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NATURAL RESOURCE ACCOUNTS FOR THE STATE AND ECONOMIC CONTRIBUTION OF FORESTS AND WOODLAND RESOURCES IN SWAZILAND

R.M. Hassan
Centre for Environmental Economics and Policy in Africa (CEEPA),
University of Pretoria

P. Mbuli
Central Statistical Office (CSO), Swaziland

C. Dlamini
Forestry Sector, Ministry of Agriculture and Co-operatives, Swaziland

The Centre for Environmental Economics and Policy in Africa
University of Pretoria

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R. M. Hassan, Centre for Environmental Economics and Policy in Africa (CEEPA), University of Pretoria

P. Mbuli, Central Statistical Office (CSO), Swaziland, and

C. Dlamini, Forestry Sector, Ministry of Agriculture and Co-operatives, Swaziland

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EXECUTIVE SUMMARY

This study made an attempt to account for the true contribution of forest and woodland resources to economic wellbeing in Swaziland. A natural resource and environmental accounting approach was used to correct national accounts for the missing values of forest resource stocks and flow benefits. As the produce of cultivated plantations and their forward processing industries is commercially exploited and sold in markets, their contribution to national income is captured in the formal national accounts. However, the value of net accumulation in their asset stocks is not part of the assets' accounts' balance sheets. This study established the timber and carbon assets' values of cultivated plantations for the 1988-99 period. When assets' accounts were corrected for the net accumulation in timber and carbon stocks of plantations, gross domestic savings, a measure of genuine welfare improved by more than 2.3%. The study however, did not correct for the environmental externality costs of plantations in terms of their impacts on ecosystem's functions such as stream flow reduction and erosion of biodiversity.

On the other hand, natural forests and woodlands support the livelihood of large segments of the population of Swaziland, especially in rural areas where 75% of the population reside and where poverty is very high. It has been estimated that 55% of the rural population in Swaziland (estimated at approximately 88,000 households) are classified as poor living on a per capita income of E 76 per year at 1998 prices. The vast majority of the rural poor highly depends on and derives many direct and indirect use and non-use benefits from natural forest and woodland resources. Unlike the case of cultivated forests where only asset values are not accounted for, both flow benefits and asset values of natural forests and woodlands are not captured in the SNA. This is mainly due to the fact that most of the direct and indirect benefits derived from these resources are not commercially supplied and traded in the market.

The study established values for a number of major products and services of natural forests and woodlands. Rural communities were found to derive a total value of E 428 per person every year in the form of timber and non-timber products of natural forest and woodland resources. This amounted to about 44% of the average rural household consumption expenditure in the country at 2001 prices, suggesting a very high reliance of rural communities in Swaziland on these resources for their livelihood. The highest contribution to rural households' budget came from the value of firewood. We consider our estimates to be rather conservative as a number of other benefits derived by rural population from natural forests and woodlands are not captured in this study. Examples of important direct use and non-use benefits include livestock grazing, tourism, etc. When only livestock benefits were added, the total contribution of natural forest and woodland resources to rural household income in Swaziland jumped to 57%. It is also important to note that our estimates of medicinal benefits were based on estimates of direct harvesting by rural households for own use (including collection by traditional healers). This however, excludes the value of services provided by healers to thousands of people who do not directly collect and use medicinal products. Other studies indicated that the value of medicinal use benefits in Swaziland range between E 4 – E 35 million, which are way above our conservative E one million. One should further remember that this contribution excludes the value of indirect benefits and ecological services provided by these resources, such as watershed protection, nutrients supply, pollination services, carbon sequestration and biodiversity.

Natural forests contributed a total value of E 229 million at 2001 prices to rural communities' consumption expenditure (income). This contribution in flow benefits was equivalent to 2.2% of the total GDP, 20% of agriculture's GDP and 440% of the contribution of forestry reported in the formal national accounts for 2000. This provides another evidence of the massive value of natural forests and woodland resources missing from the SNA in Swaziland. If one considers other direct and indirect use values (e.g. tourists' recreation, full medicinal use benefits, etc.) and ecological services (watershed protection, nutrients supply, pollination services, carbon sequestration and biodiversity, etc.) this value will even be higher by many folds.

