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Preliminary economic asset and flow accounts for forest resources in Namibia

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Abbreviations

GNP	gross national product
MAI	mean annual increment
MET	Ministry of Environment and Tourism
NTFP	non-timber forest product
SNA	System of National Accounting

Abstract

The completion of the national forest inventory enabled a set of preliminary forest resource accounts to be developed for Namibia in 2004. Total woody resources volume for Namibia is an estimated 257 million m^3*. The currently used volumes are small relative to the physically utilisable potential. Similarly, economically feasible use in the next 30 years will involve only a portion of the physically utilisable sustainable yields. Nationally, stocks are not threatened, but regional and local depletion occurs. Local depletion might be ameliorated through greater commercialisation of production, or local forest management initiatives.*

The value of current forest use in terms of the gross output is some N$1.2 billion. This makes a direct contribution to the gross national product (GNP) of N$1 billion. This amounts to some 3% of GNP. This is roughly half the estimated contribution made each by agriculture, fishing, mining, and tourism. The total direct and indirect economic impact of the forest use sector on the broader economy was estimated at N$1.8 billion. Government is only capturing some 0.5% of the resource rents generated in the forest use sector through licence fees. Most rents accrue directly to low-income rural households, so there is little incentive for Government to capture more resource rent.

Namibia's standing forest assets (the natural capital stock) were estimated to have a value of N$19 billion. Forest stocks represent a significant national asset, comparable with those for fish, minerals and wildlife. Attempts to ameliorate forest depletion need to be focussed at the local level. Here, initiatives to strengthen community management of forest resources and promotion of commercial harvesting hold promise. Potential for commercial saw timber production could be developed with appropriate management planning to ensure sustainability. Capture of resource rent by Government should be restricted largely to commercial forest use activities, especially any large-scale saw timber extraction.

1. INTRODUCTION

This document describes the preliminary development of natural resource accounts for forest resources in Namibia. This work follows and completes that of Björkmann (1999), who developed a partial set of accounts.

True forest is absent from Namibia, and *forest resources* are here defined as all woody plants that occur in the woodlands and shrublands (savannas) of the country. Namibia embraces some 824,000 km^2 on the south-western coast of Africa, and has a human population of 1.8 million. The climate ranges from extremely arid in the west and south, to semi-arid in the north-east. Woody resources are extremely sparse in the arid desert environment, but increase in density toward the north-east, through shrubland and savanna habitats commonly dominated by *Acacia* species, *Terminalia* species and *Colophospermum mopane*, to woodland where *Burkea africana*, *Combretum* species and *Baikiaea plurijuga* tend to dominate. Almost no planted forests occur, and the accounts deal exclusively with natural forest resources.

Natural resources have several types of economic value, and in resource economics, these values are commonly classified in the framework of "total economic value". *Total economic value* embraces direct use values, indirect use values, and non-use values. Direct use values derive from the direct use of the resource, i.e. in production of tangible goods, usually with market value. Indirect use values derive from the resource's value in ensuring ecological function, such as watershed conservation. Non-use values derive from the value of preservation of the resource either for future use (*option value*), for its mere existence (*existence value*), or to bequeath to future generations (*bequest value)*. The preliminary forest accounts deal exclusively with direct use values.

The direct use values derived from the use of Namibia's natural shrubland and woodland resources come from harvesting fuel wood and poles for the construction of houses and fences. The wood harvested is mostly consumed directly by rural households, but is also for limited sale in urban areas. In the past, commercial harvesting of saw timber took place in the woodlands of the north-east. Here, resources of saw timber, including species such as *Baikiaea plurijuga, Pterocarpus angolensis, Guibourtia coleosperma*, and *Burkea africana*, exist on Kalahari sand. No commercial extraction of these species currently takes place. Forest use value also comes from other plant products, most of which are harvested for home consumption by rural households. These non-timber forest products (NTFPs) include plant products for craft production (carving, basket-making); plant products for food, medicine and cosmetics; and grass for thatching. The forest accounts do not include the use of woodlands and savannas for livestock grazing or for their wild fauna. These activities are considered best treated in separate accounts.

The forest accounting activity forms one component of a broader national natural resource accounting programme being undertaken by the Environmental Economics Unit of the Ministry of Environment and Tourism (MET). The latter programme extends the conventional macroeconomic national accounts through the development of satellite asset accounts for natural resources such as fish, forests, minerals, water and wildlife. While the *use* of these natural resources has been included in the conventional national accounts, the resources have not been accounted for as *assets*. National accounts have historically only incorporated man-made or owned assets. However, exclusion of natural assets from the national accounts prevents sound planning for sustainable development.

In natural resource accounting, the natural assets are valued in two ways. First, the annual contribution of the resource to the national income, in terms of direct use values, is measured in a production, or flow, account. Second, the value of all existing stocks of the resource is estimated in an asset account. Here, the value of the stock, as a national capital asset, is measured in terms of its potential to generate resource rent (also known as *economic rent* or *excess profit*) in the future.

2. METHODS

Table 1 provides a summary of some of the criteria and assumptions used in the development of the forest accounts. The approach and methods used to derive these criteria and assumptions, as well as the accounts themselves, are described below. Monetary values in this paper are given as Namibia Dollars (N$) at 2004 prices. In 2004, N$1.00 was equal to R1.00 (South African Rand), P0.75 (Botswana Pula) and US$0.16 (United States Dollars).

