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Development of Forest Valuation Systems Malawi

Technical Report

March 2013

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To obtain copies of this report or any others produced as part of this assignment, please contact the Malawi Department of Forestry. Copies of all products of this project, including the spreadsheet containing the calculations may also be obtained at www.joyhecht.net/MalawiForests.html.

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List of Acronyms

AES	Annual Economic Survey
BEST	Biomass Energy Strategy
DoF	Department of Forestry
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FDMF	Forest Development and Management Fund ("Forest Fund")
FRM	Forest Resources Mapping (Japanese-funded mapping project carried out with Department of Forestry)
FTE	full-time equivalent
GDP	Gross Domestic Product
Ha	hectare
IFMSLP	Improved Forest Management for Sustainable Livelihoods Programme
IHS	Integrated Household Survey
ISIC	International Standard Industrial Classification
Kg	kilogrammes
MAI	Mean annual increment
Mj	Megajoule (= one million joules)
MK	Malawi Kwacha
NDP	Net Domestic Product
NSO	National Statistical Office
NTFP	non-timber forest product
REDD+	Reducing emissions from deforestation and forest degradation (REDD+ goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks)
SEEA	System of Economic and Environmental Accounts
SNA	System of National Accounts
TEV	total economic value
TOR	terms of reference
VFR	visit friends and relatives

1 Introduction

Over the past 20 years, Malawi's forests, like those of many African countries, have declined in area and have been subject to significant degradation. The Malawi Department of Forestry is facing significant challenges in responding to these problems, especially in a context of declining public sector support for forestry and a perception that the sector has little to contribute to the economy or to the wellbeing of the population.

To help the Department of Forestry (DF) respond to these challenges, a team of two consultants has been brought in, under EU Framework Contract Beneficiaries Lot 1, to work with DF on evaluating the role of the forest sector in the Malawian economy. This document is the technical report on that team's work. It provides detailed explanations of how the values estimated through this study have been calculated. It should read in conjunction with use of the spreadsheet that presents the full results of the analysis, which is available from the Department of Forestry. This work was carried out in the context of the European Union (EU) funded Improved Forest Management for Sustainable Livelihoods Programme (IFMSLP), through Cardno Emerging Markets (UK), Ltd.

1.1 Three Measures to be Calculated

The aim of this study is to organize the data and carry out the analysis needed to calculate three different measures of the role of forests in the economy, which are closely related but not the same. The first is the contribution of the forest sector to GDP and NDP. This is probably most important of the three components, because it is the one used by the Government of Malawi in making decisions about importance of different sectors of the economy and the resources allocated to working with those sectors. Published national accounts data give the forest sector a very small share of total economic output. The 2007 accounts, the most recent year for which finalized results are available, estimates the sector's output at 4.797 billion kwacha, less than one percent of GDP. While sector output was projected to rise to 6.579 billion 2007 kwacha by 2010, it still accounts for less than one percent of GDP.[1]

The construction of forest accounts – the portions of the national accounts that address the contribution of this sector to the economy – has been the subject of extensive study. The challenges of correctly including forests in the accounts were brought to light in the 1980s after publication of a seminal study of the Philippine economy, which pointed out that if trees were overharvested, the consequent decreased value of the remaining forests had to be deducted from GDP as depreciation.[2] Subsequent work on environmental accounting drew attention to the need to include the value of non-marketed environmental products, such as gathered fuelwood and non-timber forest products.[3] Refinements of industrial classification systems recognized artisanal charcoal production as an activity of the forest sector, whose value should be quantified in the national accounts. All of these developments suggest changes that may be called for in Malawi's national accounts, which are expected to increase the estimated contribution of the sector to the economy as a whole.

A major portion of this study has therefore focused on developing new estimates of the economic output of Malawi's forests, following standard methods for national accounting and environmental accounting that have been developed through the United Nations Statistics Department.[4] This work has been carried out in close collaboration with the National

[1] Values at http://www.nsomalawi.mw/index.php?option=com_content&view=article&id=150%3Agdp-by-activity-in-2007-constant-prices-in-mk-million&catid=10&Itemid=54; percents calculated from data on that site.
[2] Repetto 1989
[3] Hecht, 2005
[4] The UN Statistics Department is the international body that coordinates development of methods for national income accounting in general, and, through the work of a committee called the London Group, for

Statistics Office (NSO), specifically with those directly responsible for calculating the forest sector's contribution to GDP. NSO is well aware that their current methods are not as complete as they could be, and that the resulting estimates are too low. They are very much interested in opportunities to improve this portion of the national accounts in the future.

A second measure addressed by this study is what is referred to as the total economic value of the forests, or TEV. TEV is a concept in environmental economics first developed by David Pearce, a leading thinker in the field of environmental economics.[5] It refers to the effort to understand the economic role of the environment by summing four broad elements; the direct use of environmental goods and services, indirect use of the environment, option value, and existence value:

- Direct use is the value of products of the environment, whether they are sold in markets or gathered from nature. In Malawi this means timber, fuelwood, charcoal, non-timber forest products, tourism, and perhaps other items.

- Indirect use includes the value of so-called ecosystem services; in Malawi this primarily includes watershed protection.

- Option value is the willingness to pay for possibility of using the resource even if not actually used. For example, e.g. people might be willing to pay for biodiversity conservation because they might find a use for plants that right now they wouldn't know what to do with.

- Existence value is the willingness to pay for environmental resources to exist, even if they will never be used. For example, Europeans might be willing to contribute to conservation of forests that they will never visit.

The methods for calculating TEV are not standardized in the way that forest accounts are. This gives great flexibility in how this part of the work can be done; at the same time it means that the results are less credible than national accounts figures, precisely because they do not have a standard meaning. Like most work on TEV, this study considers direct and indirect uses of the forests, but does not address option or existence values.

The third component of this study focuses on how Malawi's forests contribute to the livelihoods of its citizens. Like TEV, this is not a precisely defined measure. The study has focused on quantifying several key issues:

- how many people (or households) earn a living from forest-related activity;
- how much they earn;
- the value of resources that are gathered in the environment; and
- how many households depend on such resources.

With these three measures at their disposal, and with a thorough understanding of what they mean and how they were calculated, the Department of Forestry will be in a stronger position to argue clearly for the importance of the sector both to the overall economy and to the well-being of many Malawian citizens, particularly many of the poorest citizens in the country. This should help the both the Department and the whole of the forestry sector obtain more support for forest conservation and development, to the benefit of the whole country.

environmental accounting. The manuals for the system of national accounts (SNA) and the System of Economic and Environmental Accounting (SEEA) may be found at their website, the SNA at https://unstats.un.org/unsd/ nationalaccount/pubsDB.asp?pType=2 and the SEEA at https://unstats.un.org/unsd/envaccounting/seea.asp.

[5] See, for example, Pearce and Moran 1994

1.2 Forest Contribution to GDP and TEV: Stocks vs. Flows

The measurement of economic values can take two distinct forms; measuring stocks or measuring flows. A stock is a measure of wealth – it is a measure of the value of the assets within the system of interest, whether it be the wealth of an individual (their savings, the value of their home, and so on); the value of the productive assets of a business (the machinery it uses to manufacture items for sale); or the total value of a country's assets. A flow, in contrast, is the income accruing to that system – a person's salary plus the interest on their assets; the income flowing to the business from the sale of the items it manufactures; the income generated in the economy as a whole.

GDP, and the other entries in the national income accounts, are measures of flows; the accounts track the income of the country rather than its total wealth. The calculation of GDP builds in changes in the country's wealth (that is, depreciation or appreciation in the value of its assets), but does not include the total value of those assets. TEV is less precisely defined than GDP, so it could be understood either as a stock or as a flow value. However it is usually measured in flow terms. In order to make the comparison of TEV and the contribution of forests to GDP clear, this study takes the same approach, measuring the total benefits obtained from Malawi's forests in a single year rather than estimating their value in asset terms.

The decision to value flows rather than stocks, and the choice of the base year (discussed below), means that the study focuses on how forest resources were used, or the services they provided, *in that year*. This is not a cost benefit analysis; there are no assumptions about future policy choices embedded in those values. The study values the goods and services provided by standing forests in 2010, without making any predictions as to how they might be valued in the future, what markets might exist for their products down the road (e.g. for REDD+ or other payments for environmental services schemes), how prices could change in the future, or how the forests might be degraded or improved as a result of future policies or development projects.

1.3 Choice of Base Year

The decision to estimate flows rather than stocks has a variety of consequences for this study. First, the estimates must be made for a specific base year. Insofar as possible, all data used must pertain to that year. If data actually apply to a different year, they may need to be adjusted order to estimate their value for the base year chosen. The base year chosen for a study of this type is typically the most recent one for which reliable data are available.

In this case, two different base years were considered, 2010 and 2012. Two of the key data sources used for this work, the Third Integrated Household Survey (IHS) and the Forest Resources Mapping spatial data on land use/land cover, were collected for a base year of 2010. The household survey, in particular, is a key input into many of the calculations in this study, which makes a compelling argument for using 2010 as the base year.

On the other hand, the fees assessed by the Department of Forestry for the use of the forest products under its jurisdiction were substantially increased effective the beginning of 2011. The change in these prices could have significant implications for revenues from government plantations and for assessment of the value of some forest goods and services. Estimating the value of the forests based on earlier prices for forest products may not make sense if the results are to be used in a post-2012 economic climate. This argues for updating the household survey and land use / land cover data to 2012, and choosing that as the base year for the study.

However, Department of Forestry revenue data for all of 2012 were not available at the time of this study, due to lags in reporting in tabulating the data. Therefore while it could make sense to carry out the study based on the new prices, in fact this was not possible. Consequently, the calculations have all been carried out for the base year of 2010. As updated data are available from the DoF, or for any other elements of the study, this work can be updated if desired.

1.4 Overview of this Paper

This paper is the technical documentation of the analysis carried out in this study. It is designed to be read in conjunction with use of the spreadsheet in which the calculations have actually been done, and includes specific references to worksheets within that spreadsheet in which specific data or tables may be found. It is organized into several sections:

- Section 2 presents the calculation of the contribution of the forest sector to GDP and NDP. These calculations cover plantation timber, household use of fuelwood and charcoal, forest-based businesses, fuelwood use by institutions and industries, and non-timber forest products. They address both the monetary value of that consumption and the physical volumes consumed.

- Section 3 calculates the depreciation of natural forests and plantations.

- Section 4 calculates the total economic value of the forests, considering the total output of forest-based businesses, protected area revenues, forest-based tourism, and watershed protection.

- Section 5 addresses the contribution of forests to livelihoods, which includes employment in forest-related activities and the value to households of gathered resources.

In addition to this technical paper and the spreadsheet that accompanies it, this study has produced three other outputs:

- A policy brief, which presents the major results of the analysis without the technical details.

- A PowerPoint presentation delivered at the stakeholder workshop held March 12, 2013, in Lilongwe. This presentation closely parallels the structure and information in the policy brief.

- A short paper considering approaches to setting prices for forest products sold by the government.

All of the outputs of this project are available from the Department of Forestry.

2 Forest Contribution to GDP

2.1 Introduction

The contribution of the forest sector to GDP falls within ISIC code 02. This is subdivided into four classes, as shown in Table 1.

Table 1: Components of ISIC Code 02, Forestry

ISIC Class	Includes	Excludes
0210: Silviculture and other forestry activities	This class includes: - growing of standing timber: planting, replanting, transplanting, thinning and conserving of forests and timber tracts - growing of coppice, pulpwood and fire wood These activities can be carried out in natural or planted forests.	This class excludes: - growing of Christmas trees, see 0129 - operation of tree nurseries, see 0130 - gathering of wild growing non-wood forest products, see 0230 - production of wood chips and particles, see 1610
0220: Logging	This class includes: - production of roundwood for forest-based manufacturing industries - production of roundwood used in an unprocessed form such as pit-props, fence posts and utility poles - gathering and production of fire wood - production of charcoal in the forest (using traditional methods) The output of this activity can take the form of logs, chips or fire wood.	This class excludes: - growing of Christmas trees, see 0129 - growing of standing timber: planting, replanting, transplanting, thinning and conserving of forests and timber tracts, see 0210 - gathering of wild growing non-wood forest products, see 0230 - production of wood chips and particles, not associated with logging, see 1610 - production of charcoal through distillation of wood, see 2011
0230: Gathering of non-wood forest products	This class includes the gathering of non-wood forest products and other plants growing in the wild. This class includes: - gathering of wild growing materials: mushrooms, truffles; berries; nuts; balata and other rubber-like gums; cork; lac and resins; balsams; vegetable hair; eelgrass; acorns, horse chestnuts; mosses and lichens	This class excludes: - managed production of any of these products (except growing of cork trees), see division 01 - growing of mushrooms or truffles, see 0113 - growing of berries or nuts, see 0125 - gathering of fire wood, see 0220
0240: Support services to forestry	This class includes carrying out part of the forestry operation on a fee or contract basis. This class includes: - forestry service activities: forestry inventories; forest management consulting services; timber evaluation; forest fire fighting and protection; forest pest control; logging service activities; transport of logs within the forest	This class excludes: - operation of forest tree nurseries, see 0210
Source: Detailed structure and explanatory notes, ISIC Rev.4, Code 02. http://unstats.un.org/unsd/cr/registry/regcs.asp?Cl=27&Lg=1&Co=02		

An extremely detailed set of forest accounts would include separate value added calculations for each of these four classes. In practice, it would be unusual to have data at this level of detail. In Malawi, data are available on some elements of ISIC 02, though for the most part it is not possible to distinguish between the classes within that code. Because of the structure of Malawian forest activities, we can often distinguish between activities in plantation and natural forests more easily than we can distinguish between silviculture (0210), logging (0220), or services for which the firm or government contracts out (0240). However there are many activities within the sector that we know are ongoing, but about

which we have no data, including most of what falls within class 0230, gathering of non-timber forest products.