Despite their significant economic contribution, there are indications that these valuable forest and woodland resources are not sustainably utilised and face threats of depletion from over exploitation by communities and conversion into other land uses. This study estimated that natural forest and woodland resources in Swaziland are being depleted at a net national annual depletion rate of 201,000 m^3 (0.3 m^3/ha) of timber stocks. All vegetation types were facing depletion at varying degree except wattle, open montane and open mixed woodlands, where there is net accumulation of timber (gain). When one compares the two forest assessment inventories of 1990 and the FPLP1999 FRA it appears that forest area has increased by 9% between 1990 and 99. This difference however, was considered to reflect variations in technical factors including methods used and mapping detail of the two inventories rather than physical expansion of forest cover. Nevertheless, the study examined our results in the context of the results of the 1990 and 1999 forest resource assessments. Differences in the two inventories' estimates of standing timber volumes of natural forests and woodlands were used to calculate an estimate of net accumulation between 1990 and 1999. This gave a figure of negative total net accumulation (depletion) of 1.983 million m^3 of timber over the 9 years period, which translates to an average of 220,000 m^3 per annum. This figure compares very well with this study annual depletion estimate of 201,000 m^3, based on total (rural and urban) user populations. The value of the above estimated physical net depletion figures was equivalent to E 111.2 million and E 2.85 million for timber and carbon asset stocks, respectively.

The above results have important implications for the current measures of social wellbeing and economic performance as well as for policies and strategies for sustainable management and exploitation of the natural resource base. The measure of GDP for 2000 rose by 2.2% when corrected for flow benefits of natural forests and woodlands with timber products making 90% of this increase. The fact that the national accounts include the contribution of plantation forestry as the only value attributed to the forestry sector in Swaziland, indicates the high underestimation of the value of natural forest and woodland resources to the people of Swaziland, especially the rural poor. This omission is the major reason behind underestimating the opportunity cost of converting forests and woodlands into other land uses leading to over conversion and excessive removal of the country's tree cover.

More over, the fact that asset values of forest and woodland resources are not captured in the SNA results in generation of incorrect indices and measures of economic performance and wellbeing such as the rate of savings and capital formation, sending wrong signals to policy design and development planning. When net accumulation in asset values was accounted for, the SNA measure of domestic savings dropped by 32.6% as a result of net depletion of natural forest and woodland resources' timber and carbon stocks in excess of net accumulation realised in cultivated plantations. This implies that the country is liquidating its natural capital by depleting its forest resource stocks through over extraction by rural communities, which is another piece of information critical for sustainable management and exploitation of these resources that is missing from the SNA.

The results of this study show very clearly how forest and woodland resources can be mismanaged and over exploited leading to resources' depletion and degradation as a result of excluding or underestimating the true contribution of such resources to human wellbeing. In order to generate proper indicators of welfare change, current measures of income and wealth must be corrected for net accumulation (depletion) in natural resource assets and the total value people directly or indirectly derive from their use. Genuine measures of sustainable income, savings and capital accumulation provide more appropriate information that is crucial for sustainable development planning and design of sound policies for economically efficient and sustainable use of natural resources such as the forests and woodlands of Swaziland.

LIST OF ACRONYMS

VAD	Value Added
NNP	Net National Product
NRA	Natural Resource Accounts
NP	Net Price
NPV	Net Present Value
SNA	System of National Accounts
CAV	Change in Asset Value
GDP	Gross Domestic Product
NNP	Net National Product
FRA	Forest Resource Assessment
FPLP	Forest Policy and Legislation Project
SEEA	System of Integrated Environmental and Economic Accounting
G&S	Goods and Services
I-O	Input-Output
CSO	Central Statistical Office

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1. INTRODUCTION

1.1 The Setting

The people of Swaziland derive many direct and indirect benefits from their forests and woodland resources. The country is endowed with extensive cultivated plantation and natural forests and woodlands covering about 45% of the total land area (Danced, 1999). Commercial forestry and related timber processing industries form very important part of the economy of Swaziland, contributing approximately 12% of the GDP and about 14% of total exports over the past 13 years. The forestry and forest products (timber processing) sectors provide employment to approximately 8000 people, which are 12 percent of the total formal employment in Swaziland (Danced, 1999). These figures however highly underestimate the true contribution of forest and woodland resources to the national economy and the social wellbeing of the Swazi people.

A number of factors are behind the failure of current economic accounting systems to fully capture the value of forests and woodland resources. First, the system of national accounts (SNA) includes the value of *produced*[2] outputs that are *traded* in the market. This immediately misses the value of the many timber and non-timber products that are directly harvested from forests and woodlands by communities, such as fuel wood, medicinal products and wild foods. While harvesting of these products represent an informal production process involving the use of un-purchased (own) community resources (household labor time and tools) and directly contribute to consumption and economic welfare, these values go missing from the SNA. The main reason being that, these products are usually harvested from *open access* resources and directly used for *own consumption* and hence escape trade and market exchange. Similarly, many indirect use benefits and ecological services (watershed protection, carbon storage, bio-habitat functions, etc.) of forests and woodlands do not pass through the market and their values are usually attributed to the wrong economic activities (recipient sectors).

