

Valuing the Losses Caused to Mabira Forest by Hydropower Development in Uganda

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As East Africa faces a higher and higher demand for energy, new infrastructure is being set in place all over the region so as to generate this power. In particular, investments in hydroelectricity developments are being implemented in Kenya, Tanzania and Uganda. These are having a number of effects on forests – as well as relying heavily on forest catchment services to safeguard their water supplies and thus energy generation, in many cases hydropower schemes are impacting on forests due to the ways in which they modify or change downstream ecosystems. New environmental legislation in East African countries however now requires that an environmental impact assessment is carried out for these types of developments. Increasingly, environmental economic values are being incorporated into such assessments.

One case where economic valuation techniques were used to gauge the environmental impacts of hydropower development is that of Mabira Forest, in Eastern Uganda. AES Nile Power proposes to build, own and operate a 250 MW hydropower plan on the River Nile. The first phase of development, installing 3 X 50 MW generators, is scheduled to come into service in 2003. To evacuate electricity from the power station, AES Nile Power proposes to construct a number of transmission

lines to connect to the Uganda Electricity Board grid. Among other areas, these transmission lines will involve the clearance through Mabira Forest of a 40 m X 18 km wayleave.

The clearance of part of Mabira Forest for the power transmission line will result in the physical loss of a number of direct and indirect use values, including timber, poles, firewood, wild game, honey, biodiversity and habitat values, carbon sequestration and eco-tourism. A study was carried out to estimate the economic impact of these losses, including the incremental management costs that the Forest Department will have to meet during the 18 month period while they monitor the implementation of the impact mitigation measures.

In total, the economic cost of locating the wayleave through Mabira forest is the sum of the direct loss of standing tree biomass that will be cleared, the disturbance and relocation of ecotourism infrastructure (such as walking trails and cycling tracks), the likely impact on tourist numbers and revenues, the damage costs associated with loss of carbon sequestration functions, loss of biodiversity use values, and the additional management costs associated with the supervision and surveillance of project activities by the Forest Department.

These impacts were



Participants at a roundtable organized by the African Centre for Technology Studies recently. The participants, drawn from several African countries, agreed on the establishment of a process that will mobilize Africa's intellectual and political resources to develop a concrete, dynamic and long-term regional science and technology development strategy and action plan.

Methods for Valuing Mabira Forest Economic Losses

Forest value	Method of calculation
Timber production	Inventory and market analysis
Pole production	Inventory and market analysis
Non-timber forest products (firewood, wild game, honey, etc.)	Secondary information on household usage per annum
Biodiversity values	Secondary information derived from WTP studies in Ghana
Carbon sequestration	Effect on production combined with secondary information carbon sequestration deals
Eco-tourism	Replacement cost of infrastructure
Management costs	Cost of staff time and other inputs using labour market rates
Revision of forest management plan	Actual costs

valued using a number of different techniques.

The valuation study estimated the average standing volume (timber size trees per hectare on a whole tree basis) within the proposed way leave (approximately 72 hectares) to be 211 m³/ha or 15,192 m³ for the total 72 hectare impact area (Table 1). The study further found out that most of the standing stock comprised of Class II timber tree species. Considering that the cost per m³ of Class II timber is U Shs.28,100 per m³ over bark (i.e. with bark on), the total value of standing volume in the impact area is USh 426,895,200 or US\$ 237,000.

The study computed the density of bush pole size trees (30 cm 10 cm dbh) in the impact area to be about 267 trees per hectare. The two hundred and sixty seven trees yielded an estimated 1,932 running metres per hectare implying that the total impact area had up to 139,104 running metres of pole size trees. Considering that a running metre of Class II bush poles costs approximately USh 550, the total value of the pole size standing stock in the impact area was estimated to be USh 76,507,200 or US\$ 43,000.

The time available to this study did not allow a detailed survey of the quantity and prices of firewood, wild game, honey and other non-timber forest products (NTFPs) that surrounding communities obtain from the forest. The study, therefore, used secondary information on community livelihood and dependence on forest resources.

An earlier study of the Bwindi Impenetrable Forest National Park in South Western Uganda estimated that the fuel-wood, honey and other non-timber forest products surrounding communities derive from forests were worth about US\$ 80/hh/yr (i.e. Ushs 120,000) per annum. This figure was adopted to estimate the total community value (associated with 15,631 hh) of Mabira Forest to be about USh 1.876 billion per annum. Considering that the total area of Mabira Forest Reserve is 30,600 ha of forest, the impact of wayleave clearance (72 ha) will be about USh 4,413,459 per annum or US\$ 2,500.