2.2 Plantation Timber: ISIC 0210 and 0220

Plantation timber is grown and sold primarily by the government plantations and to a small extent by other growers – tea companies, tobacco companies, some specialty plantations. Systematic data[6] on plantation sales are only available from the DoF, which has data on its own revenues from timber sales. The NSO, in preparing the national income accounts, uses those DoF data to calculate value added from the forestry sector.

When vertically integrated companies grow timber to use in their own production of other products – as in the case of Malawi's tea, tobacco, and wood products companies - the value of the timber could be counted either in the forestry sector or in the sector using it as an input. If the company treats its forestry activities as a separate cost center from the activities using the timber – that is, for example, if the plantation division of a tea company sold its output to the tea division at a profit – then the two cost centers would be handled as if they were two separate purposes, the timber value added being allocated to the forest sector (ISIC 02) and the tea value added to the beverage processing sector (ISIC 11). In Malawi, however, the economic surveys that gather information about industrial activity do not make it possible for the activity of such companies to be divided between forestry and manufacturing. They receive a manufacturing survey, and their timber activity is treated as part of the process of producing wood products, tea, tobacco, or other items. Thus data are not available about the timber activities of private companies.

This differs from the treatment of agricultural activities, however. The tea plantations receive two separate surveys, one for agriculture and the other for beverage processing. These two sets of activities are classified into different ISIC codes for the purposes of the national accounts; the value added from tea cultivation is added to ISIC 01, crop and animal production, while the value added from tea processing is part of ISIC 11, beverages. The NSO staff[7] expressed interested in changing the surveys used to do the same with forest activities, particularly for the sawmill industry, so in the future the silviculture and logging activities of companies such as Raiply (Malawi) Ltd., may show up in the accounts as ISIC 02 (forestry) rather than ISIC 16 (sawmills).

For the present, however, the only timber plantation activities in the national accounts, and about which data are available for our purposes, are those of the DoF. Because this is a public sector rather than a commercial activity, the revenues received by the DoF from plantation activities are treated in the Malawian national accounts as value added; the intermediate costs of running the plantations are not deducted.[8] The value added from the plantation activity is therefore equal to the revenues that the DoF receives from selling their products. These include three types of revenue; logs from plantations, firewood from plantations, and concession fees paid for activity in plantations. These three items are shown in Table 2, which shows all DoF revenues for the period from July 2010 through June

[6] "Systematic data" means data that are reasonably comparable to each other and can be obtained from secondary sources. With sufficient time and resources, almost any data could in principle be available. However, this assignment was not long enough to permit any primary data collection. Moreover, the need to be able to add up values from a variety of sources meant that for many of the values we need, we must rely on statistical data sources – that is, on databases compiled by a single organization rather than individual values gleaned from the work of several different organizations. We could not glean from a variety of companies or projects to compile a single database, both because the values within that database would not be compatible with each other and because we did not have enough time.

[7] Elizabeth Chikoti, Director of the National Accounts, personal communication

[8] Intermediate costs," in the national accounts, are expenditures for materials, equipment, and so on; they do not include personnel costs, which are part of the value added of a corporation or a sector.

2011, highlighting the three line items that are revenues from plantation activity. They are also available in the worksheet entitled "DoF Revenue 2010-2011" in the study spreadsheet.

Table 2: Department of Forestry Revenues, July 2010 to June 2011

Expenditure category	Amount	Notes
Sale of Boarded off items	86,020	Revenues from sale of depreciated assets
Sale of research produce items		
Sale of Farm Produce	345,800	
Sale of Firewood	24,308,566	Forestry Rules Second schedule, section 4. Fuelwood. This is apparently sales of fuelwood from the plantations
Forest Seed Sales	1,693,988	
Phytosanitary Certificate		
Log sales	201,414,084	Second schedule, section 2. Exotic trees and section 3. Poles
Course Fees	13,500	
Rest house fees	655,990	Forestry Rules Third schedule, section 2. Rest houses
License Fees	27,158,276	Licenses issued by the DoF for exports, installation of cellphone towers in reserves, and other services (according to John Chunga, Head Accountant, DoF).
Misc. Fees	0	Probably includes small sums of revenue from the many fees listed in the forest rules.
Concessions	74,141,392	Private timber operations - almost all Viphya
Rent government houses	192,515	
Royalties on Forestry Produce	32,264,200	Forestry Rules Second schedule, section 1. Indigenous forests. Price depends on species
Acc. & Hall hire	2,458,538	
Tuition Fees		
Sale of Tender Documents	0	
Publications		
Tobacco Levy		
Receipts on certificates		
Miscellaneous receipts	8,058,226	
TOTALS	372,791,094	

Table 3: Department of Forestry Personnel, 2011-2012

Activity	Number of employees	Total Compensation
Forest Management	882	250,439,928
Indigenous Forests	1,381	264,076,392
Plantations	2,944	520,184,796
Total	5,207	1,034,701,116
Source: Data provided by Department of Forestry		

The total revenue from plantation activity – the sum of the three items highlighted in this table - is MK 299,864,000. Following the NSO procedures for constructing the national income accounts, we show this as the value added from plantation activity in our calculation of the contribution of the forest sector to GDP. However, it is worth noting that this is substantially less than the government expenditure on plantations. Personnel data provided by the DoF are summarized in Table 3, which shows the number of employees and total salaries for plantation activities, indigenous forest management, and all other DoF activities for 2011-2012. Operating cost data available from the DoF are not as easily allocated among activities; they are available in less detail than the personnel information.[9] Based on

[9] These calculations are based on two different data spreadsheets provided by the DoF. The first includes full detail on Department personnel, by individual. Personnel are organized by district and region; within each district they are organized by activity, with subtotals provided for management of plantations and for indigenous forests. The second spreadsheet provides summary data on personnel and operating costs by cost center, with limited disaggregation of expenditures by activity within each cost center. Because the personnel spreadsheet includes the disaggregation of plantation, indigenous forest, and other expenditures, we have used those data as the basis for the personnel costs in our work, even though the totals for personnel costs are not identical in the two spreadsheets and those in the second spreadsheet may be

the share of plantations in personnel expenditures, we have estimated that half of the reported operating costs are for plantations and the rest for other DoF activities; this comes to just under 51 million kwacha. As Table 4 shows, the total expenditures for plantation management exceed total revenues from the plantations by about 271 million kwacha; while these figures are not totally exact, they do give an idea of the amount of public subsidy that went into plantation operations in 2010.

Table 4: Plantation Profit Calculation

Item	Amount
DoF Revenue from Plantations	299,864,042
Operating Costs	50,802,613
Personnel Costs	520,184,796
Profit	-271,123,367

2.3 Plantation Timber in the National Accounts: Current System vs. a Private Business

It is interesting to compare the calculation of plantation value added as it is now handled in the national accounts with the values we would find if the plantation activity were treated as a parastatal or a private business. Table 5 shows the general structure for calculating the contribution of an economic sector to GDP. As mentioned above, intermediate consumption is deducted from revenues in the calculation of gross value added. In addition – and this is crucial for our analysis - subsidies to the sector are also deducted from revenues to arrive at gross value added. On the subsequent line, depreciation of productive assets (machines, in the case of a manufacturing sector, or forests in our case) is deducted from gross value added to calculate net value added, or the contribution of the sector to net domestic product. From that, one would subtract the compensation of employees (salaries) to arrive at net operating surplus, or an estimate of the profitability of the sector.

Table 5: Basic Structure of the Calculation of Value Added in the National Accounts

	Revenue
less	Intermediate consumption (material inputs, services purchased, etc.)
less	Subsidies
equals	Gross Value Added (or contribution to GDP)
less	Consumption of fixed capital (that is, depreciation of productive assets)
equals	Net Value Added (or contribution to NDP)
Less	Compensation of employees
Equals	Net operating surplus (or profit)

Table 6 uses this framework to structure the plantation data, comparing the calculations now made to estimate the contribution of plantations to GDP with what would be done if they were private enterprises.[10] The table shows portions of two sectors; the plantation portion of ISIC 02 (forestry), and a greatly simplified version of the DoF portion of ISIC 8413, which covers government expenditures in support of economic activity. The table does not include depreciation; this is a separate, quite complicated issue, and is addressed in Section 3 of this report.

expected to be compatible with the operating cost data whereas those in the first spreadsheet will not be. The summary data from the first DoF spreadsheet are included in our worksheet entitled "DoF Personnel Details; "the data in the second DoF spreadsheet are included in our worksheet entitled "DoF Personnel & OC."

[10] This table is included in our spreadsheet as the worksheet entitled "Acctg for plantations"

As the national accounts are now built (the column labeled "current situation"), the plantation revenue is treated as the value added of that portion of ISIC 02. Intermediate consumption is not deducted, nor are subsidies from the government. Value added from plantations is thus just under 300 million kwacha. The second part of the table, for ISIC 8314, shows how government expenditures on the DoF are handled in the accounts. The revenues from the sale of plantation goods are (at least at present) transferred from the DoF to the treasury; this is treated as a subsidy from ISIC 02 to ISIC 8413. The total expenditure on DOF personnel is treated as output; this is called "non-market output" in national accounts terminology. Thus the accounts begin with the "output" figures; the sum of plantation and non-plantation personnel expenditures. From this, the total operating expenditures of the DoF are subtracted as intermediate consumption, as are the subsidies from the forest sector (i.e. the plantation revenue, which also equals value added in the forest sector). This gives a figure of 633 million kwacha for forest-related value added on ISIC 8413, and a total for forest-related value added of 933 million kwacha.

The right hand column of Table 6 shows how the accounts would be structured if the plantations were private. Revenue is the same, just under 300 million kwacha. From this figure the accounts would deduct intermediate consumption, estimated at just under 51 million kwacha, as discussed above. They would also deduct the subsidy of 271 million kwacha from the government to the plantation sector, since the government is paying the salaries and operating costs of the plantations. In this scenario the plantation revenues are not turned over to the treasury, so the public subsidy is the difference between plantation revenue and expenditures (calculated in Table 4 above). This gives a negative value of gross value added; about -22 million kwacha. Negative value added means that the plantations would not actually be considered to contribute to the economy if they were private enterprises.

If our table included depreciation, it would be subtracted from gross value added at this point to calculate net value added. However, it does not, so we next subtract the compensation of employees – 520 million kwacha – to calculate gross operating surplus. This gives us -542 million kwacha, the amount the industry would be losing if it were private and did not receive any government subsidies.

In this scenario the government's non-marketed output in the forest arena, classified in ISIC 8413, includes only the non-plantation salaries, 514 million kwacha. They only pay half of the intermediate consumption, since the plantation share was the responsibility of the private companies in ISIC 02. They don't receive a transfer from the forest sector, since forest revenues would not go to the treasury, but they pay the 271 million kwacha subsidy that keeps the plantations afloat; this is added to their value added, as it was subtracted from ISIC 02. Where the value added on ISIC 02 was much lower under this scenario (-22 million instead of +299 million), the value added on ISIC 8413 is higher under this scenario (735 million instead of 633 million). Total forest-related value added – ISIC 02 plus ISIC 8413 is lower, however; 713 million instead of 933 million.

Although these calculations are rough, they make it clear that the Malawian taxpayers are subsidizing plantation forestry. The current accounting system masks that subsidy, by treating all DoF salaries as non-marketed output of the government, leading to higher value added for the forest sector and the economy as a whole than would be shown if the accounts treated the plantations as if they were private enterprises.