Another more important omission in the SNA is the exclusion of the asset values of forests and woodlands from the balance sheet of capital resources. A standing tree has no value to our current accounting system until it is felled and sold to generate income. Accordingly, not only the contribution of forests and woodlands to total national wealth (asset value) is missing, but also the depletion resulting from liquidation of the standing timber stocks (conversion to current income) is not accounted for. While the depreciation of manufactured capital is accounted for as a reduction in national capital, the depletion of timber assets and the consequent environmental degradation (loss of the many benefits and ecosystem services) are not taken into account in measuring net national income. As a result, countries achieving high rates of economic growth (improperly measured) at the expense of high depletion rates of their natural capital and at serious environmental degradation costs are considered to be making progress in improving the social wellbeing of their

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[2] Production here means the use of purchased economic inputs and factors' services in a managed and owned organised production processes.

population. When one considers the impact of economic expansion and growth on the state of the natural resource base and environmental quality, such measures of economic performance fail to provide proper assessment of how an economic system is progressing towards the goals of social welfare.

The case of forests and woodland resources in Swaziland provides a typical example of how the SNA can underestimate the true contribution of natural resources to social wellbeing generating poor measures of economic performance and incorrect policy signals. The consequence is poor understanding and awareness of the nature and true value of the economic and environmental benefits of the resource by communities, resource managers and policy makers leading to misuse and unsustainable utilisation. Natural resource and environmental accounting attempts to correct for such deficiencies in current measures of wealth and wellbeing. This will improve our ability to properly assess and weigh the trade-offs between various states of nature and the changing condition and capacity of ecosystem's to supply the various goods and services critical for present and future wellbeing. As we alter some ecosystems such as conversion of forest and grasslands into agricultural systems to increase the supply of food and fibre for instance, we reduce the capacity of the ecosystem to provide other goods and services previously supplied (timber, flood control, carbon sequestration). The net effect of such ecosystem change may be a reduction rather than an increase in social welfare when all associated costs and benefits are accounted for. Accounting for the value and benefits of forests and woodland resources is therefore critical for adequate assessment of such trade-offs and for making sound and optimal social choices for sustainable management and use of these resources. The present study is a step in that direction applying natural resource accounting tools to assess the true value of forests and woodland resources and the manner in which they are exploited in Swaziland.

1.2 Objectives of The Study

The overall purpose of this investigation is therefor to establish the total value of forest resources to Swaziland. This includes the benefits from indigenous as well as cultivated forests. The following specific objectives are targeted for this prime goal:

1. A forest resource accounting framework will be developed for determining the direct and indirect use as well as non-use social, economic and environmental benefits of forests and woodland resources in Swaziland

2. Physical resource accounts will be constructed to assess the stock, flow and use of the physical forest and woodland assets in the country

3. The constructed physical resource asset and flow accounts will be employed to derive monetary accounts in order to measure the true contribution of forest and woodland resources to national economic wellbeing

4. Current measures of the value of forest resources to Swaziland will then be adjusted for missing use and non-use benefits from forests and woodland resources

5. Asset accounts will also be corrected for the depletion/appreciation of the country's forest and woodland resources to provide a proper measure of progress towards sustainable development

6. Provide information on improved measures of economic performance and indicators of sustainable development to help improve the design of long-term development planning strategies and policy formulations

1.3 Organisation of The Research Report

The material presented in this report fall in 6 sections. The next section provides an overview of the state and economic significance of forests and woodland resources in Swaziland. The forest resource accounting framework and analytical techniques are described in section 3. Section 4 develops natural resource accounts for cultivated plantations for policy analysis. Resource accounts for natural forests and woodlands are constructed in section 5. The final section uses the developed forests and woodlands resource accounts to correct measures of national income and wealth for the true contribution of these resources and distils conclusions and policy recommendations.

2. FORESTS AND WOODLAND RESOURCES IN SWAZILAND

1.1 Types and Extent of Forest and Woodland Resources of Swaziland

Swaziland is endowed with extensive forest and woodland resources covering about 45% of the total land area of the country (Danced, 1999). According to the most recent Forest Resource Assessment (FRA) carried under the Forest Policy and Legislation Project (FPLP) indigenous forests and woodlands covered 83% of the total forest area and the remaining forest land is occupied by cultivated plantations (14%) and wattle forests (3%) (Table 1 and Map 1). The characteristics of the different vegetation types of Table 1 are described in detail in the FRA report (Danced, 1999) cited above.

