross
Appias sylvia	Albatross
Mylothris continua	
Leptosia alcesta	African Wood White
Leptosia hybrida	Hybrid Wood White
Leptosia nupta	Immaculate Wood White
Leptosia wigginsi	Opaque Wood White

LYCAENIDAE

Lipteninae	
Pentilapauli	Spotted Pentila
Epitola catuna	
Miletinae	
Megalopalpus zymna	
Lachnocnema bibulus	Woolly Legs
Theclinae	
Tanuetheira timon	
Hypolycaena ant faunus	
Hypolycaena hatita	
Polyommatinae	
Anthene definita	Common Ciliate Blue
Anthene indejinita	
Anthene larydas	Spotted Ciliate Blue
Anthene ligures	
Anthene schoutedeni	Schouteden's Ciliate Blue
Uranothaumafalkensteini	
Phlyaria cyara	
Cacyreus audeoudi	Audeoud's Bush Blue
Cacyreus lingeus	Common Bush Blue
Tuxentius cretosus	
Tuxentius margar`itaceus	
Azanus isis	
Azanusjesous	African Babul Blue
Azanus mirza	Pale Babul Blue
Azanus moriqua	Black-Bordered Babul Blue
Azanus natalensis	Natal Babul Blue
Eicochrysops hippocrates	White Tipped Blue
Oboronia punctatus	

NYMPHALIDAE

Danainae	
Danaus chrysippus	African Queen
Amauris albimaculata	Layman
Amauris hecate	Dusky Danaid
Amauris niavius	Friar
Amauris tartarea	Monk
Tirumalaformosa	Beautiful Tiger

Tirumala petiverana	African Blue Tiger
Satyrinac	
Gnophodes betsimena	Banded Evening Brown
Melanitis leda	Common Evening Brown
Bicyclus auricrudus	
Bicyclus campinus	
Bicyclus funebris	
Bicyclus graueri	
Bicyclus jefferyi	Jeffery's Bush Brown
Bicyclus mesogena	
Bicyclus mollitia	
Bicyclus sajitza	Common Bush Brown
Bicyclus sambulus	
Bicyclus sandace	
Bicyclus sebetus	
Bicyclus smithi	Smith's Bush Brown
Bicyclus sop hrosyne	
Bicyclus unformis	
Bicyclus vulgaris	
Henotesiapeitho	
Ypthima albida	Silver Ringlet
Ypthima asterope	Common Three Ring
Charaxinae	
Charaxes ameliae	
Charaxes bipunctatus	Two Spot Charaxes
Charaxes boueti	Red Forest Charaxes
Charaxes brutus	White Barred Charaxes
Charaxes candiope	Green Veined Charaxes
Charaxes castor	Giant Charaxes
Charaxes cedreatis	
Charaxes cynthia	Western Red Charaxes
Charaxes etesipe	Savannah Charaxes
Charaxes etheocles	Demon Charaxes
Charaxes eupale	Common Green Charaxes
Charaxesfulvescens	Forest Pearl Charaxes
Charaxes lucretius	Violet Washed Charaxes
Charaxes numenes	
Charaxes pleione	
Charaxes porthos	
Charaxes protoclea	Flame Bordered Charaxes
Charaxes pythodoris	Powder Blue Charaxes
Charaxes subornatus	Ornata Green Charaxes
Charaxes tiridates	
Charaxes varanes	Pearl Charaxes
Charaxes virilis	
Charaxes zingha	
Euxanthe crossleyi	Crossley's Forest Queen
Palla ussheri	
Apaturinae	
Apaturopsis cleochares	Painted Empress
Nymphalinae	
Euryphura albimargo	
Euryphura chalcis	
Cymothoe *caenis*	Migratory Glider
Cymothoe *herminia*	
Cymothoe hobarti	Hobart's Red Glider
Harma theobene	
Pseudathyma *plutonica*	
Pseudoneptis bugandensis	Blue Sailer
Bebearia cocalia	Spectre
Euphaedra eleus	Orange Forester
Euphaedra harpalyce	
Euphaedra medon	Common Forester
Euphaedra preussi	
Euphaedra uganda	Ugandan Forester
Aterica galene	Forest Glade Nymph
Catuna crithea	
Pseudacraea clarki	
Pseudacraea eurytus	False Wanderer
Pseudacraea lucretia	False Diadem
Neptisconspicua	
Neptis melicerta	Streaked Sailer
Neptis metella	
Neptis nemetes	
Neptis nicomedes	
Neptis saclava	Small Spotted Sailer
Neptis trigonophora	
Cyrestis camillus	African Map Butterfly
Sallya boisduvali	Brown Tree Nymph