Table 1. Some key criteria and assumptions applied in the forest accounts for Namibia, 2004[1]

Measure	Units	Forest products			
		Fuel wood	**Poles**	**Saw timber**	**NTFPs***
% stock physically usable	%	90%	15%	1%	–
Yield/physically usable stock	%	7%	7%	6%	–
% annual yield currently used	%	6%	12%	0%	–
% annual yield economically usable	%	16%	27%	50%	–
Yield (mean annual increment) by Region					
Caprivi	m^3/ha/year	1.7310	0.2885	0.0821	–
Erongo	m^3/ha/year	0.0036	0.0006	–	–
Hardap	m^3/ha/year	0.0036	0.0006	–	–
Karas	m^3/ha/year	0.0014	0.0002	–	–
Kavango	m^3/ha/year	1.2960	0.2160	0.0199	–
Khomas	m^3/ha/year	0.0090	0.0015	–	–
Kunene	m^3/ha/year	0.0054	0.0009	–	–
Ohangwena	m^3/ha/year	1.4400	0.2400	0.0200	–
Omaheke	m^3/ha/year	0.0900	0.0150	–	–
Omusati	m^3/ha/year	0.1447	0.0241	–	–
Oshana	m^3/ha/year	0.0405	0.0068	–	–
Oshikoto	m^3/ha/year	0.6178	0.1030	–	–
Otjozondjupa	m^3/ha/year	0.2106	0.0351	–	–
Consumption per household	m^3/year	4.60	4.37	–	–
Price per m^3	N$ (2004)	634	529	5,753	
NTFP value/fuel wood value	%	–	–	–	64%
Direct value added	%/output	94%	89%	66%	68%
Total value added	%/output	149%	149%	114%	149%
Income multiplier	Factor	1.71	1.71	1.59	1.71
Resource rent	%/output	84%	73%	41%	68%

* Non-timber forest products (NTFPs) used for food, medicine, cosmetics, craft-making and thatching

2.1 Approach

The asset and flow accounts were developed in accordance with the standardised methodology for natural resource accounting – the Integrated Environmental and Economic Accounting/IEEA Manual – developed by the United Nations (2000) and later refined (UN, EC, IMF, OECD & WB 2003). The methods have also been described in manuals by Eurostat (2002) and Lange (2004a). The IEEA Manual was developed to complement the

[1] See text for details

conventional, internationally adopted System of National Accounts (SNA), used to measure economic performance in most countries around the world (CEC, IMF, OECD, UN & WB 1993). Conventional national accounting incorporates capital accounts, but tends to restrict these to assets that are owned or man-made. IEEA, on the other hand, aims to include accounts for natural resources that are not man-made, such as natural forests, fish and wildlife, in the national economic data records and the planning process.

The approach involved developing physical accounts for national natural forest assets. These detail the standing volumes of woody resources in each administrative Region of the country. Then the current annual use of these resources is detailed in flow accounts; the latter present the volumes and economic characteristics of this use. Flow accounts measure use in terms of output, contribution to gross national product (GNP), and employment, in conformity with the SNA. The physical accounts are then valued in order to produce monetary asset accounts, so that changes in the capital value of forests can be measured. As stated previously, the value of natural assets is measured as the resource rent that can be generated from their use in the future.

The valuation of renewable natural resource assets such as forests, fish and wildlife can be done in several ways (UN 2000; UN, EC, IMF, OECD & WB 2003). The most appropriate of these, namely the Net Present Value Method, estimates the present value of all future returns in resource rent from the use of the resources. In the absence of realistic data on future use and discount rates, other – less satisfactory – alternatives are often employed such as the Net Price Method or, as it is referred to in the case of forests, the Stumpage Value Method. The Net Price Method measures the annual resource rent, which is simply the difference between the market price (unit export value) and the cost of extraction or use, including a normal return on the investment in capital.

In this study we used the Net Present Value Method, with streams of rents from expected growth in use over the next 30 years. Forest stocks tend to be stable and their future use pattern predictable. With resources such as fish and minerals, future stock and use values are much less predictable and, to value these, others (e.g. Lange 2004b; Lange & Hassan 2003) have had to assume no growth in use (constant rent) into the long-term future.

An important consideration in valuing natural asset stocks is that resources that are not exploitable, either for legal or economic reasons, have a zero value. Thus, only that portion of the natural stocks that could realistically be brought into viable production in the future was valued.

The accounts developed are for the year 2004. Asset accounts should include consideration of depletion, degradation, conversion and accumulation of stocks during the accounting year. The changes in volume and value of stocks can then be accounted for over time. The current use of forest products is significantly below the sustainable and economically possible potential for this use, and data are lacking to measure changes in overall stock volumes. In any case, at this stage, such changes are expected to be extremely small, relative to the overall stock.

2.2 Field survey

A specific household and focus group survey was conducted to obtain data on the use of forest resources (fuel wood, poles, and NTFPs) among rural residents. This provided measures associated with resource use and sales, which, combined with parameters extracted from the literature, enabled computation of the accounts.