A literature review on the biodiversity value of Mabira Forest indicated that

the forest is not one of the most important biodiversity refugia in Uganda. The forest ranks 24th out of 65 ranked forests and has a score of only 13.1 against other investigated forests in Uganda. Mabira forest, however, is important in terms of the rarity value of its species. The forest supports six (6) rare species of butterflies, one (1) of moths, one (1) of birds and one (1) of trees. The forest is, in fact, the only block of medium altitude moist semi-deciduous forest type D1 (Langdale-Brown et al., 1964) in the protected area system, a vegetation type that does not occur in any of the country's other protected areas (Davenport et al., 1996).

The time available for this study, again did not allow for the empirical valuation of the biodiversity roles of the forest. The study however, benefited from earlier studies of the biodiversity values of forests in Ghana (Peasah, 1994). The Ghana study estimated the biodiversity value of tropical forests in Ghana at US \$5 per hectare per annum. This figure was adopted to estimate the equivalent biodiversity value that will be lost due to the clearance of 72 ha of forest in the impact area to be USh 550,800 per annum or US\$ 300.

The carbon sequestration capacity of tropical evergreen forests like Mabira Forest has been estimated at 144.0 tones of carbon per hectare (tC/ha) for total above ground biomass and 66.0 tones of carbon per hectare for soil and below ground biomass respectively. This means that the clearance of 72 ha of closed forest may extinguish the opportunity to sell 15,120 tC equivalently in protocarbon credits (at US\$20 per tC). This lost opportunity translates into a cost to the economy of approximately US\$300,000 as a one off figure at current proto-carbon credit prices.

Uganda's tropical high forests (THFs) have some of the richest diversity of plant and animal life in the world. In the last ten years, therefore, an increasing number of people world-wide have shown interest in visiting them. This growing willingness is demonstrated by the positive growth in tourist visitor numbers to Mabira Forest.

Discussions with management at the Forest Department and at the Eco-

Economic Value of the Forest Impacts of Wayleave Construction

tourism Centre in Mabira did not indicate potential loss of revenue due to wayleave construction. The discussions, however, pointed out the need to relocate tourist facilities including cycling tracks and foot trails away from the project impact area to minimise the visual impact of the wayleave. The cost of relocating the above facilities estimated to total about US\$ 1,200,000 or US\$ 670, was the only cited monetarizable eco-tourism related damage associated with the location and construction of the proposed wayleave in the tourism section of the Forest Reserve.

Forest value	Number of units affected	Value (US\$)
Timber production	15,192 m ³	237,164
Pole production	139,104 RM	42,504
Non-timber forest products (firewood, wild game, honey, etc.)	15,631 hh	2,452
Biodiversity values	72 ha of tropical evergreen forest	306
Carbon sequestration	15,120 tC	302,400
Eco-tourism	45 kms	667
Management costs	3 staff	4,391
Revision of forest management plan	-	833
TOTAL		590,717

The Forest Department will need to commit three forest staff including a Forest Officer, a Forest Ranger and driver plus a departmental vehicle and accessories to monitor the implementation of the mitigation measures proposed in the project EIS. The cost of staff time in the field was therefore, computed using standard subsistence daily allowances for the three categories of staff effort for a period of 18 months (based on a 22 day/month working schedule). A total of US\$ 7,904,160 or US\$ 4,400, including US\$ 6,526,080 as staff costs and US\$ 1,378,080 as cost of fuel and vehicle maintenance will be the cost associated with assigning personnel time to project related activities.

The total economic value of the overall impact of way leave construction computed by simply adding together the individual values of the impacts of way leave construction on timber and pole production, non-timber forest products, biodiversity, carbon sequestration, eco-tourism and forest management costs – more than half a million US dollars.

The total cost should be the amount of money set aside to address the environmental impacts of wayleave construction through Mabira Forest Reserve. This figure is derived using current prices and market exchange rates in which case an interest rate of 12 percent per annum (to account for the social cost of capital) should be applied to any balance of money not yet disbursed to the Forest Department once the compensation date is due.