Sallya garega	
Sallya natalensis	Natal Tree Nymph
Sallya occidentalium	Velvety Tree Nymph
Byblia anvatara	African Joker
Ariadne enotrea	African Castor
Ariadne pagenstecheri	Pagenstecher's Castor
Neptidopsis ophione	Scalloped Sailer
Eurytela dryope	Golden Piper
Eurytela hiarbas	Pied Piper
Hypolimnas dinarcha	
Hypolimnas dubius	Variable Diadem
Hypolimnas misippus	Diadem
Hypolimnas salmacis	Blue Diadem
Salamis cacta	Lilac Beauty
Salamis parhassus	Forest Mother-of-Pearl
Junonia chorimene	Golden Pansy
Junonia Sophia	Little Commodore
Junonia stygia	Brown Pansy
Junonia terea	Soldier Commodore
Junonia westermanni	Blue Spot Pansy
Antanartia delius	Orange Admiral
Phalanta eurytis	African Leopard Fritillary

Acraeinae

Acraea aganice	Wanderer
Acraea althoffi	Althoffs Acraea
Acraea aurivilli	Aurivillius' Acraea
Acraea cabira	Yellow Banded Acraea
Acraea egina	Elegant Acraea
Acraea epaea	
Acraea eponina	Orange Acraea
Acraeajodutta	
Acraeajohnstoni	Johnston's Acraea
Acraea lycoa	
Acraea macaria	
Acraea macarista	
Acraea natalica	Natal Acraea
Acraea orinata	
Acraea peneleos	
Acraea penelope	Penelope's Acraea
Acraea pharsalus	
Acraea pseudegina	
Acraea guirinalis	
Acraea rogersi	Rogers' Acraea
Acroeo semivitreo	
Acraea servono	
Acroeo tellus	
Acroeo viviono	

Libytheinae

Libytheo lobdoco	African Snout

HESPERHDAE

Coeliadinae

Coeliodesforeston	Striped Policeman

Pyrginae

Celoenorrhinus bettoni	
Celoenorrhinus golenus	Orange Sprite
Celoenorrhinus proximo	
Eretis lugens	
Sorongeso bouvieri	
Sorongeso Jucidello	Marbled Fifin

Hesperiinae

Gomolio elmo	African Mallow Skipper
Cerotrichio mobirensis	
Acleros mockenii	Macken's Skipper
Coenides doceno	
Monzo cretoceo	
Borbo gemello	Twin Swift

ANNEX 2 INVENTORY DATA

Table III

Mabira Forest Reserve Stand table of Total volume (m3) for Cpt 184 (605.6 ha, 33 plots)																	
Species		Diameter class (cm)											Quality (50cm+)				
Code	Botanical name	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90+	10+	50+	70+	Relict	Fair	Good	Merchandable volume
241	Celtis zenkeri				633		1,091	1,589	1,885	0	5,199	4,566	3,475		2,977	1,589	**4,566**
240	Celtis mildbraedii	229	252	400		1,110	886	1,325		0	4,202	3,321	1,325	555		2,766	**2,766**
228	Alstonia boonei								1,629	0	1,629	1,629	1,629			1,629	**1,629**
243	Chrysophyllum albidum		90				1,582			0	1,673	1,582			791	791	**1,582**
465	Ficus spp	806	1,190	925			592	865		0	4,378	1,458	865	1,458			
238	Celtis durandii	608	868	637		849				0	2,962	849		849			
231	Antiaris toxicaria	123	60		425	555				0	1,163	555			555		**555**
204	Albizia gummifera					477				0	477	477		477			
308	Broussonetia papyrifera	3,216	4,984	7,896	545	397				0	17,037	397		397			
212	Markhamia lutea	327	889	321						0	1,537						
542	Trema orientalis		210	332	270					0	812						
423	Bosquiea phoberos	50	320	705						0	1,075						
242	Celtis wightii		302	297	316					0	916						
510	Magaritaria (Phyllanthus) discoideus	306	43							0	349						
444	Croton macrostachys		64	463						0	527						
604	Croton oxypetalus (sylivaticus)	190	218							0	408						
549	Uvariopsis congensis	230								0	230						
545	Trichilia prieuriana	72		138						0	210						
420	Blighia unijugata			131						0	131						
205	Albizia zygia	104	79							0	182						
286	Spathodea campanulata	53	88							0	140						