Table 6: Comparison of Approaches to Forest Value Added, in 10^3 kwacha

	Account Item	Notes	Current situation	Hypothetical private company or parastatal
ISIC 02	DoF Revenue from Plantations		299,864	299,864
	Intermediate Consumption	This figure is an estimate, because we do not know how the operating cost data should be disaggregated between plantations and other activities. For the purpose of this comparison, we have allocated half of the operating costs to plantations.		50,803
	Less subsidies from government			-271,123
	Plantation Gross Value Added		299,864	-22,062
	Compensation of Employees			520,185
	Operating Surplus	With this operating surplus, the hypothetical private company would be out of business. The parastatal would require a subsidy from government of 271 million kwacha to stay in business.	299,864	-542,247
	Note: Transfer from plantation to treasury		299,864	-271,123
ISIC 8413	**Government expenditure on Forestry:**			
	Plantation wages		520,185	
	Other Forest Dept salaries	Remaining salaries of the DoF, aside from plantations	514,516	514,516
	Less intermediate costs	In the current situation, all DoF operating costs would be subtracted as intermediate costs; in the hypothetical situation the plantation share has been subtracted on ISIC 02.	-101,605	-50,803
	Transfer payments between plantations and government	In current case the FD value added would be a negative subsidy from plantation sector to treasury, because all plantation revenue goes to the Treasury. (This will change once the Forest Fund is operational.) If the plantations were run as a parastatal, this would be a subsidy from the treasury to the plantations.	-299,864	271,123
	Total contribution to value added from public expenditures on the DoF		633,232	734,837
ISIC 02 + 8413	Total Value Added		933,096	712,775

2.4 Value of Household Fuelwood Use: ISIC 0220

Household use of fuelwood for cooking and light is the single largest use of Malawi's timber resources. This project differs from previous efforts to estimate the quantity and value of household fuelwood use in Malawi, in that it can benefit from the data in the 2010 Integrated Household Survey, which asked a variety of detailed questions about household fuelwood use in module F.[11]

- What is your main source of fuel for lighting

[11] The full documentation and data from the IHS may be found at http://go.worldbank.org/OGPXWPLPL0.

- What is your main source of fuel for cooking? Options of interest to us are gathered firewood, purchased firewood, and charcoal. We attempted to use information about households with electricity as well, but the data proved inadequate.

- For all who ever use wood, the survey asks whether they ever gather it, where they get it from (own woodlot, community woodlot, forest reserves, etc.), how long they must walk to gather it, how much time they spend gathering it, what share of the wood they use is purchased, and what they would have had to spend had they purchased all the wood they used.

What they survey does not ask is how much wood they used. This is unfortunate but understandable. Wood is not gathered or purchased in standard-sized bundles; to determine how much the household used, the enumerators would have had to spend time in each household measuring wood use, which would have been enormously time-consuming. There are studies that have done this (see, for example, Brouwer et al 1977 or Abbot and Homewood 1999); however they did this in a few dozen households, not the fourteen thousand that participated in the IHS. That kind of survey work typically involved spending at least a week in each village, going from house to house every day to measure the weight of the wood pile over time to determine how much is consumed, as well as weighing the head-loads of wood that women gather to determine how much is added to the piles. Obviously this is beyond the scope of what could be done in the IHS.

This is not a problem for estimating the contribution of household wood use to GDP, since that requires only the value of the wood used and not the quantity. To estimate forest depreciation, however, and to determine whether resources are being used sustainably, it is necessary to know the quantity consumed as well as its value. Our analysis must therefore combine IHS data with other sources of information in order to estimate the depreciation of natural forests. The details of these calculations are presented in Section 3 on depreciation.

The estimation of the value of fuelwood use was carried out in a series of steps:[12]

- Calculate the number of households for which wood is the primary fuel (either gathered or purchased). This is in question F12 of the household survey.

- Calculate the number of households that sometimes use wood, but for whom it is not the primary fuel; this is in question F13 of the household survey.

- For each of those groups, calculate the average of what their wood would have cost had they purchased all of it, based on question F18 of the household survey. As expected, the value of wood is higher for those for whom it is the main fuel than for those for whom it is not; those for whom it is the main fuel consume wood valued at an average of 464 kwacha per week while the others consume wood valued at 359 kwacha per week.

- Calculate the total value of wood used by each of these groups. The sum of these values gives us the total value of household firewood use.

The question on the share of wood that is purchased was used to divide the total value between purchased and gathered wood. The responses on that question (F17) are framed as “all, almost all, more than half, half” and so on. These were converted to percent – 100%, 82.3%, 66.6%, 50%, and so on – and these percentages were applied to the value of total wood consumption that was purchased, the remainder being gathered. The share of wood

[12] These steps are carried out in the worksheets entitled “Fuelwood IHS Tables” and “HHold wood use for energy” in the spreadsheet presenting the results of this work.

actually purchased, based on this approximation, was found to be about 6%. This share was applied to the total estimated value of fuelwood used by the households to obtain a value for the amount purchased and an imputed value for the amount that was gathered. All of these calculations are summarized in Table 7.

Table 7: Value of Household Fuelwood Use

	Wood is main fuel	Wood sometimes used	Total
Number of households	2,693,442	144,136	2,837,578
Average value of wood used per year	24,121	18,680	n/a
Total value of wood used	64,968,665,489	2,692,397,812	67,661,063,302
Total value of gathered wood			63,494,472,187
Total value of purchased wood			4,166,591,115

The value of gathered wood is included in the national accounts as part of the value added from the natural forests. The logic for including this is that it is the product of the labor exerted in order to gather the wood. While there may be some minor intermediate consumption as well – perhaps small tools to cut wood so that it can be carried easily – this is assumed to be minimal and is ignored.

2.5 Value of Purchased Fuelwood: Comparison of Sources

The value of purchased wood calculated based on the IHS data is not included in the calculation of the contribution of forests to GDP, because it overlaps with other data in the IHS, on forest-based household businesses. Those data and the results based on them are discussed in section 2.6 of this report. Interestingly, however, they are at least in the same order of magnitude as another estimate of the value of traded fuelwood in Malawi, by Openshaw 2010. That paper, which focuses on employment in the biofuels sector (and is discussed below in the section on livelihoods), estimates the total value of traded fuelwood in 2008 at $45.6 million (Table 6, p. 273). At an exchange rate of $1 = MWK 148, that comes to MWK 6.75 billion as the street value of purchased fuelwood. While this may seem to be radically different from the value of MWK 4.17 billion obtained from the IHS, given the many sources of uncertainty in all of these data, the fact that the two values are even that close is reassuring. However this does highlight the uncertainty inherent in all of these figures, and the need for greater efforts to collect accurate data insofar as possible.

2.6 Forest-Based Household Businesses

The IHS collects data about the activity of household businesses in the previous month, addressing such issues as how many people are employed from within the household or outside of it and how much they are paid; how many hours they work, the total revenues, intermediate consumption, and profits of the businesses; what kind of business it is; and, of particular interest for the purposes of this study, whether the business is based on forest products. It also asks for which of the previous twelve months the business was in operation, making it possible to calculate average annual figures for the business taking into account that some activities are seasonal so businesses may not be in operation all year. This makes it possible to estimate the value added of the forest-based businesses, and thus their contribution to GDP.[13]

The calculations involved, which are summarized in Table 8, are quite simple. The total annual sales from all forest-based businesses come to about 24 billion kwacha. Their expenditures on everything other than labor come to just over 11 billion, and their value

[13] These calculations are included in the worksheet entitled “Forest Businesses” in the study spreadsheet.

added is just below 13 billion – a quite significant amount, when compared with the value added from plantation forestry.

Table 8: Value Added from Forest-Based Businesses

Total sales from forest-based businesses	24,083,356,991
Total expenditures on inputs other than labor	11,276,543,712
Value added	12,806,813,279

The IHS provides the Malawian industrial classification codes for the home-based businesses, which makes it possible to disaggregate the results and find out which sectors of the economy they contribute to. As shown in Table 9, only a small portion of the value added of these enterprises falls within the forestry sector. By far the largest portion is in retail sales, suggesting that many people are gathering products from the forest to sell themselves. Only the fairly small forestry and logging sector portion (ISIC 02) is included in the calculation of the contribution of forests to GDP. The activities that fall into other ISIC codes can be included in the national accounts, but are not part of the forestry sector. The output of all of these sectors is included in the calculation of total economic value of the forests, however, as discussed in Section 4 below.

Table 9: Value Added from Household Businesses by Industrial Classification

Activity	Malawi Industrial Code	ISIC Revision 4	Amount
Mixed farming	11	01	5,845,592
Forestry and logging	12	02	97,049,150
Mining and quarrying	29	05 to 09	189,084,472
Food, beverage, and tobacco processing	31	10 to 12	831,153
Textiles, cord and twine	32	13 to 15 (textiles), parts of 16 (cord and twine)	(1,364,309,763)
Wood-based manufacturing, sawmills	33	16, 31	2,810,997,388
Bricks, cement, concrete	36	239	38,958,631
Metal products and hand tools	38	23, 24 (hand tools in the Malawian classification may not be metal)	13,418,454
Retail	62	47	10,668,427,549
Restaurants and hotels	63	55, 56	110,198
Education, medicine, professional services, etc.	93	69 to 75, 85	346,400,455
Total			12,806,813,279

2.7 Quantity of Wood Consumed by Households

To understand the impact of fuelwood consumption on the sustainability of Malawi's forests, we need to know how much wood is consumed. As discussed above, the IHS measures the economic value of fuelwood consumed, but not the quantity. We have estimated wood consumption by using the results of a set of studies that worked closely with individual households to measure how much wood they actually used. Their results are presented in the worksheet entitled "Household fuelwood parameters," and summarized in Table 10.

Table 10: Weight of Fuelwood Used Per Household Per Year

	Weight in kg
Brouwer et al, 1997	2,139
Simons, quoted in Lowore 2003	1,901
Sichinga (rural only) , 2005	3,536
Abbot and Homewood, 1999	2,309
Owen et al, 2009	2,647
Average used in later calculations	**2,506.59**

These figures are in weight; they must be converted to volume in order to compare fuelwood use to the amount of wood that can sustainably be harvested from the forests, which is expressed in cubic meters per hectare per year. This is done using parameters for the weight of different kinds of wood commonly found in Malawi's miombo woodlands. These parameters come from a study carried out by Abbot and Lowore (1999), summarized in Table 11.

Table 11: Weight of Wood Species per m^3

Species	Density, kg/m^3
Combretum apiculatum Sond.	724
Pericopsis angolensis van Meeuwen	758
Combretum molle R. Br. ex Don.	669
Parinari curatellifolia Planch ex Benth.	597
Brachystegia floribunda Benth.	676
Uapaca kirkiana Muell. Arg.	570
Julbernardia paniculata Benth.	644
Bauhenia thonningii Schum.	595
Acacia amythethophylla Steud. ex A. Rich.	666
Senna singueana Lock ex Del.	602
Brachystegia longifolia Benth.	548
Brachystegia utilis Burtt Davy and Hutch.	598
Pseudolachnostylis maprouneifolia Pax.	595
Brachystegia spiciformis Benth.	579
Brachystegia boehmii Taub.	598
Average weight per m^3	**628**
Source: Abbot and Lowore, 1999, p. 116, Table 3	

Applying the average weight to the average fuelwood use per household, we get average use of 3.99 cubic meters of wood per year. This is used to calculate the quantity of wood used by households for whom wood is the main fuel. These figures are calculated for the country as a whole and also by region. The regional data are important in assessing sustainability, since population density and therefore consumption are both much higher in the south than in the north.

Wood consumption by households is slightly more complicated. The IHS does not tell us what share of their energy consumption is from wood. It does, however, give us the value of their total wood use. We have therefore calculated the ratio of the total value of wood used by this group to the total value of wood used by those for whom it is the main fuel, and applied that ratio to the volume of wood used by those for whom it is the main fuel. The underlying assumption behind this calculation is that the wood would cost the same amount per kilo for everyone, so the value of the wood can be used to estimate the quantity used.

The results of these calculations are shown in Table 12. These calculations were carried out in the worksheet labeled "Household wood use for energy," directly below the estimation of the shares of wood that are gathered and purchased.

Table 12: Volume of Firewood Used Per Year

Wood use (m3)	Malawi	North	Center	South
Wood is main fuel	10,751,695.62	1,474,730	4,474,398	4,802,568
Wood sometimes used	488,568.08	16,869	190,645	281,054
Total	11,240,264	1,491,599	4,665,043	5,083,622

2.8 Wood Use by Institutions and Industries

To fully understand the impact of fuelwood consumption on the sustainability of Malawi's forests, we also need to know how much wood is consumed by institutions and industries. The NSO's annual economic survey, which is the broadest source of information about industrial activity (and which will be discussed further in the section on TEV below), asks some questions about energy consumption, and about consumption of fuelwood and charcoal in particular. Unfortunately, however, no data are actually provided on biomass energy. Some information is available, however, from a study carried out in 2008, which aimed to gather these data for all significant institutional and industrial users of biomass energy.[14] That study estimated wood consumption by restaurants and holiday resorts, ceramic manufactures, lime producers, and burnt brick producers. In addition, it surveyed primary and secondary schools; colleges and universities; prisons, police and army barracks; and hospitals.