There are indications that these rich forest and woodland resources of Swaziland are under pressure from human activities facing mounting threats of depletion and degradation. While the FRA report of 1999 showed an increase in total area under forests and woodlands compared to an earlier assessment conducted in 1990 (Hess et al., 1990), discrepancies between the two assessments were attributed to technical factors rather than true appreciation in the state of the resource (Danced, 1999). At the same time, about 18,000 ha of indigenous forests and woodlands have been converted to other land uses between 1985 and 2000. Those include clearings for sugar cane and cotton growing, business and residential structures and water supply projects (Danced, 2000). Although clearance of forest resources for subsistence cultivation does not seem to pose an immediate threat to forest resources in the short-run, regions with easy access to high population densities such as the Swazi national land tenure areas experience high pressures. That is mainly due to the uncontrolled and unmanaged exploitation of the forest and woodland resources by communities for the many services they derive from them.

The different forest and woodland vegetation types of the country provide a wide range of products and services to the people of Swaziland. The pattern and nature of utilisation of these resources are dictated by the dominant plant species, the purpose of use, land tenure systems and the magnitude of population pressure (Danced, 2000). A good review of a number of assessments of variations in the extent of pressure due to communal exploitation patterns and nature of human exploitation is given in the FPLP report on identification of protection worthy areas (Danced, 2000). The present study makes an attempt to update those assessments of the state and magnitude of pressure on the countries' forest and woodland resources in section 5.

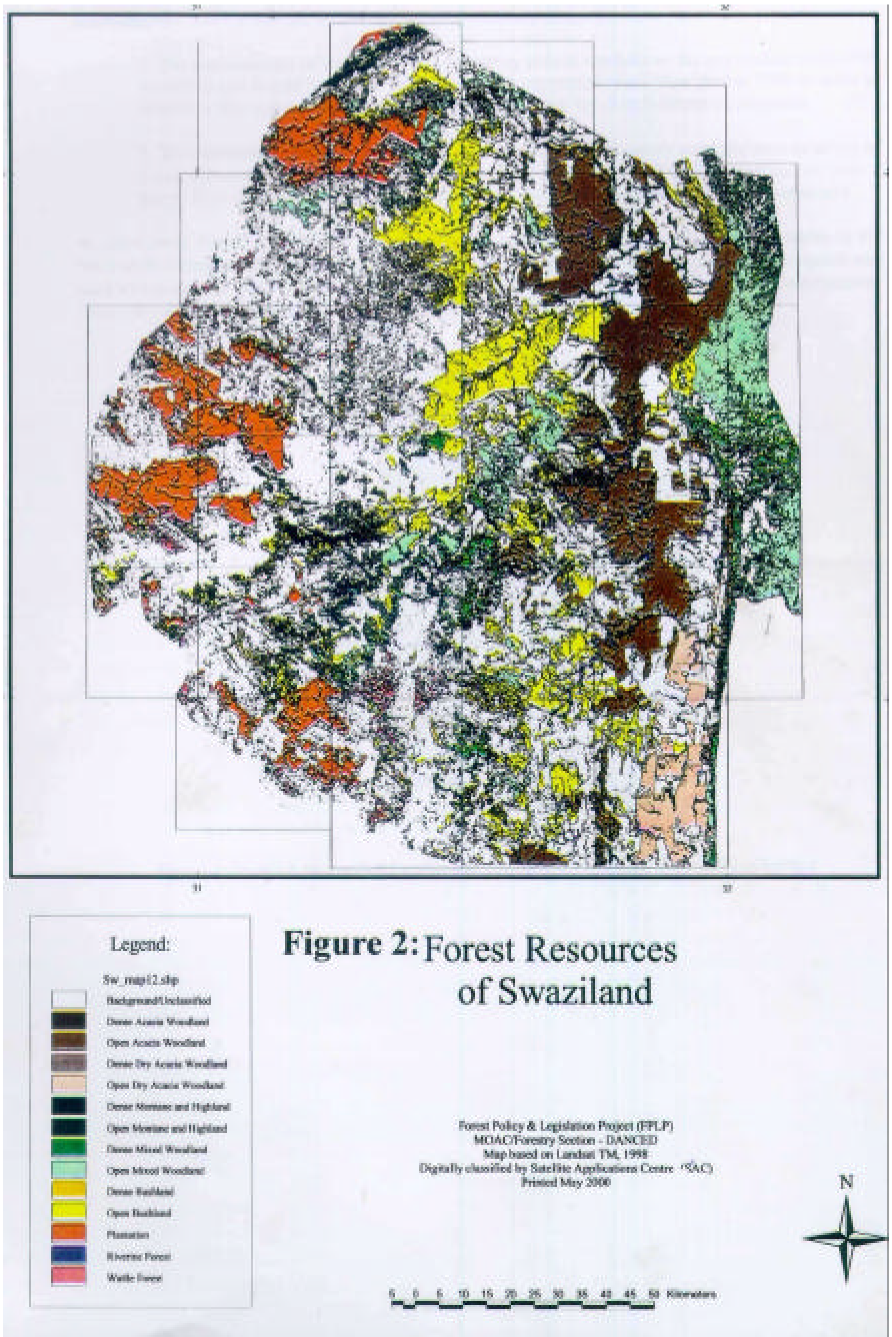
1.2 Economic Importance

The forestry sector plays a very important role in the economy of Swaziland. Official statistics indicate that plantation forestry contributed more than 1% of the country's gross domestic product (GDP) and more than 3% of total employment, on average between 1988 and 2000 (Table 2). However, the combined contribution of plantations and the forest products' sectors to GDP was 12% over the same period. This share of total value added (VAD) exceeds the average contribution of agriculture to GDP,