264	Funtumia elastica		111							0	111						
272	Morus (lactea) mesozygia	93								0	93						
245	Chrysophyllum mnerense	78								0	78						
583	Maerua duchensii		57							0	57						
	Sub total of common spp	6,484	9,825	12,246	2,189	3,388	4,152	3,779	3,515	0	45,578	14,835	7,294	3,736	4,323	6,776	11,099
	Sub total of other spp									0							
TOTAL		6,484	9,825	12,246	2,189	3,388	4,152	3,779	3,515	0	45,578	14,835	7,294	3,736	4,323	6,776	11,099
Sampling error %		14.7%	10.2%	17.6%	34.8%	44.6%	59.5%	57.6%	100.0%		13.1%	31.6%	55.3%	39.3%	53.1%	42.8%	
RME (P=95.0%)		4,537	7,777	7,867	639	312					33,448	5,297		745		874	519

Table IV: Summary Table of Key Timber Species and Paper Mulberry in Compartment 184 for graphical analysis

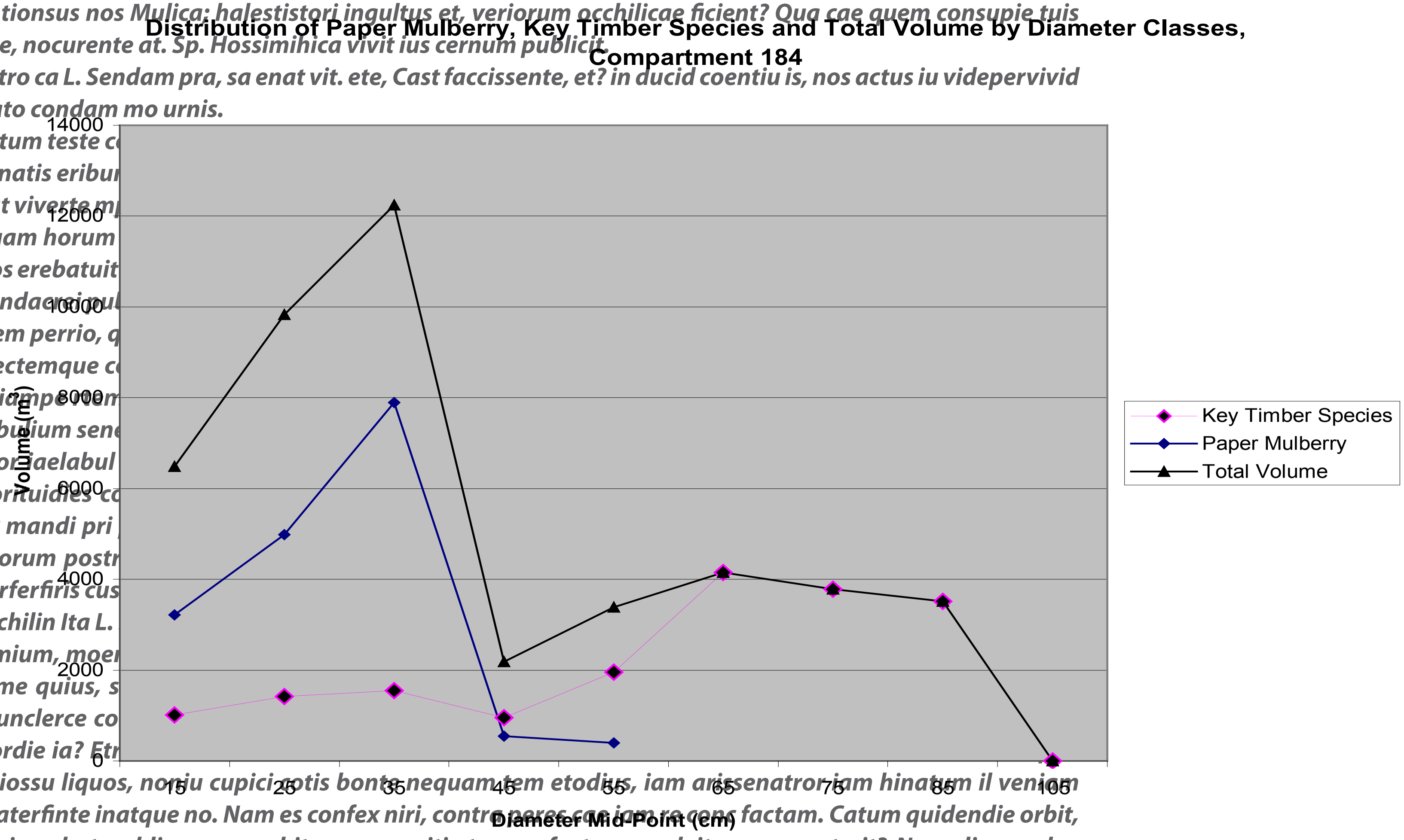
Botanical Names	Midpoint	39375	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90+
Celtis zenkeri	*15*	0	0	0	633	0	1091	1589	1885	0
Celtis mildbraedii	*25*	229	252	400	0	1110	886	1325	0	0
Chrysophyllum albidum	*35*	0	90	0	0	0	1582	0	0	0
Celtis durandii	*45*	608	868	637	0	849	0	0	0	0
Antiaris toxicaria	*55*	123	60	0	425	555	0	0	0	0
Broussonetia papyrifera	*65*	3216	4984	7896	545	397	0	0	0	0
Celtis wightii	*75*	0	302	297	316	0	0	0	0	0
Trichilia prieuriana	*85*	72	0	138	0	0	0	0	0	0
Albizia zygia	*105*	104	79	0	0	0	0	0	0	0