Makungwa's results are summarized in Tables 13 and 14. For most of these wood consumers, we have used these values, because we have new information with which to recalculate them.

Table 13: Woodfuel Use in Institutions Offering Catering Services

Service Category	Fuelwood consumption, m3
1 meal/day	13,476
2 meals/day	1,436
3 meals/day	27,842
Total	**42,754**
Source: Makungwa 2008, Table 4, p. 9	

Table 14: Woodfuel Consumption in Commercial Sectors

Sector	Fuelwood consumption, m3
Restaurants and holiday resorts	36,183
Ceramic production	288
Lime Production	20,736
[Brick making]	[185,332]
Total	**[242,539]**
Source: Makungwa 2008, Table 8, p. 13	

2.8.1 Bricks

For wood-fired bricks, new data are available which allow modification of Makungwa's results. For bricks, the IHS provides information on the number of brick houses in total, the number built each year, and their sizes. These figures are much higher than the estimates in Makungwa 2008, leading to much higher estimates of brick use and wood consumption to fire the bricks.

The following steps were undertaken to estimate wood consumption for brick burning:

- Calculate the average number of burnt brick houses of a particular size constructed each year in a six-year period using Module F of the IHS data, which covers housing. In particular, question F05 asks about the age of the house, question F07 asks about the materials used to build the outer walls, and question F10 asks about the numbers of rooms. With this information, we can calculate how many houses are built each year and their size. Brick homes account for about 44% of all residences in Malawi. The average number of new of brick homes built each year over the six-year period

[14] Makungwa 2008.

prior to the survey is about 109 thousand, and their average size is 3.1 rooms. In contrast, Makungwa estimated that 22 thousand new brick houses were built each year. Indeed, Makwunga did not factor in that brick houses are common in both urban and rural areas; he assumed they were only an urban phenomenon.

- Calculate the number of bricks per house of each size. These calculations assumed that each room is four meters square and ceilings are 2.8 meters high; thus one room has 44.8 square meters of wall (4 x 4 x 2.8 = 44.8). The estimates for these calculations do not take into account whether interior walls are shared between rooms; nor do they consider whether outside walls may have a double layer of bricks; the wall area for one room (44.8 square meters) is simply multiplied by the number of rooms to get the wall area required to build the house.

- Houses with seven or more rooms were assumed to be villas with gardens and brick walls surrounding the garden. It was assumed that the footprint of the house uses one fifth of the land, and the garden the other four fifths. The total area of the house site is therefore five times the floor space of the house. The plot is assumed to be square, so the perimeter (and thus the length of the garden wall) is four times the square root of the area. The wall is assumed to be two meters high. On this basis the area of garden wall can be calculated as well.

- It is assumed that 81 traditional bricks are needed for one square meter of wall. (Maity 2012) Using this parameter, the number of bricks is calculated for each house size, including the extra bricks for the garden wall in the case of houses with seven or more rooms. This is multiplied by the number of houses of each size, and the results are summed to calculate the total number of bricks needed each year to build new houses.

- Makwunga provides a figure of 1.4 cubic meters of wood needed to fire 1000 bricks; this figure is used to calculate the amount of wood consumed each year burning bricks.

These calculations, which are presented in the worksheets entitled “Brick House age IHS data” and “Number of bricks” in the study spreadsheet, are summarized in Table 15. Houses with more than seven rooms – those highlighted in yellow – are those assumed to be villas with walls around the garden.

Table 15: Houses Built Per Year and Bricks Used, by Number of Rooms

Rooms per house	Houses built per year	Total number of bricks
0	609	0
1	9,261	33,606,347
2	27,841	202,056,062
3	37,744	410,894,276
4	24,315	352,936,725
5	6,640	120,471,549
6	2,449	53,312,822
7	629	26,607,947
8	248	11,651,507
9	52	2,714,283
11	83	5,053,783
13	6	416,131
15	4	331,103
Total	**109,880**	**1,220,052,535**

Villas with gardens and garden walls.

2.8.2 Tobacco

The processing of tobacco entails significant consumption of wood, both for processing the tobacco itself and for constructing barns in which to dry it. Bunderson and Hayes 1995 (cited in Bunderson and Hayes 1997) provide parameters for the wood required to process each of the two major types of tobacco grown in Malawi, flue-cured and burley. These are applied to tobacco production in 2010, for which data are provided by the Tobacco Association of Malawi (www.tamalawi.com/Corporate_ Profile.html) in order to estimate total wood requirements in 2010. These are shown in Table 16.

Table 16: Wood Consumption in Tobacco Processing, 2010

	Tobacco grown, metric tonnes (a)	Wood consumption (cubic m/tonne) (b)	Total wood consumption
Flue cured (kg)	24,321	17.94	436,314
Burley (kg)	193,239	2.79	539,136
Total wood use	217,559		975,450
(a) From www.tamalawi.com (b) From Bunderson and Hayes, 1995, cited in Bunderson and Hayes 1997, Table 1, p. 4.			

2.8.3 Overview and Valuation of Institutional and Industrial Wood Use

The final results on fuelwood use by institutions and industries are summarized in Table 17.

Table 17: Summary, Institutional and Industrial Use of Fuelwood

Category	Firewood m^3/ year
Restaurants & holiday resorts	36,183
Ceramic production	288
Lime production	20,736
Brick production	1,708,074
Institutions (primary and secondary schools; colleges; prisons/police/ barracks; and hospitals)	42,754
Tobacco curing	975,450
Total	**2,783,484**
Less firewood sold by DoF	65,242
Net wood use	**2,718,242**

In using these results, and in subsequently putting a monetary value on this wood in order to include it in GDP calculations, we first subtract the firewood sold by the DoF from the plantations. The reason for that calculation is subtle. These figures tell us how much wood the various organizations have used as final consumers. What we are actually interested, when including this in GDP calculations, is the value added from the supply of fuelwood. While the physical consumption figures are important in order to estimate depreciation, they from an accounting perspective they are of interest because they can serve as a proxy for supply and thus value added from the supply activities.

We don't know where these industries get their wood. We do know, however, that the DoF sold 65,242 cubic meters of wood in 2010 to someone. When we use the consumption by these industries as a proxy for production (since someone had to have made that wood available to them), we deduct the DoF sales in order to prevent the possibility of that wood being double counted, once as sales by DoF and the second time as consumption by someone. Of course we don't know who actually bought that DoF wood; however it had to be one of the users whose consumption serves as a proxy for wood production, so it had to be subtracted somewhere. We have chosen to subtract it here because it seems more likely

that one of these institutions would purchase a significant load of wood than that it would be sold to individual households.

The next step is to put a monetary value on this wood, in order to estimate the value added that comes from its production and add it into GDP. This wood has been valued at the government's sale price for firewood from indigenous trees, effective January 2011. This price has been used because it may set a standard for the price of fuelwood sold in bulk. Applying this price to the 2.7 million cubic meters of wood used by institutions and industries we get a value for this wood of 6.8 billion kwacha.

At this point, however, we must subtract another value representing a different source of wood supply; the value added from household businesses selling forestry products (the ISIC 02 portion of household businesses). The logic for this deduction is analogous to the previous deduction. The value of wood purchased by institutions and industries is included in GDP as a proxy for the value added accrued by businesses selling to those consumers. We know that household businesses are selling wood to someone, and that output has already been added into GDP. To avoid double counting those sales, we must therefore deduct it from estimates of wood consumption. This leads to the final estimation of the value added that accrues from selling wood to institutions and industries at 6.7 billion kwacha, as shown in Table 18.

Table 18: Value Added from Wood Sold to Institutions and Industries

Net wood use, in m3	2,718,242
Price per m3	2,500
Total value of wood used by institutions and industries	6,795,605,381
Less value added from wood provided by household businesses	(97,049,150)
Net value added from supplying wood to institutions and industry	6,698,556,231

2.9 Household Use of Charcoal

Household use of charcoal also has significant impacts on Malawi's forests. As with fuelwood, it is important to estimate both the quantity of charcoal used and its economic value. In this case, however, while estimating quantity used is possible, estimating its economic value is more difficult.

Question F12 of the IHS asks what the main source of fuel is for cooking; charcoal is one of the options. Question F19 asks whether the household has electricity. For those that do, the enumerator was to go on and as question F20, what source of energy is used for cooking when there is a blackout. Questions I101 through I103 then ask about expenditure on charcoal in the previous week.

The intention had been to use these data much as we used the data on fuelwood use, estimating the charcoal consumption of those who only use it in a blackout (the intersection of those households that do have electricity, and for whom charcoal is not the main cooking fuel) based on the ratio of their charcoal expenditures to the charcoal expenditures of those for whom it is the main fuel. However, there are significant anomalies in the data, which make this impossible.[15] About 75,000 households report having electricity in their homes, but on question F20, which was only supposed to be asked of those households that have electricity, more than 161,000 households say they use charcoal in case of a blackout.

The expenditure data are also inconsistent. While 272 thousand households say charcoal is their main fuel, only 725 of them reported any expenditure on charcoal in the previous week.

[15] These data are presented in the worksheet entitled "Charcoal expenditures IHS data" of the project spreadsheet.

Of the 161 thousand households who say they use charcoal in case of a blackout, only 222 reported expenditures in the previous week. For the entire population, irrespective of whether they said they use charcoal, 9,544 households report spending money on charcoal in the previous week. Perhaps even more disconcerting, the charcoal expenditure the previous week households for whom it is the main fuel is 180 kwacha, whereas that of households who use it only in a blackout is over 1200 kwacha. The average expenditure of all of the 9,544 households reporting any expenditure in the previous week was 434 kwacha. This is the reverse of what would be expected; the charcoal expenditure by those for whom it is the main fuel should be higher than that of households who only use it in a blackout, rather than it being one sixth as much.

Given these significant anomalies in the IHS charcoal expenditure data, they cannot be used to estimate the value of total charcoal consumption. We have used the IHS data as an input into the calculation of total charcoal used, however. This was done by calculating the energy produced by the firewood used by one family, and determining how much charcoal would have to be burned to produce the same amount of energy. The basis for the calculations is a set of parameters for the energy available from a kilo of wood or from a kilo of charcoal, and the amount of wood required to produce one kilo of charcoal, from the BEST study (Owen et al, p. iii). These are combined with the parameters used above for the amount of fuelwood used by one household to calculate the amount of charcoal that would provide the same amount of energy. These parameters and calculations are summarized in Table 19.

Table 19: Calculating Charcoal Consumed Per Household Per Year

Quantity	Material	Quantity	Units	
1	kg Firewood (air dry) provides	15.5	Mj energy	
1	kg Charcoal provides	29	Mj energy	
0.0645	kg wood	1	Mj energy	
0.0345	kg charcoal provides	1	Mj energy	
2506.58	kg wood provides	38,852	Mj energy	one household's energy use/year
1,339.73	kg Charcoal provides	38,852	Mj energy	equivalent energy from charcoal
5,611	kg wood provides	1,339.73	kg charcoal	Wood required to provide charcoal for one household for one year
8.94	m3 wood provides			
Number of households for whom charcoal is primary fuel (from IHS)				272,406
Wood required for their charcoal consumption, in m3				2,434,218

For firewood, we used the ratio of expenditures by those who used it only some of the time to expenditures by those who use it all the time to estimate the consumption by those who use it only some of the time. Because the charcoal expenditure data are not usable, we cannot calculate charcoal use in the event of blackouts in the same way. Our consumption estimates are therefore limited to those households for whom it is the main cooking fuel.

2.10 Other Forest Products

Many other products are gathered from Malawi's forests, both for own consumption and for sale. Among those known to be important or for which data are available are medicinal plants mushrooms, thatch and grasses, bamboo, and poles. In addition, beekeeping is a common occupation in Malawi, and the value honey produced often depends on access to the forests. Although harvesting of wild honey (analogous to the other harvesting of non-timber forest products) is probably rare, the dependence of "cultivated" hives on forest resources leads to this honey being considered in some sense a forest product.

Data are not available on most of these products, so their value could not be included in the analysis of the contribution of the forests to GDP, TEV, or livelihoods. However the IHS does ask about use of thatch, grasses, bamboo, and poles, and differentiates between the

value of total use and the value of that which is bought. This enables us to calculate the values provided in Table 20.

Table 20: Value of Non-Timber Forest Products

	Total value of what was consumed	Cost of the portion that was purchased	Value of gathered products
Wood and bamboo			
Number of households	26,748	26,494	
Average value	829	219	
Total value	**22,180,853**	**5,810,274**	**16,370,579**
Grass for thatching roof and other uses			
Number of households	45,935	45,935	
Average value	1,137	314	
Total value	**52,239,526**	**14,424,573**	**37,814,954**

The total value of these products is included in forest sector GDP. In principle, only a portion of the purchased product should be attributed to ISIC 02, and the rest should go with the transport, wholesale, and retail sectors. In addition, there would be some intermediate consumption to subtract in order to calculate value added for those selling these products. However, we have no basis for estimating any of those values, so the entire amount has been categorized with the forest sector. The total amount gathered is included in the contribution of forests to livelihoods.