Table 1. Types and extent of forests and woodlands in Swaziland (1999)

Vegetation type	Area	Percent
	ha	of total
Natural forest	**36556**	**4.64**
Montane highland forest	*11349*	*1.44*
Dense	10510	1.33
Open	839	0.11
Riverine forest	*25207*	*3.20*
Cultivated forest	**136662**	**17.33**
Pine and gum	*110222*	*13.98*
Wattle	*26440*	*3.35*
Woodlands	**382261**	**48.48**
Moisture savanah	*169620*	*21.51*
Dense mixed woodlands	52971	6.72
Open mixed woodlands	116649	14.80
Accacia savanah	*178313*	*22.62*
Dense accacia	10293	1.31
Open accacia	168020	21.31
Dry accacia savanah	*34328*	*4.35*
Dense	1482	0.19
Open	32846	4.17
Bushland	**232954**	**29.55**
Dense	*55683*	*7.06*
Open	*177271*	*22.48*
TOTAL	**788433**	**100.00**

Source: Danced (1999)



Map 1. Forest Resources of Swaziland (Danced, 1999)

which was 11.5% for the same period. Forest products also contributed about 14% of the total value of exports, on average over the same period with pulp making the highest contribution (75.4%) to total forest products' exports.

Over the period between 1988 and 1998, the contribution of manufacturing to GDP remained stable around the 28% average whereas, agriculture's share improved after 1993 (Figure 1). On the other hand, the contribution of forestry and forest products to GDP fluctuated around its 12% average showing a sharp rise in 1995 due to the high jump in the contribution of forest products to exports (Figure 2). Forest products' share in total exports however, showed a steady decline over the period except for the 1995 peak. Similarly the contribution of plantation forestry to employment has slightly declined over that period (Figure 2).

It is important to note however, that official statistics record only the contribution of commercial forestry sectors as their products are traded in respective domestic and foreign markets. The fact that the value of many products and services of natural forests and woodlands go missing from the national accounts for several reasons indicate that official statistics highly underestimate the true contribution of forests and woodlands to the economic wellbeing of Swaziland. The next two sections make an attempt to account for some of the missing values of benefits provided by forests and woodland resources. A few studies have shown that the benefits derived from utilisation of various tangible forest and woodland products that are unaccounted for in the national accounts of Swaziland are significant. For example, it has been estimated that the bulk of energy supply in Swaziland comes from harvesting of firewood from forests and woodlands (Lasschuit, 1994 and 1995; Brown, 1999; Danced, 1999; Hess et al., 1990, Allen et al., 1988). Also, rural communities in Swaziland harvest a great deal of timber from these resources for construction purposes (Cassidy et al., 2000; Brown, 1999; Atkins, 2000; Deall and Matsebula, 1998). Moreover, significant values are derived from harvesting medicinal products from the wild in Swaziland (Brown, 1999; Danced, 1999; Mander, 1998). Forests and woodlands provide many other benefits to the people of Swaziland including food and drinks (Ogle, 1987; Danced, 1999), crafts and domestic tools (Danced, 1999).

Although several studies analysed the potential and utilisation of the many direct and indirect benefits and services of forests and woodlands in Swaziland (Makhubu, 1978; Dlamini, 1981; Dlamini, 1999; Masson, 1991; BASAP, 1999; Braun and Dlamini, 1994; Danced, 2000b), information on the economic values of such benefits remains very deficient. The task taken by sections 4 and 5 of this study deal with estimation of economic values of such goods and services provided by forests and woodlands in the country.