A stratified sample of 182 households in the Ohangwena, Omusati, Oshana and Oshikoto Regions of north-central Namibia was targeted. The sample was designed to cover residents in all the biomes present in the Regions. Household sampling within biomes was randomised. The questionnaire was aimed at obtaining quantitative information on a basic household profile; volumes of forest products harvested, consumed and sold; prices; harvesting costs; and the relative importance of forest income to household livelihoods. The questionnaire was finalised after two pilot surveys, each of which involved ten respondents. Two graduate economists and four undergraduate enumerators, who were trained prior to the survey, were deployed. Household heads were interviewed in Oshiwambo for approximately one hour.

A sample of 25 forest product traders and trader groups in the north-central Regions were targeted by means of a similar questionnaire designed to solicit information on volumes, prices and costs for trading in fuel wood, poles and NFTPs. This complemented the household survey, and provided additional information on the size and characteristics of product market chains. The sampled entrepreneurs were from both rural and urban locations, and were both full-time and part-time traders. They operated at open markets in Ondangwa and Oshakati, and on public roads across the survey area. The field survey also involved engaging with local forestry experts, regional councillors and regional development planners to formulate an overall picture of the use and potential of the forest sector in the study area.

2.3 Standing woody resource volumes

The forest *asset* account was based on information regarding standing woody biomass volumes, which had been assembled by the national forest inventory subcomponent of the Namibia–Finland Forestry Programme in the Directorate of Forestry. These data are presented in various Directorate reports. The standing volumes make up the physical asset account.

Standing volumes were assembled for each Region in the country. In some cases, Region-wide inventory estimates were available, e.g. for Caprivi (Chakanga et al. 1998a), Omusati (Selänniemi et al. 2000a), Oshana (Selänniemi et al. 2000b), Oshikoto (Angombe & Laamanen 2002) and Otjozondjupa (Korhonen et al. 1997). These estimates were used as benchmarks and, for the other Regions, local inventory estimates and ecological information were used to interpolate and extrapolate estimates. Local estimates were extracted from, in order of relative importance, Chakanga et al. (1998b, 1999), Chakanga and Selänniemi (1999), Angombe et al. (2001, 2002), Laamanen and Angombe (2001), Laamanen et al. (2002), Mulofwa et al. (2002), Kanime (2002, 2004), Kanime and Laamanen (2002, 2003), Kanime and Kakondo (2003), Kamwi (2003a, 2003b), Boois (2004), and Mwilima and Boois (2004). Standing volume estimates made in similar habitats in Botswana (Nickerson 1984, ERL Energy Resources Ltd 1985, Norwegian Forestry Society 1992) were also used to corroborate the interpolations and extrapolations.

Standing volumes, specifically as regards the more valuable saw timber species that occur in the north-east, were also obtained from the inventories. Estimates for the whole Caprivi Region were provided by Chakanga et al. (1998a), and local measures – extracted from Chakanga et al. (1999), Angombe et al. (2000, 2001), Kanime and Laamanen (2002), Mulofwa et al. (2002) Kamwi (2003a, 2003b), Kanime and Kakondo (2003), and Kanime (2004) – were used to interpolate and extrapolate estimates.

2.4 Current use of woody resources

The flow account requires a measure of the current use of natural woody resources. Current use has tended to be restricted to areas relatively close to human settlement. In Namibia, fairly extensive tracts of natural woodland and savanna are uninhabited, and are not currently utilised. For fuel wood and poles, the approach employed to get aggregate output values was to multiply the estimates of product sales/consumption per household, by the numbers of households that make use of these resources in each Region. Results from the National Population and Housing Census of 2001 (unpublished data, 2004; Central Bureau of Statistics, National Planning Commission) contain statistics on the proportions of households in each Region that make use wood for fuel and poles for construction and fencing.

Measurements of fuel wood consumption are highly variable, so the annual consumption of fuel wood, per household and per capita, was calculated by averaging results from 12 studies in South Africa, and 6 studies from Namibia. Besides a personal communication from S el Obeid (2005), these were extracted from Shackleton et al. (2004), Ollikainen (1991), and Bembridge and Tarlton (1990), as well as from our own survey, as described above. After two outliers were excluded, the average came to 4.60 m^3 per household, or 0.88 m^3 per person per annum. For pole consumption, our survey estimate was combined with data from the forest inventory (Selänniemi et al. 2000a, 2000b) to derive an average (4.37 m^3 per household, or 0.83 m^3 per person per annum). Where it was necessary to convert fuel wood and pole units from cubic metres to tonnes, a factor of 0.8 was applied following the *South African forestry handbook* of Odendaal et al. (1983).

Several studies in southern Africa have provided estimates of the values of use of both NTFPs and fuel wood. Our own survey provided these data as well, as did those by Dovie et al. (2002) and Shackleton et al. (2002). We used an average of the ratio between the values for NTFP and fuel wood use, derived from three case studies in South Africa and our own in Namibia. Thus, we estimated that for every N$1 of fuel wood value produced, N$0.64 of NTFPs was produced. We then applied this ratio to the wood fuel use values for the Regions to get a measure of value for NTFP use.