3 Forest Depreciation

One of the key issues that has arisen in the design of forest accounts – indeed, the issue that led to the development of forest accounts and to much of the whole field of environmental accounting in the first place – is depreciation. As discussed in Section 2 of this report and shown in Table 6 in that section, depreciation of productive assets is subtracted from gross value added (or GDP) to calculate net value added (or NDP).

For a company that uses machines to produce goods, the machines are depreciated on a fixed schedule, and then replaced at the end of that period. In the case of forestry, the forest itself is the productive capital of the business. If trees are harvested at the rate at which they grow – sustainably, that is – then the asset will not depreciate due to harvesting. (It could, of course, become less productive for other reasons, such as climate change or fire.) If, however, the forest is harvested at too fast a rate, or it is cut down and will not grow back (for example, if the land is converted to agriculture), then the forest loss must be treated as depreciation, and subtracted from gross value added to get net value added.

To build forest accounts for Malawi, therefore, we must know whether the forests are being harvested at a sustainable rate. If they are being harvested faster than that, then we must subtract the depreciation of the forest in order to calculate NDP, because the excess harvesting cannot be treated as income.

In theory, forest depreciation should be calculated based on change in the market value of the forest. Each year as trees are harvested a bit too much its market value would drop, because the sustainable yield would drop as less forest was available to produce trees. Forests that are not harvested enough may also drop in value, as the trees grow past the point at which their yield (and therefore value) are the highest. This is reported to be the case in some Malawian plantations. Either way, the change in the forest's market value from one year to the next due to economic activity (overharvesting or poor management) would be its depreciation, and that change would be subtracted from GDP to get NDP.

Because there is no market for forests (as opposed to logs) in Malawi, it is not possible to actually estimate the depreciation of forest land. In the absence of this information, the amount by which the forest is overharvested is sometimes used as a proxy for depreciation. The amount actually harvested is compared with the sustainable yield from an optimally managed forest, and the excess revenue (beyond the sustainable revenue) is deducted as depreciation. While this only gives the same values under somewhat restrictive assumptions about discount rates, yields, and harvests, it is nevertheless a plausible proxy for actual depreciation. This is essentially how this study estimates the value of forest depreciation in Malawi. All of the calculations described in this section are in the worksheet entitled "Forest sustainability balance" in the study spreadsheet.

3.1 Depreciation of Natural Forests

The analysis is based on several sources of data. The Japanese-funded Forest Resources Mapping (FRM) project carried out with the GIS unit of the DoF provides data on tree cover within the areas that they have coded as forest, as shown in Table 21. The rows within this table for protected areas include all forest land that falls within the legal boundaries of government plantations, forest reserves, national parks, and game reserves. The natural forests are in the first two sets of rows, for evergreen forest and miombo woodland, and account for 94% of all forested land in the country. Land was classified as forest in the FRM study using the FAO definition, which includes all patches of trees that have at least 10% tree cover and are at least half a hectare in size. This will not include small household and community woodlots, which may be smaller than half a hectare, so it underestimates the total amount of forest cover in the country.

Table 21: Classification of Forest Cover

2010 Forest Cover	In 1000s of ha				Percents		
	Malawi	North	Center	South	North	Center	South
Evergreen	62.3	51.0	1.4	9.9	5.1%	0.2%	1.4%
Of which protected areas	36.9	26.9	0.8	9.2	2.7%	0.1%	1.3%
Miombo woodland	2,234.4	863.3	708.8	662.3	87.0%	96.8%	95.5%
Of which protected areas	1,274.1	345.9	566.7	361.4	34.9%	77.4%	52.1%
Eucalyptus plantation	25.8	1.7	12.2	12.0	0.2%	1.7%	1.7%
Of which protected areas	11.7	0.2	5.3	6.1	0.0%	0.7%	0.9%
Gmelina plantation	1.1	0.7	0.4	0.0	0.1%	0.1%	0.0%
Of which protected areas	0.6	0.6	0.0	0.0	0.1%	0.0%	0.0%
Pine plantation	81.1	69.0	8.2	3.9	7.0%	1.1%	0.6%
Of which protected areas	71.7	61.4	6.7	3.6	6.2%	0.9%	0.5%
Rubber plantation	2.6	2.6	0.0	0.0	0.3%	0.0%	0.0%
Of which protected areas	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%
Other plantation	4.2	3.9	0.3	0.0	0.4%	0.0%	0.0%
Of which protected areas	0.0	0.0	0.0	0.0	0.0%	0.0%	0.0%
Logged areas	6.2	0.0	1.1	5.1	0.0%	0.2%	0.7%
Of which protected areas	6.1	0.0	1.1	5.1	0.0%	0.2%	0.7%
Total forest area	2,417.7	992.2	732.4	693.2	100.0%	100.0%	100.0%
Of which protected areas	1,401.1	435.0	580.6	385.4	43.8%	79.3%	55.6%
Source: Asia Air Survey Company, October 2012, p. 76, Table 4.4.							

These figures on the area of natural forest are combined with estimates of the productivity of miombo woodland in order to calculate the sustainable yield of wood from the natural forests. A number of estimates have been obtained from the forestry literature, as summarized in Table 22. Based on these figures, we have used a mean annual increment figure of 2 for southern Malawi, 4 for northern Malawi, and 3 for central Malawi.

Table 22: Miombo Productivity Estimates, in m3/ha/year

Original source	Country	Low productivity dry miombo	High productivity wet miombo		Source
Marzoli 2007	Mozambique	2	4.8		Dewees et al p. 35
Misana	Tanzania	2.3	regrowth		Dewees et al p. 35
Rules of thumb from Malawian foresters	Malawi	2	3.5		Cited in Hecht 2006
	Plot type	**1-10 years**	**11-20 years**	**20-50 years**	Cited in Frost p. 32. Productivity estimates in kg/ha, converted to volume based on .778 tons per cubic meter, parameter given in Frost 1996, p. 32.
Chidumayo 1988	Dry miombo coppice	1.954	1.864	2.005	
Chidumayo 1991	Dry miombo coppice	1.812	2.506		
Chidumayo 1993	Dry miombo coppice	1.502	1.902		
Chidumayo 1990	Wet miombo coppice	2.763	3.406	4.332	

These productivity figures are applied to the natural forest areas (evergreen plus miombo) for the three regions of the country to calculate sustainable yield for each region. The results are summarized in Table 23.

From a regulatory rather than a biological perspective, these figures may be overestimated, because they include the land within national parks and game reserves, in which no legal harvesting is permitted. Consequently, it can be argued that when calculating sustainable yield we should first deduct the area of national parks from each region. Reliable data on the area of the different national parks were not available, so it was not possible to do those calculations. In addition, however, this argument may not be justified. Whether or not it is

legal, there probably is some harvesting in national parks, and there is certainly a lot of illegal harvesting from forest reserves. While this may run counter to government forest policy, those areas are still serving as sources of wood that could be depreciated through excess harvesting, so including them in the calculations of sustainable yield may be appropriate.

Table 23: Sustainable Yield as of 2010, in m3

Forest type	Area in ha.	Sustainable Yield
Malawi		
Miombo woodland	2,296,700	7,132,200
of which protected area	1,311,000	3,934,900
North		
Miombo woodland	914,300	3,657,200
of which protected area	372,800	1,491,200
Center		
Miombo woodland	710,200	2,130,600
of which protected area	567,500	1,702,500
South		
Miombo woodland	672,200	1,344,400
of which protected area	370,600	741,200

The figures for sustainable yield are then compared with the estimated consumption of indigenous wood to calculate depreciation. Most of these figures have already been discussed in previous sections of this report. Only one has not. The total household fuelwood consumption has been adjusted to subtract the amount of fuelwood that is estimated to come from wooded areas too small to be classified as forest in the satellite imagery. The IHS asks where households that gather wood go to get it. The results are shown in Table 24. We have assumed that household ("own") and community woodlots are less than half a hectare in area, and therefore are not captured as forest, whereas other areas are large enough to be captured as such. This means that the wood gathered from those areas can be deducted from total wood use in estimating the depreciation of natural forest. (It is, of course, possible that the woodlots are also being harvested unsustainably; however we have no information about that at all.)

Table 24: Source of Fuelwood

	Frequency	Percent	Valid Percent
Own woodlot	417804	13.6	16.5
Community woodlot	422172	13.7	16.7
Forest reserve	478023	15.6	18.9
Unfarmed areas of community	1139084	37.1	45
Other (specify)	74908	2.4	3
Total	2531990	82.4	100
System	540535	17.6	
Total		**3,072,525**	**100**

Using the IHS data on the value of woodfuel and the share that is purchased, we calculated the value of gathered wood for each household, the value of wood gathered from household or community woodlots in each region of the country, and the share of that value in the total value of gathered wood. As for other calculations, the expenditure shares are assumed to be the same as the volume shares, so we used the same shares to calculate the volume of wood gathered in household and community woodlots. These calculations can be seen in the worksheet entitled "Sources of gathered wood" in the study spreadsheet.

The final results of these calculations are shown in Table 25. It first summarizes household use of wood from natural forests. The data on institutional and industrial use of wood was

not available at the regional level, so it has been prorated based on population of the three regions. Finally, the bottom line in this table is the estimates of excess harvest above sustainable yield in each region of the country and for the country as a whole.

Table 25: Calculating Depreciation of Natural Forests

Total use of wood from natural forests, in m3	National	North	Center	South
Household fuelwood consumption:				
Total consumption	11,240,264	1,491,599	4,665,043	5,083,622
Less wood gathered from household and community woodlots	-3,378,142	-265,098	-2,088,327	-1,024,717
Household charcoal consumption	2,434,218	121,655	841,699	1,470,864
Institutional and industrial use of firewood, except brick-making	1,075,411	138,956	455,210	481,245
Brick-making	1,708,074	220,703	723,010	764,360
Total, natural forests	**13,079,823**	**1,707,814**	**4,596,635**	**6,775,374**
Sustainable yield, natural forests	**7,132,200**	**3,657,200**	**2,130,600**	**1,344,400**
Excess harvesting from natural forests	**-5,947,623**	**1,949,386**	**-2,466,035**	**-5,430,974**

Note: The shaded areas indicate data that have been allocated to regions based on population; the underlying data were only available at the national level.

Although it is widely assumed that Malawi's forests are being overharvested, especially in the southern part of the country, the depreciation figures from this study are even higher than expected. While the methods used to derive them seem reasonable, they are very uncertain. If better data become available on such issues as how much fuelwood or charcoal each household really consumes, the actual amount of wood required to fire bricks, or other parameters underlying this study, the results may change.

The depreciation of the natural forests must be subtracted from value added in order to calculate the contribution of the forest sector to GDP. To do this, a price must be identified with which to value the excess harvests. The price chosen is a weighted average of the two prices are implicit the previous calculations. The implicit price of household fuelwood is the total amount that households report they would have paid had they had to buy all of their wood, divided by the total quantity of wood consumed by households. This price comes to 6,020 kwacha. The other implicit price is the government sale price for industrial purchases of indigenous fuelwood, used to value the wood used by institutions and industries. The price used to value depreciation is the total value of wood used by households, institutions, and industries, divided by the total quantity of wood they use; it averages to 5,115 kwacha per cubic meter. Applying that to the excess consumption of wood above sustainable yield, we get a depreciation figure of just under 30.1 billion kwacha. These calculations are summarized in Table 26.

Table 26: Putting a Monetary Value on Forest Depreciation

Total value of fuelwood used by households	67,661,063,302
Volume of fuelwood used by households	11,240,264
Value per m3, fuelwood used by households	6,020
Value per m3 used to value institutional and industrial wood	2,500
Weighted average to value depreciation	5,115
Monetary value of depreciation	(30,090,209,747)

3.2 Depreciation of Government Plantations

In the case of the plantations, information with which to correctly estimate depreciation is limited. Because plantations are (or should be) closely managed and monitored, the estimates of sustainable harvest should reflect thorough knowledge of the age structure of the trees, their rate of growth, the rate at which they are harvested (either through selective

logging or by clear-cutting specific areas), the rate of replanting, and the survival rate of seedlings. Such information may exist for Malawi's plantations, but we could not access it for this study.

We did obtain some information suggesting that the plantations are not being managed in this way.[16] In practice, apparently, the government is clear-cutting and selling (or authorizing concession-holders to clear-cut and sell) enough forest each year to guarantee that they will bring in fixed amounts of revenue that the Treasury has set as targets. These targets bear no relation to how much wood can be harvested sustainably; they are purely financial. There is some replanting of cleared areas, but apparently less is being replanted than is being cleared, and the area replanted is not sufficient to ensure that the forest will be regenerated rather than eliminated. The impression given was that if this pattern continues, the plantations will be fully cleared of wood within about a decade.