Table 2. Contribution of forestry to domestic income, exports and employment

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Average Percent
GDP (E million)	1828	2224	2428	2765	3225	3771	4596	5073	5686	6612	7449	8410	9673	
Percentage shares of:														
Agriculture	12.0	10.2	11.3	9.0	11.1	10.2	11.7	12.7	13.7	12.3	12.3	11.8	11.1	11.5
Mining	2.1	1.8	0.9	1.6	1.5	1.4	1.0	0.9	0.8	0.7	0.7	0.7	0.4	1.1
Manufacturing	30.6	29.1	29.6	28.5	27.4	27.6	27.8	26.6	27.6	28.2	27.5	25.8	24.7	27.8
Forestry	1.0	1.0	1.2	0.8	0.8	0.7	0.7	0.6	0.6	0.5	0.4	0.5	0.5	0.73
Forest products [a]	9.5	9.9	11.1	10.6	9.8	9.6	11.1	18.2	11.1	9.5	13.2			11.23
Forestry and forest products	10.5	10.9	12.3	11.4	10.6	10.4	11.8	18.8	11.6	10.0	13.7			12.00
Percent of Agriculture GDP	87.5	107.0	109.2	126.0	95.4	101.8	100.6	148.5	84.8	81.5	111.4			104.89
Total Exports (E million)	1059	1207	1464	1712	1894	2203	2808	3146	3571	3569	5303			
Percent share of forest products	20.3	18.7	15.8	13.7	12.8	11.8	11.8	17.3	10.5	9.2	9.6			13.77
Share of pulp in forest products exports	82	81	65	80	92	75	74	86	56	83	55			75.40
Total employment (000 people)	98.3	96.4	98.4	96.4	94.5	92.7	88.4	88.4	91.5	89.1	88.2	88.8	88.5	
Percent share of forestry	4.1	4.2	3.9	3.7	3.8	4.0	3.3	3.0	2.9	2.5	2.2	2.2	2.2	3.23

Source: CSO and own calculations

a. Based on a value added share of 45% of gross revenue (using South African data) and 80% export share in total forest products, e.g. domestically used forest products are 20% of total).