Since products consumed directly by households have no market value, they were valued at replacement cost, i.e. using the market prices received when these products were sold. However, there is a dearth of current price information for informal market products, so the approach taken to value products was to estimate averages for prices recorded in surveys and in the literature from Botswana, Namibia and South Africa. Where necessary, prices were adjusted to 2005 Namibia Dollar levels, using first the appropriate inflation rates, and then the current exchange rates. Similarly, prices for wood fuel were obtained from our own survey as well as from LaFranchi (1996), Loxton, Venn & Associates (Botswana) (Pty) Ltd (1986), Ntshona (2002), and two case studies by Shackleton et al. (2002). Prices for poles were taken from our own study as well as that of Loxton, Venn & Associates (Botswana) (Pty) Ltd (1986), two case studies by LaFranchi (1996), and three case studies by Shackleton et al. (2002). Ex-sawmill prices for commercial saw timber (mostly blend prices for *Baikiaea plurijuga* and *Pterocarpus angolensis*) were obtained from case studies in Namibia (Björkmann 1999; Loxton, Venn & Associates and Plan Medewerkers 1985) and Botswana (Norwegian Forestry Society 1992).

2.5 Potential use of woody resources

The forest asset account requires the potential of the standing forest stocks, as measured in the physical asset account, in order to produce resource rent in the future. Depending on the forest product itself, only part of the total standing stock is physically suitable for use. Furthermore, at least in Namibia, for economic and policy reasons only part of the physically suitable stocks will be exploited in the future. Some stocks cannot be viably exploited from an economic point of view, as they are too remote from human settlement and infrastructure, or have restricted markets for their products.

The proportion of standing woody volume that was physically utilisable for fuel wood was estimated at 90%, allowing for a component of that volume which would be unsuitable. Using the estimates of – in order of importance – Kanime and Laamanen (2003), Mwilima and Boois (2004), and Boois (2004), the proportion of standing volume physically utilisable for poles was assumed to be 15%. These percentages were applied to the standing volumes to derive volumes and yields per Region for physical wood fuel and pole potential. The physical asset account includes estimates of standing volumes for high- and medium-quality commercial saw timber (see above), and these volumes in themselves make up the physical saw timber potential.

As stated, the physically suitable resources may not all be economically exploitable. Also, it should be noted that there is some overlap between the physically suitable potential for different uses. Thus, for example, should all the physical fuel wood potential be used, then some pole potential would have to be sacrificed. A choice would then be required, and normally the most valuable use would get priority. However, should current and/or economically viable future use levels be sufficiently less than the physical potential, then no choice between uses would need to be made.

Mean annual increments (MAIs) were estimated to gauge the sustainable annual production potential of physically utilisable standing volumes for fuel wood, poles and saw timber. Measurements of MAI were not made during the national forest inventory, so it was necessary to use the few available estimates from comparable habitats around the southern African region. Thus, MAI values for the woodlands and savannas in each Region were estimated using data from – in relative order of importance – Nickerson (1984), ERL Energy Resources Ltd (1985), Loxton, Venn and Associates (Botswana) (Pty) Ltd (1986), Musokotwane and Kufakwandi (1986), Loxton, Venn and Associates and Plan Medewerkers (1985), Millington et al. (1989), Timberlake (1999), and Scholes and Walker (1993).

The main constraints to economically viable fuel wood and pole harvesting are remoteness, transport costs, spatially restricted markets, and market size. Similar constraints affect expansion of the use of NTFPs. We assumed that the use of these products would grow as human populations grew, and as new initiatives developed in the harvesting and sale of these products for commercial purposes. Thus, within a 30-year future discount period, and in those Regions where physically suitable potential existed, fuel wood harvesting activities were calculated to increase by 200% to account for rural population growth, and by a further 150% to account for new initiatives in commercial harvesting for urban markets. Similarly, pole use could be expected to increase by 200% as populations grew, and by a further 140% as new commercial production initiatives developed. Growth predictions for each Region were restricted so as not to exceed the estimated sustainable yields of physically suitable material in the Region concerned. It was assumed that demand in excess of future production in these Regions would be met from other non-timber sources, even though some of the demand may be met from harvests in other more productive Regions.

No current saw timber harvesting takes place in Namibia at present, but it is expected to be developed and expanded within the future discount period. Potential extraction volumes – and yields – could be derived from the inventory recourse volume data. About 50% of the saw timber resource was considered too remote and inaccessible for economically viable use in the next 30 years.

2.6 Valuation of flow and asset accounts

The value of the current and potential output of forest resources is the product of the volumes produced and the market prices, as described above. A proportion of this output represents the direct contribution of the resource in terms of value added to the GNP, as measured in the flow account. Another proportion of this output represents the amount of economic rent that the resource generates.

The Environmental Economics Unit uses a system of models, originally developed by Barnes (1998), to measure the financial and economic values associated with natural resource use. These are detailed budget and cost-benefit analyses that measure returns to investors as well as the national economy. Such models have been developed for household forest use activities such as harvesting fuel wood, poles and thatch-grass, harvesting for craft production, and harvesting for commercial timber and saw milling (unpublished data, 2004; Directorate of Environmental Affairs, Ministry of Environment and Tourism).