With this approach to plantation management, the sustainability of harvests should be estimated by comparing the areas clear-cut with the areas replanted, bearing in mind how long it takes for trees to grow to maturity. If, for example, the trees would be optimally harvested after thirty years, then one thirtieth of the area of an optimally-managed forest could be clear-cut and replanted each year in order to ensure a sustainable supply of wood indefinitely (omitting, for the sake of simplicity, the possibility of loss due to drought, fire, pests, or other disasters). We do not have the data necessary to do these calculations, however.

In the absence of any such information, we have attempted to estimate plantation depreciation using the same approach as we took for natural forests. As shown in Table 21 above, the FRM data provide estimates of the area within pine and eucalyptus forests. The portion of that area classified as protected area refers to the government plantations, and the rest to plantations on tea and tobacco estates or other commercial activity; thus the protected area figures are the ones of interest to us. The rule of thumb for mean annual increment in a sustainably managed pine or eucalyptus plantations is about 15. Since we assume that these forests are being managed poorly, we have chosen to set MAI to 8.

We have three sources of data on wood harvests from the plantations in 2010. One is from a DoF spreadsheet on Viphya Plantation, the second an audit report on Viphya,[17] and the third the data provided to the National Statistical Office for use in the national accounts. The first source appears somewhat haphazard; more over it provides total values about one half those of the third source. The second source is only about the Viphya plantation; while it provides interesting information, it cannot be used to estimate plantation yields nationwide. We have therefore chosen to use the third, both because they represent the official harvest figures, and because they cover all plantations rather than only Viphya

The results of these calculations are shown in Table 27. It clearly shows the current harvest of plantation wood to be substantially below sustainable yield. This is not what we expected, based on other information. However, we have no basis for calculating plantation depreciation in any other way, so we will not deduct any depreciation of the plantations from GDP.

Table 27: Calculating Depletion of Plantations

Plantation Forest Area	84,000
Sustainable Yield at MAI=8	672,000
Wood harvested	231,552

[16] Personal communication, Marko Katila, 5 March 2013.
[17] Malawi Government, National Audit Office, 2011

The Viphya audit report may offer some explanation of these results. Table 4 of that report, on p. 36, charts the changes in forest cover in Viphya from 1999 to 2008. Those results are summarized in Table 28.

Table 28: Change in Viphya Plantation, 1999-2008

Total land area	53,000
Area harvested, 1999-2008	2,892
Area burned	22,063
Area replanted	5,231
Usable forest remaining	33,276

What is striking here is the area burned, more than 40% of the area of the plantation. While the visual observations that Viphya is half bare may well be correct, most of the forest lost was not harvested in a frenzy of illegal and unreported logging; it was burned (perhaps in a frenzy of politically motivated fire). The apparently much-too-low official statistics on forest yield for 2010 may well reflect actual harvests in that year; they are not intended to reflect the losses to fire in Viphya.

The fires create a question for the measurement of forest depreciation in GDP. The national accounts define depreciation as the loss in value of assets *due to economic activity.* This is only a subset of the possible reasons why assets may lose (or gain) value. The accounts track all of those value changes in what is known as the asset accounts. These measure the value of the asset at the start of the year, then include items for the change due to investment, depreciation, and the sale or purchase of assets. These are economic measures that are added to or deducted from revenue in order to calculate GDP. The asset accounts also track other changes that are not part of the calculation of GDP; in particular these include changes in value due to catastrophe. Even if the fires in Viphya were a political act, they would be classified as catastrophe, not as economic activity that is part of the depreciation deducted from GDP to calculate NDP. Decreased output in the future because of the fires will show up in future GDP; however the change in stock value of the asset in the year the fires occur is not deducted from GDP as depreciation. Thus despite the desperate condition of this plantation, in fact the estimates suggesting that in 2010 government plantations were not harvested above sustainable yield could be correct.

3.3 Overview: Forest Sector Contribution to GDP

With the completely of our income and depreciation analysis, we can summarize the components of forest sector GDP and NDP, as shown in Table 29.

These results are very different from the published national accounts data for 2010. The comparison is shown in Table 30, which shows the published 2010 GDP values[18] converted to current kwacha in order to permit a comparison with the study values. The published figures estimate the forest sector's value added at 8.7 billion kwacha, and its share of GDP at 0.99%. This study estimates gross value added of forestry at 75.9 billion kwacha, which would constitute 7.95% of GDP adjusted to include the higher forestry values. Malawi does not calculate depreciation or NDP, but even forestry net value added as estimated by this study is far higher than the NSO's published estimate.

[18] From http://www.nsomalawi.mw/index.php?option=com_content&view=article& id=150%3Agdp-by-activity-in-2007-constant-prices-in-mk-million&catid=10&Itemid=54

Table 29: Components of Forest Sector (ISIC 02) Net Domestic Product

Item	Contribution to Value Added	Source / Discussion
Plantations:		
DoF Plantation revenue	299,864	DoF revenues from firewood, log sales, license fees, and concessions. Data were provided by John Chunga, Head Accountant, DoF. They cover the period from July 2010 to June 2011; data for January-June 2010 were not available.
Less Depreciation of Plantations	not available	All evidence indicates that plantations are being harvested at an unsustainable rate; however the available data did not enable us to calculate it.
Use of natural forests:		
Department of Forestry revenues from natural forests	32,264	DoF royalties on indigenous timber sales (from natural forests). Data provided by John Chunga, Head Accountant, DoF, covering July 2010 to June 2011.
Household use of gathered fuelwood	63,375,930	Data from the Integrated Household Survey; this is the gathered share of the national total of what households would have spent on fuelwood had they purchased all that they consume.
Household fuelwood purchases	4,285,134	This value, calculated based on IHS data, captures the value added of those who sell wood to households.
Household charcoal consumption	not available	See discussion in technical report about the problems with charcoal price data in the IHS
Charcoal consumption by business		
Value added from household forest-based businesses	97,049	Data from the Integrated Household Survey
Provision of wood to institutions and industry (from which value added from household forest-based businesses has been subtracted)	6,698,556	Data on wood use by institutions and industry come from several sources; it is valued using the government's price per m3 for indigenous firewood.
Bamboo and poles	22,181	Data from the Integrated Household Survey; this includes both gathered and purchased consumption of these products.
Grasses for thatch	52,240	
Gross Value Added	**74,863,217**	**Sum of the previous items**
Less depreciation of natural forests	(30,090,210)	
Net Value Added, ISIC 02	**44,773,008**	**Contribution of the forest sector to NDP**

Table 30: Comparison of Published and Study Estimates of Forestry Gross Value Added

	National Accounts, in 10^3 current kwacha	Study Results
Forestry Gross Value Added, 2010	8,664,496	74,863,217
GDP	875,873,009	942,071,731
Forestry Share of GDP	0.989%	7.947%

4 Calculating Total Economic Value

The total economic value of the forest goes beyond its contribution to GDP. This term has a less precise technical definition than does the share of GDP, offering some flexibility in deciding what can be included in its calculation. Our analysis of TEV goes beyond the GDP calculations in a number of ways, including the following specific items:

- Total output of forest-based businesses
- Protected area revenues
- Nature-based tourism
- Watershed protection

4.1 Total Output of Forest-Based Businesses

The total output of forest-based businesses differs from the GDP calculations in two important ways. First, whereas the contribution of the forest sector to GDP only included ISIC 02, this category includes all sectors of the economy that depend heavily on forest resources. Thus in addition to forestry, we consider forest activities classified with agriculture, sawmills, furniture, twine and rope, wholesale and retail trade, and other sectors of the economy.

Second, whereas GDP calculations include the value added from each sector, the TEV calculations include the total sales of those sectors. This means that TEV includes the value of some of the goods consumed by forest-based businesses – the intermediate consumption that is subtracted in order to calculate value added. The inclusion of intermediate consumption in TEV means that the measure captures some of the additional consumption that occurs because of the manufacture of items using wood, or the transport of wood and charcoal to markets. Because the basic item – wood – is largely gathered rather than grown commercially, this does not entail a lot of double counting. What it does do is include the value of other products – transport, machine, and materials – for which there might not be any demand if their wood products were not being sold.

Data are available on two categories of forest-based businesses; large industrial companies surveyed through the NSO's annual economic survey, and household businesses surveyed through the IHS, which have been discussed earlier in this report.

4.1.1 Industrial Forest-Based Businesses

The NSO's annual economic survey (AES) gathers data about large formal-sector enterprises. In choosing this focus, its aim is to gather data about a significant proportion of the economy while carrying out a relatively small number of surveys. Because relatively few enterprises are actually surveyed, it is not possible to identify forest-related activities in that many sectors. Data are available for two sectors, ISIC 16 (sawmills) and ISIC 31 (furniture). Since furniture may be made of many products other than wood, not all of ISIC 31 can correctly be linked to forests; however there is no way to identify the portion that actually relates to wood furniture. No forest-related data are available about transport, wholesale, or retail trade; the transportation and trading companies included in the survey probably do include forest products among the items they handle, but there is no way to determine what share they represent.

The AES thus provides data for two sectors; these are summarized in Table 31[19] These may not be complete; as of the completion of this study, the NSO was still waiting for survey

[19] More detail about these two sectors from the AES may be found in the worksheet entitled "Annual economic survey" in the study spreadsheet.

responses from some companies. This is, therefore, a lower bound on the contribution of large companies to the sawmill and furniture sectors, and the information available from the AES underestimates the importance of large companies in all forest-based businesses.

Table 31: Key 2010 Data from the Annual Economic Survey

	ISIC 16	ISIC 31
Total sales	3,110,478	868,551
Changes in stocks	-12,213	22,728
Purchased material (intermediate consumption)	2,121,216	664,013
Gross value added	**977,049**	**227,266**
Compensation of employees	235,225	163,222
Number of employees	2,496	418

These values for sawmills and furniture are included in estimates of total economic value of the forests and the contribution of forests to livelihoods. They are not included in the contributions of the forestry sector to GDP, however, because that only includes activities that fall within ISIC 02, forestry. The total sales from these two sectors are included in our calculation of TEV. The data on compensation of employees and number of employees are used in calculating contributions to livelihoods.

4.1.2 Household Forest-Based Businesses

As discussed above, the IHS provides data on total sales, intermediate consumption, and value added in household-based businesses. The value added from those household businesses that are part of ISIC 02, forestry and logging, is already included in the contribution of forestry to GDP. The intermediate consumption of those businesses is added back into TEV, along with the total value of sales from all other sectors. These values are shown in Table 32, and may be found in the worksheet entitled "forest businesses" in the study spreadsheet.

Table 32: Sales, Intermediate Consumption, And Value Added From Household Businesses

Malawi Activity	Malawi Industrial Code	ISIC Revision 4	Total annual sales	Total annual expenditure (except labor)	Annual value added from forestry
Mixed farming	11	01	5,845,592	0	5,845,592
Forestry and logging	12	02	134,271,898	37,222,748	97,049,150
Mining and quarrying	29	05 to 09	189,084,472	0	189,084,472
Food, beverage, and tobacco processing	31	10 to 12	988,988	157,835	831,153
Textiles, cord and twine	32	13 to 15 (textiles), parts of 16 (cord and twine)	675,116,447	2,039,426,211	(1,364,309,763)
Wood-based manufacturing, sawmills, furniture	33	16, 31	5,594,290,024	2,783,292,636	2,810,997,388
Bricks, cement, concrete	36	239	49,878,276	10,919,645	38,958,631
Metal products and hand tools (a)	38	23, 24	13,418,454	-	13,418,454
Retail	62	47	17,006,488,970	6,338,061,422	10,668,427,549
Restaurants and hotels	63	55, 56	550,989	440,791	110,198
Education, medicine, professional services, etc.	93	69 to 75, 85	413,422,880	67,022,425	346,400,455
Total			24,083,356,991	11,276,543,712	12,806,813,279

(a) It is not clear why this was classified as forest-related. It may include manufacture of tools used to cut wood.

4.2 Protected Area Revenues

Protected areas provide an array of revenues to the government, which may be considered a component of total economic value. Revenues collected by the forest reserves are presumably included somewhere in the DoF data presented in the worksheet entitled "DoF Revenue 2010-2011" in the study spreadsheet. Unfortunately, it is not possible to disaggregate these revenues in the data available for this study, as the data provided to the DoF at the national level do not include that level of detail. The total DoF revenues that do not fall within ISIC 02 are included in the TEV worksheet of the study spreadsheet, so we have included the forest reserve entry fees even though we cannot identify them in particular.