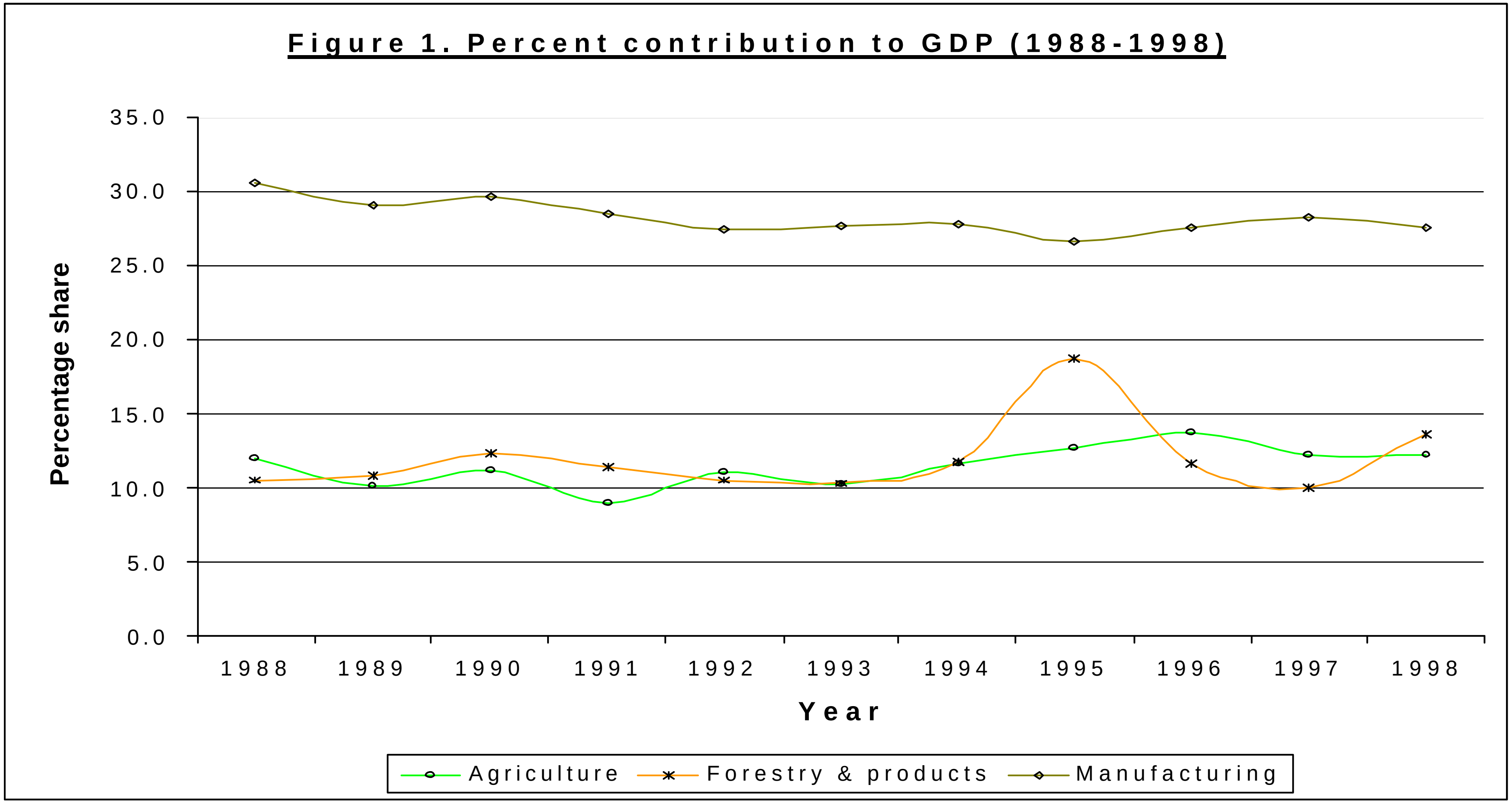


Figure 1. Percent contribution to GDP (1988-1998)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
Percentage share
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
Agriculture
Forestry & products
Manufacturing

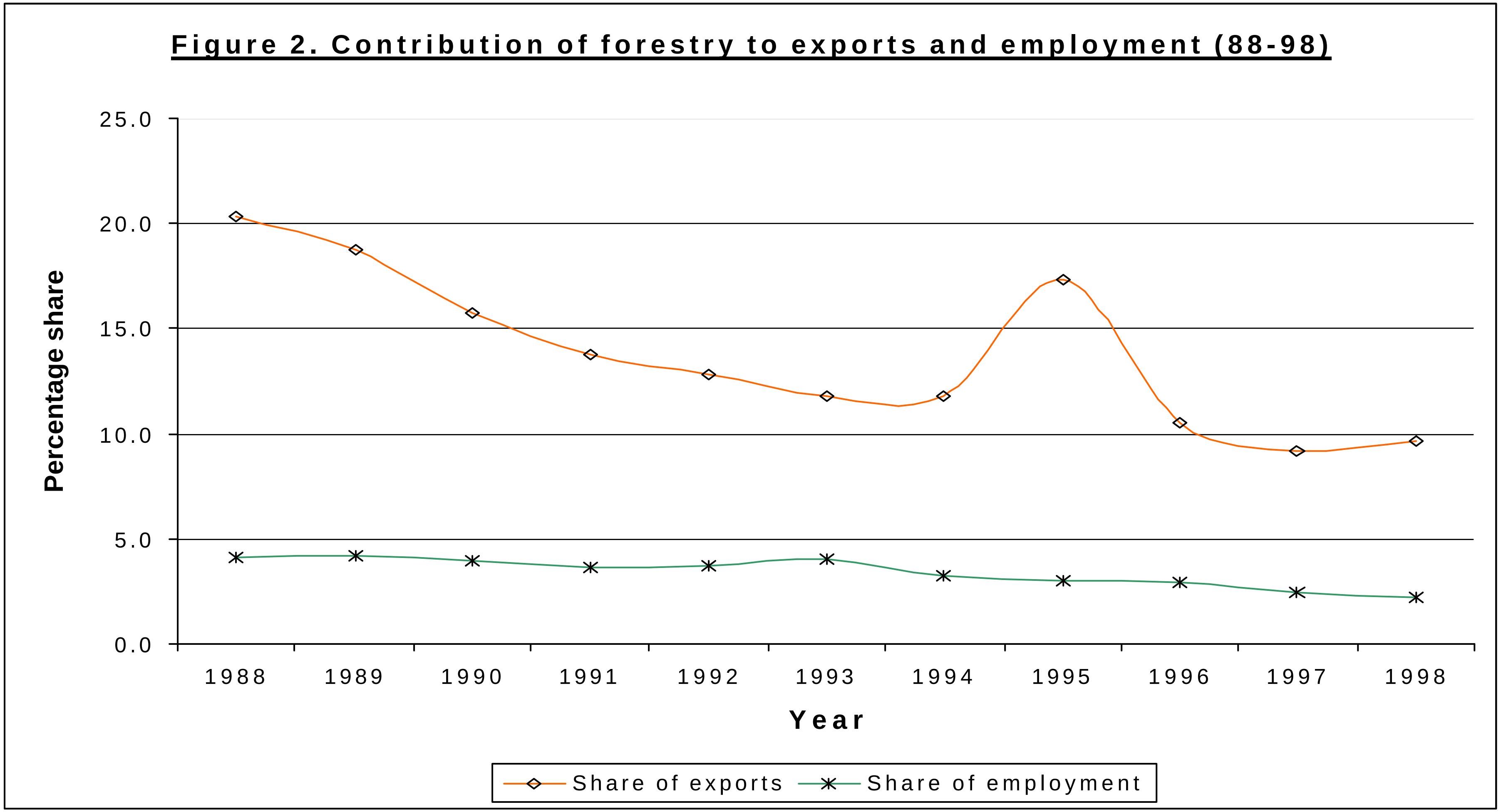


Figure 2. Contribution of forestry to exports and employment (88-98)
25.0
20.0
15.0
10.0
5.0
0.0
Percentage share
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Year
Share of exports
Share of employment