For the monetary flow account, the models were used to calculate the direct contributions of forest uses in terms of *value added* to the GNP. *Value added* is defined as the return to the internal factors of production in the activity, namely capital, labour and entrepreneurship. The value added is calculated in the models as a residual by subtracting intermediate expenditures from the gross output or total revenue. Value added/output ratios were then applied in the flow account to determine the *direct economic contribution* of forest use activities. The direct contribution creates further demand in the broader economy through indirect multiplier and linkage effects. This represents the *total economic contribution*, or impact of forest use in the economy. As an example, the use of transport services in fuel wood harvesting would indirectly involve further value added being generated in the transport sector. The flow account included a measure of this total impact. To measure the total economic contribution, a social accounting matrix model of the Namibian economy was used (Lange et al. 2004).

For the monetary asset account, the financial and economic models were also used to calculate the *resource rents* generated in forest use activities. These economic rents are also calculated as a residual – by subtracting intermediate expenditures, the compensation of employees, the consumption of fixed capital, and normal profit from the gross output or total revenue. Normal profit was assumed to be a 15% return on initial fixed capital. The rent calculations were used in valuing the assets, using the Net Present Value Method. The portion of standing woody resource stocks that was not likely to be used economically in the foreseeable future was given a zero value in the monetary asset account.

The amounts of the resource rent generated in the forest sector by local communities, Government and others were also calculated using the models mentioned. Further details on rent capture by Government were obtained from Directorate of Forestry statistics on sales of licences to harvest, transport and trade forest products (unpublished data, 2004; Directorate of Forestry, Ministry of Environment and Tourism).

3. RESULTS AND DISCUSSION

3.1 Physical forest account

Table 2 shows the physical volume estimates for woody resources in Namibia per Region. The volumes are presented as average volumes per hectare for each Region, and then as the total estimated volumes for each Region and the whole country. Volumes per unit area range from 21.4 m^3 per hectare in the north-east (where volumes of 70–80 m^3 per hectare are found in better-developed teak woodlands) to 0.05 m^3 in the southern Karas Region, where trees are small and restricted largely to drainage lines. Total volume for Namibia is an estimated 257 million m^3. As stated, there are no reliable data available to measure change in woody biomass due to the conversion of forest to cropland, or due to damage by fire or wild animals during 2004. Nonetheless, in the context of the total stock, such change is likely to be extremely small.

Table 2. Estimated forest standing volumes per hectare and aggregate, and physically suitable annual yields for fuel wood, poles, and saw timber, 2004

Region	Forest biomass*		Physically suitable annual yield**		
	Density	Volume	Fuel wood	Poles	Saw timber
	’000 m^3/ha	’000 m^3	’000 m^3/year	’000 m^3/year	’000 m^3/year
Caprivi	21.37	30,916.0	2,504.2	417.4	118.8
Erongo	0.10	635.9	22.9	3.8	0.0
Hardap	0.10	1,096.6	39.5	6.6	0.0
Karas	0.05	805.4	21.7	3.6	0.0
Kavango	18.00	87,269.4	6,283.4	1,047.2	48.2
Khomas	0.25	921.5	33.2	5.5	0.0
Kunene	0.20	2,303.1	62.2	10.4	0.0
Ohangwena	20.00	21,388.0	1,539.9	256.7	4.3
Omaheke	2.00	16,888.0	760.0	126.7	0.0
Omusati	3.22	8,538.4	384.2	64.0	0.0
Oshana	0.90	781.4	35.2	5.9	0.0
Oshikoto	11.44	44,237.3	2,388.8	398.1	0.0
Otjozondjupa	3.90	41,080.3	2,218.3	369.7	0.0
Total		**256,861.3**	**16,293.5**	**2,715.6**	**171.3**

* Total standing stock of woody resources
** Physically suitable or utilisable yields from standing biomass, not necessarily economically exploitable

Table 2 also shows the estimated sustainable harvest of wood fuel, poles, and saw timber from the total stocks, in terms of what is physically utilisable or suitable for use. These yields are some 16 million m^3 per annum for fuel wood, 2.7 million m^3 per annum for poles, and 170,000 m^3 per annum for saw timber. Economic factors such as remoteness, access, market size, and the size of rural populations would preclude use of all these yields, however.

3.2 The value of forest use

Table 3 shows the estimated volumes actually harvested in 2004. Some 1 million m^3 of fuel wood and 334,000 m^3 of poles were harvested. It also shows the estimated economically utilisable annual potential yields, after 30 years of expected future expansion. These are the estimates of what could realistically be used in the next 30 years, given the economic constraints on the increase of use. In 30 years the current harvest could more than triple itself. In the longer term, as increasing human populations and infrastructure allow more of the forest stocks to be economically harvested, this use of the potential yields should grow even further. The currently used volumes (i.e. 6% for fuel wood and 12% for poles) are small in relation to the physically utilisable potential (see Table 2). Similarly, economically feasible use in the next 30 years is likely to take only a portion of the physically utilisable sustainable yield, i.e. some 16% for fuel wood, 27% for poles, and 50% for saw timber.