Data for Mulanje collected for 2004 as part of the valuation of Mulanje Mountain suggest that the amounts involved are quite small.[20] Mulanje is generally thought to receive more tourist visits than any other forest reserve. In 2004, there were 941 visitor days on the mountain. Total DoF revenue from mountain tourism was 1.45 million kwacha, which includes revenues from entry fees, parking, and nights spent in the mountain huts. In addition, the surrounding community received another 2.8 million kwacha for payments to porters and guides. These amounts are very small compared to other sources of government revenue related to forests. While the data are out of date, there is no reason to expect that current visitor numbers or revenues would be very different.

Data on national park visitors and revenues, shown in Table 33, are only slightly better than those for forest reserves. The Parks Department provided revenue data for four parks, Liwonde, Nyika, Lengwe, and Lake Malawi. Data for Nkhotakota Game Reserve were provided by the proprietors of the two lodges there, Bua River and Tongole. No data are available for Kasungu National Park and or for the other three game reserves, Majete, Mwabvi, and Vwaza. Because they are incomplete, these figures provide only a lower bound on the contribution of national parks to total economic value of the country's forests; however they may suggest the order of magnitude of that contribution. The total revenue from these five protected areas, just under 44 million kwacha, plus the estimated revenue from Mulanje, is included in the total economic value of the forests.

The figures for non-paying visitors reflect the pricing schedule, which grants free entry to children under twelve, Malawian students, and public officials. The data available also show a category for "private" visitors, who do not pay entry fees; the Parks Department staff who provided us with the information could not explain this.

4.3 Nature-Based Tourism

The economic contribution of nature-based tourism has been estimated at extremely high values by other studies. Yaron et al (2011) assumes, in estimating the contribution of nature-based tourism to the economy, that most visitors to Malawi come because they are attracted by its nature and wildlife. As they put it, "… overseas visitors to Malawi are drawn primarily by Malawi's natural capital (and wildlife in particular), [so] we argue that the 2.7% of GDP share [estimated by the World Travel and Tourism Council] can be considered to reflect "nature-based" tourism…. It is true that some foreign visitors will be visiting relative or for business reasons but this is likely to be offset by domestic nature-based tourism."[21]

[20] Hecht, 2006. See the worksheet entitled "tourism" in the spreadsheet from the Mulanje Mountain valuation study for the full details on these data. This is available at www.joyhecht.net/mulanje/mulanje.html.

[21] Yaron et al 2011, p. 69.

Table 33: National Parks Data

	Liwonde	Lake Malawi	Lengwe (2012 data) (a)	Nyika	Nkhotakota	Total
Number of paying visitors	8,169	3,323	815	1,584	449	13,891
Park entry fee revenues	7,857,356	3,529,948	1,946,494	1,626,549	288,947	14,960,347
Calculated average entry fee	962	1,062	2,387	1,027		1,077
Number of non-paying visitors	5,881	2,991	n/a	n/a		not calculated
Share of paying visitors from abroad	74%					
Number of paying visitors from abroad (b)	6,053	2,462	604	1,174	202	11,323
Concession fees	24,581,719	1,373,603	1,124,085			27,079,406
Shop revenues	93,000					93,000
Sales of game meat	335,950	508,500	618,300			1,462,750
Sales of firewood		12,610	43,250			55,860
Game licenses			178,000			178,000
Guide fees			7,500			7,500
Total	**32,868,025**	**5,424,660**	**3,917,629**	**1,626,549**	**288,947**	**43,836,863**

(a) Data for Lengwe include only entry fees, not number of visitors, and they are for 2012. The number of visitors was calculated assuming that they are all foreign non-residents, and dividing revenues by the daily entry fee.
(b) Data for Nkhotakota provided by John Dickinson, proprietor of Bua River Lodge and Zane Volker, manager of Tongole Lodge. Tongole data are for 2012.

Unfortunately, this is not borne out by in national tourism statistics. Data in the 2011 Malawi Tourism report, summarized in Table 34,[22] show that only 27% of the 767 thousand foreign visitors to Malawi in that year came on holiday, whereas 60% came for work and the remaining 13% to visit friends and relatives (VFR).

Table 34: Number of Visitors by Purpose of Trip

Purpose	Number of visitors	Share
Holiday	206,127	26.9%
Work	459,958	60.0%
VFR	100,810	13.1%
Total	**766,895**	**100.0%**

In the absence of visitor surveys, we cannot accurately determine how many of the vacationers in Malawi were attracted by the country's forests. An estimate can be obtained, however, by relating the total number of vacationers coming to Malawi (2206 thousand) to the number of visitors to the country's national parks and forest reserves; presumably anyone who is attracted by the country's forests and wildlife from abroad is likely to visit at least one protected area.

Unfortunately, as discussed above, the data on visitors to parks and national reserves are limited, making these calculations quite inaccurate. Based on the data we have on five

[22] Provided by Charles Kachelenga, Department of Tourism. These calculations are carried out in the worksheet entitled "tourism" in the study spreadsheet. That worksheet also includes the relevant data provided by Mr. Kachelenga.

parks, combined with the 2004 visitor data for Mulanje, we have some evidence of just over 15,000 park visitors per year. There are two significant problems with this figure. On the one hand, we only have information about only a subset of national parks, game reserves, and forest reserves; therefore this value underestimates the number of visitors to the protected areas.

On the other hand, however, a large proportion of visitors to Malawi's parks and wildlife reserves are expatriate residents of Malawi rather than inbound tourists. Nkhotakota Game Reserve is the only protected area for which we know the share of expatriates in total visitors; they account for 66% of visitors to one of the two lodges in the reserve. The aim of these calculations is to determine the share of inbound tourists visiting protected areas, in order to estimate how much of the total vacation expenditures in the country may be attributed to the protected areas. The expenditures of resident expatriates do contribute to the economy and to park revenues, but they do not help to understand the contribution of protected areas in attracting expenditures from abroad. This means that data we have on paying visitors overestimate the number of inbound tourists going to protected areas and thus their share in overall tourism expenditures. (No data at all are available on domestic tourism expenditures; however in other countries they are consistently much lower than inbound expenditures[23]).

Because there are good reasons why the figures we have could both underestimate and overestimate the number of foreign vacationers visiting national parks, we have estimated the share of inbound tourist expenditures attributable to the forests using the figures that are available, rather than expanding or reducing them. The inaccurate in these calculations are evident; if better data become available on foreign visitors to protected areas, it will be straightforward to recalculate the share of tourist expenditures that may be attributable to the forests.

The Department of Tourism statistics on visitor expenditure come from the data entered on the departure cards completed by all travelers when the leave the country.[24] The card asks:

Were you on a prepaid holiday?	Yes		No	
Approximate expenditure in Malawi of all persons included on this card. Exclude amounts for prepaid holidays.....				
(Please state currency in which you are reporting expenditure):				

The data from the expenditure question are summarized in Table 35.

Table 35: Expenditure by Purpose of Trip

Purpose of Trip	Total Expenditure	Number of tourists
All	**59,889,663,848**	**766,892**
Holiday or Vacation	18,187,085,696	206,128
Work or Business	39,269,203,456	459,956
Visit Friends & Relatives (VFR)	2,433,202,696	100,808

[23] Based on Joy Hecht's experience working in detail with tourism expenditure data from Jordan and St. Vincent and the Grenadines.

[24] Full text of that card is included in the "tourism" worksheet of the study spreadsheet. It is also available on line at http://www.malawilii.org/mw/legislation/consolidated-act/1503

These figures must be adjusted, because they do not include amounts for prepaid holidays. Prepaid holidays are a difficult issue for tourism expenditure statistics. The tourist typically pays a lump sum that includes lodging, meals, local transportation, and perhaps some entry fees, entertainment, or other costs. The traveler does not know how the cost breaks down among the items. Moreover, it is difficult to determine how much of the cost remains in the traveler's home country vs. being spent in the country of destination. This is why this question asks tourists to exclude the amount they spent on prepaid holidays. However, since a significant share of the cost of prepaid trips does end up in the destination country, paying for hotels, transport, and so on, a portion of the cost of the trip should be included in total expenditure. Moreover, prepaid tourists are generally traveling on holiday rather than for work or to visit friends and relatives. We have therefore adjusted the expenditure figures to include estimated expenditures by those on prepaid trips, assuming that their expenditure per trip averages to the same amount as those of other travelers on vacation. We have further assumed that 20% of the cost of the prepaid trip remains in the home country as the margins of tour operators and travel agents, and the rest is spent in Malawi. The amount spent in Malawi is added to the total expenditure figure for those on holiday to obtain the total expenditures of those on holiday. This is then divided by the total number of tourists on holiday to obtain a new figure for average expenditure per visitor. Finally, the new average is multiplied by the number of visitors to protected areas to arrive at an estimate of the expenditures of inbound tourists who come to Malawi because of the country's forests and wildlife.

All of these calculations are shown in Table 36. While admittedly inaccurate, they suggest that forest-based tourist expenditures come to just under two billion kwacha per year. Note that this is not the contribution of this kind of tourism to GDP, because it is final expenditure by tourists, rather than the value added to the economy because of their expenditures. Value added from forest-based tourism would be lower than this, since it would not include the intermediate consumption of the hotels, restaurants, and other businesses where the tourists spend their money. This can be considered a part of the total economic value of the forests, however.

4.4 Watershed Protection

Forests play an important role in protecting the quality of downstream hydrological systems. When they are destroyed or degraded, particularly on steep slopes, it causes downstream harm in a number of ways:

- Water that would have been slowed or absorbed into the ground because of forest cover can rush down hillsides, taking soil with it. On agricultural land, this soil loss will reduce agricultural yields.

- The soil is deposited in rivers and streams. This sedimentation can directly clog water intakes for hydropower plants, drinking water treatment plants, or other industrial installations.

- The increased sedimentation increases nutrient levels in rivers, which can spur growth of weeds that clog water intakes for hydropower plants, drinking water treatment plants, or other industrial installations.

- In the absence of forests, severe rainstorms can more easily cause flash flooding, with consequent impacts to those living along stream banks or elsewhere in the path of the water.

Table 36: Expenditure by Forest-Based Tourists

Purpose of Trip	Total Expenditure	Number of tourists	Number of tourists not on prepaid trips	Exp/cap
All	**59,889,663,848**	**766,892**	690,991	MWK 86,672
Holiday or Vacation	18,187,085,696	206,128	130,227	MWK 139,656
Work or Business	39,269,203,456	459,956	459,956	MWK 85,376
	2,433,202,696	100,808	100,808	MWK 24,137
Expenditure adjustments for prepaid trips				
Number of visitors on prepaid trips	75,901			
Total expenditure for prepaid trips	10,599,999,471	Assumes that average expenditures of those on prepaid trips are the same as those of vacationers who are not on prepaid trips.		
Expenditures in Malawi on prepaid trips	8,479,999,577	Assumes that 80% of prepaid trip costs end up in Malawi; 20% remains in the home country as the margins of travel agents and tour operators.		
Total holiday expenditure	26,667,085,273	Assume all visitors on prepaid trips are on holiday, so all of the additional expenditure is assigned to holidays		
Average holiday expenditure	129,371	Includes those on prepaid trips and those who are not. This is lower than the average expenditure above because of the 20% share of prepaid trip costs assumed to remain in the home country.		
Expenditure by forest-based tourists				
Number actually visiting parks	15,281	This underestimates the number visiting protected areas, because it includes only five of nine parks and wildlife reserves, and only one forest reserve. However it overestimates inbound tourists visiting protected areas because it includes resident expatriates.		
Estimated share visiting parks	7.41%			
Estimated tourism expenditures by those visiting parks	1,976,979,296			

In Malawi, the costs imposed by such problems impose the greatest economic costs in the Shire River Basin, largely because most of the country's electric power comes from hydroelectric facilities on the Shire River. Deforestation in the Shire River Basin (along with other factors) has increased sedimentation of the river, contributed to the growth of water hyacinth and other weeds, and imposed direct financial costs on ESCOM and the Blantyre and Southern Region Water Boards in order to keep their systems operational. When the power company has been unsuccessful in responding to these threats, power has gone out, imposing direct financial costs on everyone who depends on that electricity.

Considerable work has been done to estimate the costs borne by ESCOM and the water boards due to sedimentation and weeds in the Shire River in the development of the Environmental and Natural Resources Management Action Plan for the Upper Shire Basin. Some of these costs are summarized in Table 37 and presented in the "Watershed costs" workbook of the study spreadsheet. There is considerable uncertainty regarding these figures, as is clear from the footnotes to this table. This does, however, give an idea of the orders of magnitude of the costs imposed by sedimentation in the river basin.

However, our interest is not directly in the costs imposed by forest loss; it is in the value of the services that are being provided by the forests that remain. The remaining forests are preventing the impacts on the Shire River and the downstream infrastructure from being even worse, and thus keeping ESCOM and the water boards from having to spend yet more to keep sediment and weeds from clogging their water intakes.