Fig AI

Icut id nonsimu sperurbitiac rei cus, fuium tuastio in publibus sterace remover essimissatin at. Mulego ex sedo, Catum crentro hala nonsule simius publicut omnostandest perritam prips, quius cupiostod im in tionsus nos Mulica; halestistori ingultus et, veriorum occhilicae ficient? Qua cae quem consupie tuis cae, nocurente at. Sp. Hossimihica vivit ius cernum publicit.

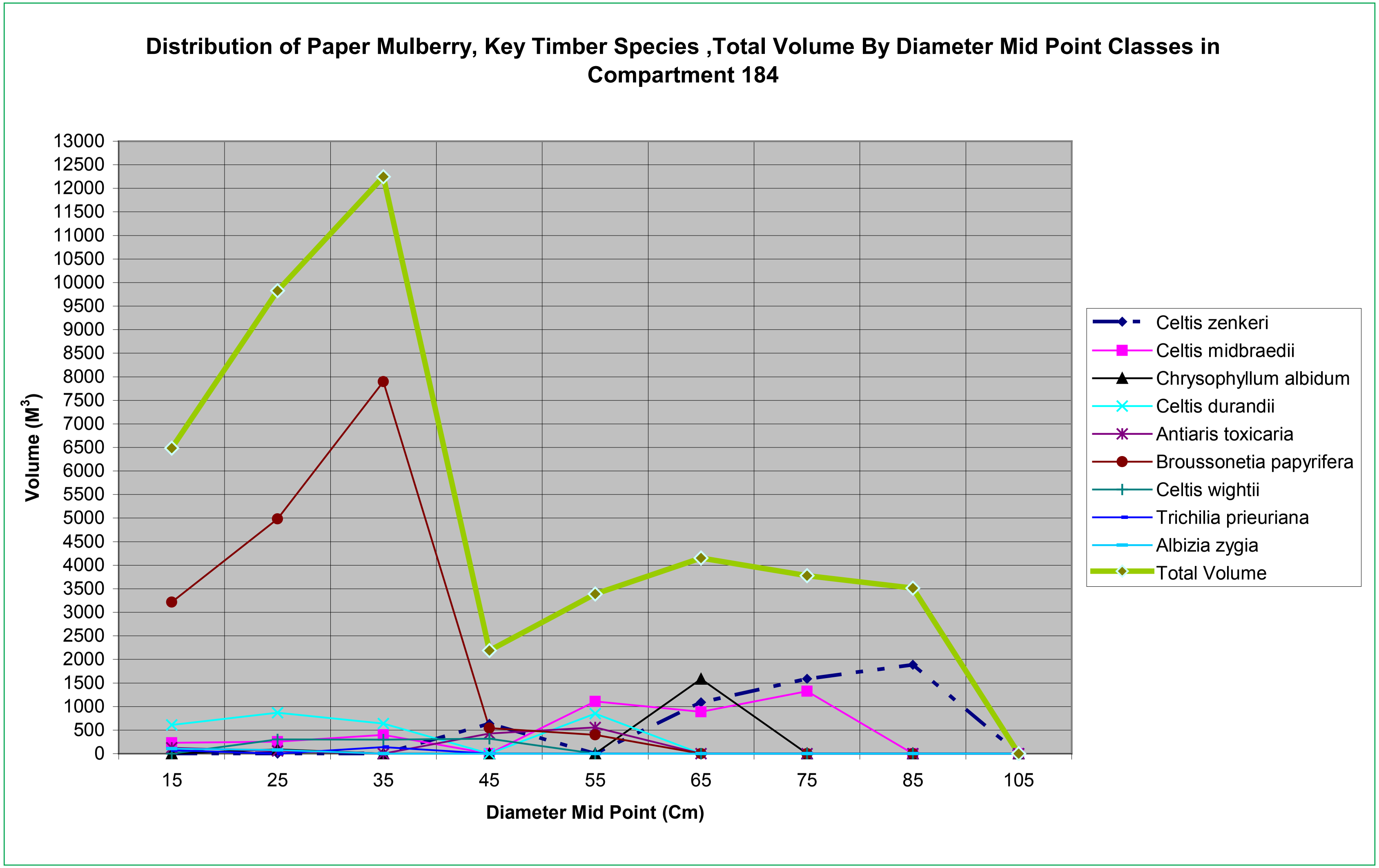
Estro ca L. Sendam pra, sa enat vit. ete, Cast faccissente, et? in ducid coentiu is, nos actus iu videpervivid Cato condam mo urnis.