Table 3. Estimated harvest volumes for fuel wood, poles and saw timber, 2004, and their economically utilisable potential annual yield after 30 years

Region	Current annual harvest			Projected annual harvest in 30 years' time*		
	Fuel wood	Poles	Saw timber	Fuel wood	Poles	Saw timber
	'000 m^3/year	'000 m^3/year	'000 m^3/year	'000 m^3/year	'000 m^3/year	'000 m^3/year
Caprivi	65.8	5.5	0.0	220.0	18.5	59.4
Erongo	21.8	6.8	0.0	22.9	3.8	0.0
Hardap	34.8	0.3	0.0	39.5	1.0	0.0
Karas	22.9	4.1	0.0	21.7	3.6	0.0
Kavango	141.4	52.5	0.0	472.9	175.7	24.1
Khomas	21.4	2.1	0.0	33.2	5.5	0.0
Kunene	47.6	2.4	0.0	62.2	7.9	0.0
Ohangwena	171.2	59.1	0.0	572.4	197.7	2.1
Omaheke	44.3	0.7	0.0	148.2	2.5	0.0
Omusati	175.0	77.4	0.0	384.2	64.0	0.0
Oshana	91.5	46.0	0.0	35.2	5.9	0.0
Oshikoto	114.2	74.1	0.0	381.8	247.6	0.0
Otjozondjupa	70.8	3.4	0.0	236.8	11.3	0.0
Total	**1,022.7**	**334.4**	**0.0**	**2,631.0**	**745.0**	**85.6**

* Expected yields after economically feasible expansion over the next 30 years

It is clear that at the national level, both the current annual harvest and the annual harvest expected in 30 years' time are much less than the physical potential. These harvests are sustainable and, on a national level, there is no depletion of the stocks through use. On a regional scale, however, there may be depletion. Comparison between estimated current harvests (Table 3) with the estimated physically suitable sustainable yields (Table 2) suggests that current harvest might exceed sustainable yields: in Karas and Oshana for fuel wood, and in Erongo, Karas, Omusati, and Oshana for poles. This was detected by Selänniemi et al. (2000a, 2000b) in the forest inventory reports for the Omusati and Oshana Regions. Although demand in these Regions may be being met from harvests in adjacent Regions, local-level studies have shown evidence of over-harvesting in, for example, the Cuvelai delta, embracing Omusati and Oshana (Erkkilä 2001), and elsewhere in the immediate vicinity of concentrated settlements. Overall, however, stocks are not threatened, and regional and local depletion problems will need to be solved through greater commercialisation of fuel wood and pole production as well as local forest management initiatives.

Table 4 shows some financial and economic characteristics of forest use enterprises, as extracted from the financial and economic models. Typical enterprises for small-scale fuel wood, pole and NTFP harvesting are depicted. The NTFP example used is grass collection. The saw timber extraction model is of a large-scale commercial enterprise producing saw-milled *Baikiaea plurijuga* and *Pterocarpus angolensis* planks. All enterprises make efficient use of capital and are financially profitable for the resource user or investor.

Although the proportion of resource rent to output is very high in all enterprises, it is more so in small-scale enterprises, particularly in fuel wood harvesting. This is to be expected since labour inputs make up a very high proportion of the costs.

Apart from basic saw milling, the forest accounts do not include the processing of forest products. The use of forest products in building, furniture manufacturing and craft production is excluded, therefore. Nonetheless, the value of these activities is captured in the estimates of the indirect contribution which forest use makes to the economy (see Table 5). It is interesting that enterprise models of craft production (e.g. Terry 1999) appear to show relatively low generation of value added and resource rent, compared with raw material collection enterprises like those shown in Table 4.

Table 4. Characteristics of some typical forest use enterprises, extracted from empirically derived financial end economic models, 2004

Characteristic	Units	Enterprises			
		Small-scale: Fuel wood*	**Small-scale: Poles***	**Commercial: Saw timber****	**Small-scale: NTFPs*****
Volume produced	m^3/annum	5.50	6.12	15,000	–
Financial (private) values					
Initial capital	N$	900	900	6,059,900	1,100
Gross output	N$/annum	4,300	2,100	23,003,300	3,400
Variable costs	N$/annum	100	100	9,060,400	600
Fixed costs	N$/annum	500	400	4,513,100	1,000
Net profit	N$/annum	3,700	1,500	9,429,800	1,800
Internal rate of return	%, 10 years	153%	84%	37%	79%
Net present value	N$, 10 years	19,300	7,700	35,650,800	7,800
Economic values					
Gross value added¶	N$/annum	4,300	1,900	16,150,900	2,200
Value added/output	%	94%	89%	66%	67%
Resource rent#	N$/annum	3,600	1,500	9,228,100	1,800
Rent/output	%	84%	73%	40%	62%

* Data from our own specific survey in the communal areas of the north-central Regions; some parameters differ from those used in the accounts (Table 1)

** Derived from data in Bjorkmann (1999) in Namibia, and Norwegian Forestry Society (1992) in Botswana

*** Data from grass-collection enterprises: derived from this study in the Caprivi Region, and from Terry (1999) in Botswana

¶ Gross output, less intermediate expenditures

\# Gross output, less intermediate expenditures, cost of labour, and cost of capital

Table 5 shows the estimated value of Namibia's use of forest resources in 2004. This is given as the gross output (the aggregate turnover of all forest use activities), the direct contribution of forest use to GNP, and the total of the direct and indirect contributions that the use of forests makes to GNP. The indirect contribution incorporates the linkage (multiplier) effects in the broader economy. Total output in the forest use sector was N$1.2 billion. This sector contributed N$1.0 million of direct value added to the GNP, and the total direct and indirect impact on the GNP was N$1.8 billion. The most significant component of forest use was fuel wood harvesting, followed by NTFP use and pole use. No legal saw-timber extraction took place at the time of the study.