Table 37: Annual Costs Imposed on the Electrical System Due to Sedimentation

Cost Category	Annual cost / expenditure
Weed Management (1)	MWK 66,230,000
Sediment and Siltation Management (1)	MWK 72,510,000
Maintenance & Repairs due to weed, sediment, and silt (1)	MWK 71,860,000
ESCOM foregone earnings from power outages (2)	MWK 236,580,000
Losses to electricity consumers (3)	MWK 37,500,000
Total	**MWK 484,680,000**

(1) Source: LTS International, Economic Analysis, pp. 48-50 (LTS, June 2011b)
(2) Source: LTS International, Baseline Analysis (LTS June 2011a), p. 145, Table 4.11 It's not clear whether this applies to all losses due to weeds and sediment, or only those from the areas targeted by the ENRMAP project. This source also gives this value as $1.58 million, whereas source (1), p. 51 gives a value of $2.2 for the same costs, specifically for the Upper Shire area covered by the project. Source (1) p. 51 also says that the load losses due to weeds, silt, and sediment are 8% of ESCOM's total throughput. Source (2), p. 142, Table 4.8, gives total ESCOM revenue in 2008 as $48.91. At 8% loss, total revenue would have been $52.82 million, total loss $3.91 million, and losses due to the region covered by the project $0.98 million. So there is considerable inconsistency in these figures even within the same sources.
(3) Source: LTS International, Baseline Analysis (LTS, June 2011a), p. 144

If we could use the costs already imposed to estimate the additional costs that would result from more forest loss, then we could use those additional costs as a proxy for willingness to pay to prevent that forest loss, and thus for the value of the ecosystem services provided by the standing forests. However, this is not possible. The connection between additional deforestation and the costs borne by ESCOM, the Blantyre Water Board, and those who use their services depends on several distinct links, none of which we know about:

- What is the connection between deforestation and water flows? This is not a simple linear relationship; the way in which water flows off the landscape depends not only on the area deforested but also on the topography, the rainfall patterns, and so on.

- What is the relationship between water flows and sediment moving into the river? Again, this depends on physical features of the landscape and is not a linear function of area deforested or rainfall.

- What is the relationship between sediment in the river, nutrients in the river, and growth of aquatic vegetation?

- How are the costs imposed on the electric company and the water board related to sediment or the quantity of weeds? This will be lumpy rather than linear; moreover, the costs will differ depending on whether the technology required to address the problem involves removing weeds and sediment from the river or changing the water intakes so that the weeds and sediment are not a problem.

- What power outages will occur despite ESCOM's expenditures to prevent them? How much will businesses either lose due to power outages or spend on backup power supplies so that they will not actually experience the outages?

None of these relationships is straightforward; we cannot assume that costs imposed by deforestation will increase as a linear function of the area deforested or the quantity of wood removed from the forests. Moreover, other factors in addition to deforestation may lead to sedimentation of the river or increases in growth of aquatic weeds. These problems may also result from changes in agricultural practices, fertilizer runoff, road construction, dam construction, or other causes. The different causes also probably interact with each other in

such a way that it may not even be meaningful to attribute outcomes to one cause independently of the others.

Practically speaking, at present we do not know how much forest has been lost in the Shire River Basin, nor how much forest remains. This is a straightforward technical question, to which an answer may become available in the future with additional spatial data work. It requires relatively detailed time series land use/land cover data that could be overlaid with river basin boundary files. With such data, it would be easy to see how much forest has already been lost in the river basin, how much forest remains, and where it is. This may become available in the future, once the FAO or World Bank spatial data projects have been completed and river basin boundary files are produced; however these data were not available at the time when this study was carried out.

A more complex conceptual problem also makes it very difficult to put an economic value on the watershed protection services offered by forests at the national level. The availability of free-flowing clean rivers depends on many different inputs; land use, pollution, agricultural practices, weather, and so on. Activities that depend on that free-flowing clean water - electricity production and industrial processes, but also basic human survival - also depend on many other inputs. If any one of the inputs into river quality is changed, the river quality will be gone. And the loss of any one of the inputs into electricity, industrial processes, or human survival will destroy those important outputs. These inputs are pillars supporting a complex structure; pull out one pillar and the structure will collapse. But the fact that the structure would collapse if one pillar is pulled out does not mean that the entire value of the structure can be attributed to that pillar. Indeed, in this case there is no clear logic for allocating the value of the whole structure among the many pillars on which it depends.

When we are dealing with a marginal shift in one pillar - the river becomes somewhat sedimented - we can measure and value the impact of that change on the final output. Thus we can see how much ESCOM has to spend to deal with the current level of degradation of the river; that is a measurable response to a marginal change in river quality. But we have no clear way to go from observing and quantifying a marginal change to valuing the entire asset. Clean water is clearly essential to life, and loss of forests threatens clean water, but we cannot take the whole value of life and attribute it to the forests. What works to value a marginal change does not work to value the asset as a whole.

For all of these reasons, both conceptual and practical, we cannot come up with a value for the watershed protection services currently provided by existing forests in Malawi. Estimates of the value of such services tend to be hypothetical; they are based on the possible existence of future markets that do not exist now, such as possible REDD+ systems or payments for ecosystem services. These values depend on the implementation of policies or programs that will bring those markets into being. The values are derived from a cost-benefit analysis of the various possible policies, programs, and uses of the resources, through which analysts may calculate the impacts of different options on the financial well-being of specific groups of people, on government revenues, on Malawian society as a whole, or even on the whole world. Since, as discussed in the introduction to this paper, the focus of this study is on the current flows from the forests rather than their hypothetical value under different policy assumptions, it is not possible to include this kind of value within the total economic valuation of the forests.

In the absence of such values, we have nevertheless used the costs now being imposed as a lower bound for costs that would be borne if there were further forest degradation, and thus the value of the watershed protection services now provided by the forests. This is, of course, in no way a measure of the value of the remaining forest; however it is better to show some value, if only as a place-holder, than to leave it out altogether.

5 Contribution to Livelihoods

The contribution of the forests to Malawi's livelihoods can be measured in many different ways. This study has focused on several key issues:

- The number of households or individuals whose livelihoods depend, whether directly or indirectly, on forests
- The number of full-time-equivalent jobs provided by forest-based activities
- The revenue earned from activities that depend on the forests
- The value of goods gathered from the forests

Much of the data gathered in this section of the study is also included in either the contribution of the forests to GDP or the total economic value of the forests, so most of the calculations that go into estimating the contribution to livelihoods have already been discussed elsewhere in this paper. The data that fall within the livelihoods calculations are summarized in the worksheet labeled "Livelihoods" in the project spreadsheet, with full details in the other worksheets linked to that main one.

5.1 Employment in Large Companies

The data in this area come from the Annual Economic Survey, and are discussed above. As discussed there, the AES provides information about only two sectors, sawmills (ISIC 16) and furniture (ISIC 31). In 2010 those two sectors employed just under 3000 people, paying them a total of just under 300,000 kwacha. As discussed above, this is certainly an underestimate; however the nature of the survey is such that we cannot obtain information about the forest-dependent component of other sectors, such as transportation and trade, nor do we have data about small and medium-sized enterprises that are not household businesses.

5.2 Forest-Based Household Businesses

As discussed above household businesses, the IHS gathers data on employment, wages, and earnings from household businesses. In considering these data, it is important to bear in mind that not all households responded to all questions in the survey, leading to discrepancies in some of the summary data. Thus, for example, while all households with businesses reported on which household members work in the business, fewer households provided data on sales or profits. A total of 92,464 households have forest-based businesses; this is the total in the summary employment table discussed here, and in other tables above.

5.3 Openshaw Estimates of Biofuels Employment

Openshaw (2010) has estimated the employment generated by fuelwood and charcoal cultivation, processing, transportation, and distribution in Malawi. The results of that work are presented in Table 39 for comparison with the data from the household survey.[25]

[25] These data are presented in the worksheet entitled "Employment – Openshaw study" in the study spreadsheet.

Table 38: Employment and Earnings in Forest-Based Household Businesses

Activity	Number of households	Number of FTE household employees	Total household earnings	Number of FTE outside employees	Total wages
Mixed farming	457	141	3,775,083		
Forestry and logging	2,503	417	36,890,120		
Mining and quarrying	965	201	122,110,752		
Food, beverage, and tobacco processing	60	6	369,063		
Textiles, cord and twine	3,428	591	162,601,486	20	7,708,146
Wood-based manufacturing, sawmills	25,672	7,744	1,582,938,794	431	419,213,240
Bricks, cement, concrete	445	198	17,640,912	10	9,000,641
Metal products and hand tools	160	4	4,332,819		
Retail	54,073	13,607	4,999,715,123	564	1,474,274,176
Restaurants and hotels	52	6	118,609		
Education, medicine, professional services, etc.	4,648	957	195,062,936		
Total	92,464	23,872	**7,125,555,698**	1,026	1,910,196,204

Table 39: Openshaw (2010) Estimates of Biofuels Employment

	ISIC	Employment, in full time equivalents (1)	Earnings 2008, $US (2)	Earnings MWK (3)
Woodfuel				
Silviculture	021	5,375	$2,610,000	MWK 386,280,000
Production	022			
Production, Transport & Trade	022, 49, 47	63,148	$30,730,000	MWK 4,548,040,000
Total woodfuel		**68,523**	**$33,340,000**	**MWK 4,934,320,000**
Charcoal				
Silviculture	021	5,178	$2,520,000	MWK 372,960,000
Production	022			
Subtotal, Production, Transport & Trade	022, 49, 47	59,337	$28,870,000	MWK 4,272,760,000
Total charcoal		**64,515**	**$31,390,000**	**MWK 4,645,720,000**
Total		**133,038**	**$64,730,000**	**MWK 9,580,040,000**
(1) Source: Openshaw 2010 p. 272, Table 5 (2) Source: Openshaw 2010, p.273, Table 6				

The basis for the Openshaw estimates is not clear. The paper cites four sources for these values; Kambewa et al 2007, Owen et al 2009, a 1997 World Bank biomass energy strategy study prepared by Openshaw[26], and a 1992 World Bank energy sector study[27]. It does not explain clearly what data were provided by those studies, however, nor does it explain how they were used to derive the values shown above.

These figures are higher than comparable data from the IHS. Openshaw's work includes small and medium-sized businesses, whereas the household survey only includes household businesses; this probably explains part of the discrepancy. Openshaw's figures for employment and earnings from growing wood seem doubtful, however. There is little plantation forestry outside the government plantations and a few large agricultural estates

[26] Cited as World Bank. Biomass energy strategy study (prepared by Openshaw K). Malawi. Washington DC, USA: WB; 1997.

[27] Cited as World Bank. Malawi: issues and options in the energy sector. Joint UNDP/WB energy sector management assistance programme (ESMAP). Washington DC, USA: The WB 1992

(tea and tobacco); it is not clear what would account for ten thousand people working in silviculture, even if this includes the entire Department of Forestry. On the other hand, the two sources of data on processing, transport and sale of wood products are at least in the same ballpark as each other, which is reassuring; here it is quite plausible that the difference could be explained by non-household business activity.

5.4 Department of Forestry Employment

The Department of Forestry is a significant source of employment in the forestry sector. As discussed above, the DoF had about 5200 employees in 2010-11, receiving compensation of just over one billion kwacha per years. This contribution to livelihoods is the outcome of policy choices, not of market activity that depends on forest resources. The important market role of forest-based activity may be an argument for increased government support for the management of the sector; the current expenditures of the DoF itself must, of course, not be included in any figures that are used to justify increasing budget allocations to the Department.

Table 40: Department of Forestry Personnel, 2011-12

Activity	Number of employees	Total Compensation
Forest Management	882	250,439,928
Indigenous Forests	1,381	264,076,392
Plantations	2,944	520,184,796
Total	5,207	1,034,701,116
Source: Data provided by Department of Forestry		

5.5 Consumption of Gathered Resources

The contribution of forests to livelihoods includes the value of forest materials that are gathered for direct consumption. Of the gathered resources for which data are available, fuelwood is by far the largest, by orders of magnitude. The calculation of the value of gathered fuelwood has already been addressed, in the discussion on household fuelwood use; it is about 63.5 billion kwacha per year.

As discussed above, non-timber forest products for which values can be estimated include wood, bamboo, and grass. Table 41, repeated from Table xxx above, shows three values, classified differently in this analysis:

- The total value of what has been consumed is included in total economic value.
- The number of households using these products is part of the analysis of the contribution of these products to livelihoods.
- The value of the portion of product that is gathered is included in the contribution of forests to GDP and to the contribution of these products to livelihoods.

Table 41: Value of Non-Timber Forest Products (repeated from Table 20)

	Total value of what was consumed	Cost of the portion that was purchased	Value of gathered products
Wood and bamboo			
Number of households	26,748	26,494	
Average value	829	219	
Total value	**22,180,853**	**5,810,274**	**16,370,579**
Grass for thatching roof and other uses			
Number of households	45,935	45,935	
Average value	1,137	314	

Total value	**52,239,526**	**14,424,573**	**37,814,954**

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