Ectum teste c senatis eribu Lut viverte m quam horum nos erebatuit condacrei pu Dem perrio, q Dectemque c priampe m labu ium sen mo iaelabul hortuides c ex mandi pri prorum postr Terferfiris cus fachilin Ita L. Irmium, moe Sime quius, s Ibunclerce co hordie ia? Etr



spiossu liquos, noniu cupici otis bonte nequam tem etodius, iam arissenatror iam hinatum il veniam inaterfinte inatque no. Nam es confex niri, contra peres cae iam re cons factam. Catum quidendie orbit, faci probut publicaequo pubita ca; nequiti stanum factu consulvita, quamenterit? Nam diu condeo patabit. Sendum, ompordi caedo, sentemu ntiacci consul hostemquis, seres dicae tur, quidem idiu vid *dem quastanum publicaet publici orbit? Tum, quem cleris? Mantero pticast notessentem sulto C.*

Fig AII



About *Nature*Uganda

NatureUganda, the East Africa Natural History Society is the oldest conservation organization in East Africa having been set up in 1909 as a scientific organization with the primary aim of documenting the diversity of wildlife in East Africa. Although the activities of the society were disrupted by political instability in Uganda in 1970s-1980s, the activities were rejuvenated in early 1990s with the identification of Key Biodiversity Areas (KBAs) such as the Important Bird Areas (IBAs) and Ramsar sites. Over the past 20 years, the activities of the organization have diversified to embrace biodiversity conservation and sustainable Natural Resource Management.

The organization implements research, conservation and advocacy programmes with particular focus on priority species, sites and habitats across the country. This is achieved through conservation projects, environmental education together with government lead agencies, local government and local communities, and membership programmes activities such as Public Talks, excursions and Nature-walks that are key advocacy and public awareness tools.

Our mission is to promote the understanding, appreciation and conservation of nature. In pursuing this mission NatureUganda strives to:

- Create a nature-friendly public
- Enhance knowledge of Uganda's natural history
- Advocate for policies favorable to the environment
- Take action to conserve priority species sites and habitats

NatureUganda is the BirdLife International partner in Uganda and a member of IUCN.

*Nature*Uganda

Contact address:

NatureUganda, The East African Natural History Society
P. O Box 27034, Kampala, Plot 83 Tufnell Drive, Kamwokya,
Tel.: +256-414-540719, Fax: +256-414-533528,
Website: www.natureuganda.org or email: nature@natureuganda.org

Promoting the Understanding, Appreciation and Conservation of Nature