The total direct value added contribution of the forest use sector of N$1.0 billion represents approximately 3% of GNP. This proportion can be compared with the estimated contributions made by other sectors (CBS 2004): 4.6% for agriculture, 5% for fishing (which includes some on-board fish processing), 6.8% for mining, and 6% for tourism (unpublished data, 2004; Directorate of Environmental Affairs, Ministry of Environment and Tourism). Much of the contribution of the forest use sector, as measured in the accounts described here (Table 5), is informal, and is not likely to have been fully captured in the national accounts to date. Thus, it largely represents an additional contribution.

In largely formal sectors such as fisheries and mining, it behoves the Government to capture as much as possible of the resource rents – excess profits – generated, so that these can be redistributed within the economy and contribute to the development process. This can be done through taxes and resource royalties. Resource rents would otherwise accrue to formal sector companies, and be relatively less likely to contribute to development. In the case of forest use, which is currently largely informal, much of the resource rent accrues to low-income rural households in communal areas. These beneficiaries are themselves likely targets for the national redistribution effort.

Table 5. Estimated gross output and direct and total contributions of use of fuel wood, poles, saw timber, and non-timber forest products in the economy, 2004

Contribution	**Fuel wood**	**Poles**	**Saw timber**	**NTFPs**	**Total**
	N$ m	**N$ m**	**N$ m**	**N$ m**	**N$ m**
Gross output in forest use sector					
Total	**648.3**	**176.7**	**0.0**	**415.7**	**1,241.0**
Direct contribution to gross national product (GNP)* by Region					
Caprivi	39.2	2.6	0.0	18.2	60.1
Erongo	12.9	3.2	0.0	6.0	22.1
Hardap	20.4	0.1	0.0	9.5	30.0
Karas	13.6	1.9	0.0	6.3	21.9
Kavango	84.3	24.7	0.0	39.1	148.2
Khomas	12.8	1.0	0.0	5.9	19.7
Kunene	28.4	1.1	0.0	13.2	42.7
Ohangwena	102.1	27.8	0.0	47.4	177.3
Omaheke	26.4	0.4	0.0	12.3	39.0
Omusati	104.4	36.5	0.0	48.4	189.2
Oshana	54.5	21.7	0.0	25.3	101.5
Oshikoto	68.1	34.9	0.0	31.6	134.5
Otjozondjupa	42.2	1.6	0.0	19.6	63.4
Total	**609.3**	**157.5**	**0.0**	**282.8**	**1,049.6**
Total (both direct and indirect) contribution to GNP**					
Total	**966.0**	**263.6**	**0.0**	**619.5**	**1,849.0**

* Direct contribution of the forest use industry to the economy, in terms of value added to GNP
** Total direct contribution to, and indirect impact on, the economy, in terms of value added to GNP, measured using a social accounting matrix of the Namibian economy (Lange et al. 2004)

There is, thus, little incentive for Government to maximise rent capture in the forest sector, except in any future formal commercial activities such as saw timber extraction. Currently, rent capture by Government is largely limited to the Directorate of Forestry's collection of licence fees, since almost no taxes are paid. Licence fees tend to be concentrated on commercial forest use activities where trading is involved, and product sales constitute a very small proportion of output. Data to hand on licence fee collection is limited, but we roughly estimate that only some 0.5% of resource rents are currently captured that way.

3.3 The value of Namibia's standing forest assets

Table 6 shows estimates of the value of the forest assets or standing stocks, the volumes of which are shown in Table 2. The values represent the ability of these stocks to generate resource rent in the future. As stated, these values were estimated using the Net Present Value Method. The basic model used for net present values contains predictions about the future streams of rent and the discount rate. Several options for the future discount rate were tested.

Table 6. The value of Namibia's standing forest stocks in 2004, estimated in terms of the resource rent that could be generated from them during the next 30 years, using the Net Present Value Method[2]

Category of comparison	Value of standing forest resources				
	Fuel wood	Poles	Saw timber	NTFPs	Total
	N$ m	N$ m	N$ m	N$ m	N$ m
By Region @ 6% discount					
Caprivi	743	45	440	388	1,616
Erongo	162	19	0	110	291
Hardap	272	2	0	185	460
Karas	150	18	0	102	271
Kavango	1,597	430	178	834	3,040
Khomas	203	17	0	138	358
Kunene	413	19	0	281	713
Ohangwena	1,933	484	16	1,010	3,443
Omaheke	501	6	0	262	768
Omusati	1,869	326	0	1,271	3,466
Oshana	270	43	0	184	497
Oshikoto	1,289	606	0	674	2,569
Otjozondjupa	800	28	0	418	1,245
Total @ 6%	**10,202**	**2,043**	**634**	**5,857**	**18,737**
Sensitivity to discount rate					
Total @ 2%	18,989	3,789	1,151	10,867	34,796
Total @ 4%	13,689	2,737	839	7,846	25,110
Total @ 6%	10,202	2,043	634	5,857	18,737
Total @ 8%	7,844	1,577	494	4,509	14,424
Total @ 10%	6,203	1,252	396	3,570	11,421

[2] Net present value of future rents generated in expected growth over the next 30 years

Forest stocks tend to be stable, unlike those of other natural resources such as marine fish or exploitable minerals, and this makes it relatively easy to predict use patterns. Our estimates of likely economically viable growth in forest use over the next 30 years, as described in Table 3, were based on expected human population growth and likely developments in commercial forest use, within the local constraints on sustainable yield. These estimates provided a good basis for applying the Net Present Value Method.

Several discount rates were tested. We consider a future real discount rate of 6% as the most likely, and so Table 5 shows net present value estimates at 6% discount for the Regions and the whole country. The total value of the stocks is N$19 billion. If discount rates between 2% and 10% are used, the stock value varies between N$35 billion and N$11 billion.

Table 7 shows a comparison between our forest asset values and the estimates made for some other Namibian natural resources.

Table 7. Comparative estimates of asset value for some Namibian natural resources,[3] and the manufactured capital stock, 2004

Resource	Asset value (N$ m)
Fish*	12,000
Minerals**	14,300
Wildlife***	10,600
Forests	18,700
Manufactured capital****	82,000
Total national wealth*****	137,500

* Derived from Lange (2004b)
** Derived from Lange and Hassan (2003)
*** Very approximate (unpublished accounts, 2004; Directorate of ?Environmental Affairs?, Ministry of Environment and Tourism)
**** Fixed capital stock; derived from the national accounts (CBS 2004); includes tangible, produced assets
***** Partial estimate only; excludes, for example, some asset values for land, water and tourism

The development of preliminary resource asset accounts for wildlife by the Ministry of Environment and Tourism (unpublished data, 2004; Directorate of Environmental Affairs) showed wildlife stocks to have a (very approximate) value of N$11 billion. Asset accounts for Namibia's marine fish stocks (Lange 2004b) show an estimated value of N$12 billion in 2001 (converted to 2004 prices). The value of mineral assets in Namibia has also been estimated (Lange & Hassan 2003), namely N$14 billion in 2001 (also converted to 2004 prices). The figures in Table 7 suggest that Namibia's forest assets have significant value, relative to those of other resources. One reason for the forests' high asset value is likely to be the fact that the (mostly informal) forest use activities generate relatively high resource rents per unit of output when compared with other (formal) sectors such as fishing and mining. Fish, mineral, forest and wildlife assets are not incorporated into the national fixed capital stock accounts.

[3] Net present values of future flows of resource rents from the stocks

4. CONCLUSION

The completion of the national forest inventory enabled the completion of a set of preliminary forest accounts for Namibia in 2004. These conform to the internationally recognised IEEA methodology. Volumes of woody resources per unit area range from 21.4 m^3 per hectare in the north-east to 0.05 m^3 in the south. The total woody resources volume for Namibia is an estimated 257 million m^3. There are no reliable data available to measure change in woody biomass due to the conversion of forest to cropland or due to damage by fire or wild animals during 2004. However, such change is likely to be extremely small, annually, in the context of the total volume.

The currently used volumes are small in relation to the physically utilisable potential: 6% for fuel wood and 12% for poles. Similarly, economically feasible use in the next 30 years will likely make use of only a portion of the physically utilisable sustainable yields: some 16% for fuel wood, 27% for poles, and 50% for saw timber. It is clear that, while some regional and local forest resources adjacent to areas of dense human settlement are being depleted, this is the case at the national level. Overall, stocks are not threatened, but local depletion problems will need to be solved through greater commercialisation of production and/or local forest management initiatives.

The value of current forest use in 2004, in terms of the gross output, was some N$1.2 billion. This made a direct contribution of N$1 billion to the GNP. The contribution amounted to some 3% of the total GNP, compared with estimated proportions of 6.8% for agriculture, 5% for fishing, 6.8% for mining, and 6% for tourism. Given the data previously available, it is highly unlikely that the national accounts have fully captured the current direct contribution of forest use, as measured here. In our study, the total direct *and* indirect economic impact of the forest use sector on the broader economy was estimated at N$1.8 billion.

Few taxes are paid, and Government only captures a roughly estimated 0.5% of the resource rents generated in the forest use sector through licence fees. Since most rents accrue to low-income rural households – which would normally be targeted for redistribution in any event – there is little incentive for Government to try to capture more.

Namibia's standing forest assets (the natural capital stock) were estimated to have a value of N$19 billion in 2004. Forest stocks represent a significant national asset, comparable with those for fish, minerals and wildlife. Fish, mineral, wildlife and forest stocks – as well as several other natural resources – are not included in the national account for manufactured capital stock, which was valued at some N$86 billion in 2004, and incorporated only owned or produced assets.

Some policy implications arise from the findings in this study. Attempts to ameliorate forest depletion need only be focussed at regional and local levels, mostly in the immediate vicinity of denser human settlements. Here, initiatives to strengthen community management of forest resources and to promote commercial harvesting hold promise. Potential for commercial saw timber production also exists, and this should be developed through a comprehensive management plan to ensure sustainability. Capture of resource rent by Government should be restricted largely to commercial forest use activities, especially any large-scale saw timber extraction.

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