3. THE FOREST RESOURCE ACCOUNTING FRAMEWORK

The SNA generates information about economic activity and produces critical summary indicators of economic performance at sectors' and aggregate levels. Two types of accounts are produced by the SNA: the current (flow) and asset (stock) accounts. The *current account* describes the flow of economic goods and services (G&S) and measures VAD in various sectors of production within the economy, which are then aggregated to the national level as the GDP or GNP. This measure, however, only reflects VAD in economic activities the output of which is traded in the market. In other words, VAD in production activities in some spheres within the economy where output is self-used (not traded), such as direct harvesting of fuel wood and other products of nature for own consumption go missing from the conventional SNA. This is a major omission in the case of forest values that natural resource and environmental accounting (NRA) attempts to correct for. VAD in the *current account* is also adjusted for depreciation of produced (manufactured) assets (machinery, buildings and structures) to derive the net national product (NNP) as the more a appropriate measure of true income since it allows for consumption of capital (UN, 1993). Nevertheless, the SNA measure of NNP is not adjusted for depreciation of natural (and human) capital (depletion), which is another correction NRA attempts to make to *current account* measures.

Another problem with the current SNA is the fact that natural and environmental assets supply many tangible inputs and intangible services that are used as intermediate inputs into the production of economic G&S. Since the value of such inputs and services of nature (water, nutrients, recreation and tourism, carbon sequestration, watershed protection, deposition of pollutants, etc.) is impeded in the value of the produced and traded G&S, it is usually captured in the *current accounts* measure of VAD. However, this value is not attributed to the natural resource sectors supplying such intermediate services. As a result, VAD in receiving/using sectors is overestimated and in turn the economic contribution or value of supplying natural resource sectors is not recognised. To avoid double counting, care must be taken in adjusting the SNA measures of VAD for such intermediate use values.

The SNA *asset account*, on the other hand provides balance sheets measuring changes over time in the value of *economic assets*, defined to be "*owned with actual or potential economic benefits*" (UN, 1993). However, *economic assets* only include produced or manufactured assets. Although the revised SNA (UN, 1993) and the system of integrated environmental and economic accounting (SEEA) (UN, 1993) broadened the definition of assets to correct for the omission of natural assets, many remain outside the boundaries of the current SNA. In addition to properly adjusting the *asset account* for depletion of natural capital, important adjustments in existing methods of valuing standing forest resource stocks need to be adopted (Vincent, 1999). A forest resource accounts framework that will attempt to adjust conventional measures of income and welfare provided by the SNA for the above said omissions is presented in the following section.

1.1 Structure of the Forest Resource Accounts

Natural resource and environmental accounting approaches and tools will be used to conduct the intended analysis. Different physical and monetary measures of the true contribution of forest and woodland resources to welfare will be developed within this framework. This will involve construction of detailed physical and monetary accounts for cultivated and natural forests and woodlands.

1.1.1 Physical Resource Accounts

These accounts will detail the physical state and patterns of use of forest and woodland resources over time (period covered will depend on availability of data) through construction of asset and flow accounts.

a. Asset Accounts

Provide information about changes and trends in the state and utilisation of forest resource assets over the period of inquiry. While the main asset account for woody resources is that of standing timber stocks, other forest assets are often considered, e.g. non-produced biological and environmental assets such as carbon stocks, etc. Some alternative accounting approaches consider carbon sequestration to be a service provided by forestry to source sectors and accordingly treat it as a flow rather than a stock variable. The timber asset accounts are structured as follows:

Closing Stocks = Opening Stocks – Net Physical Change in Standing Timber

Net Physical Changes in Timber Stocks = Additions – Subtractions

Additions = Natural growth and regeneration + New afforestation

Subtractions = Economic use (harvesting) + Other reductions in volume (damage factors such as fire, health stress, etc.)

Physical timber stocks are generally measured in terms of volume in m^3 / tons or area in ha. Adjustments in the SNA for omissions of such changes and utilisation/depletion of forest resource assets will be made to the assets accounts' balance sheets, in the same way manufactured capital formation and depreciation are accounted for.

b. Flow Accounts

Detail the flow of the G&S provided by forests and woodlands to the rest of the economy. This includes the supply and use of timber and non-timber products and other services of forestry as well as negative and positive externalities. Flow (supply and use) accounts provide the basis for the input-output (I-O) framework that captures the economy-wide (multiplier) effects of using forest and woodland products. Adjustments for missing flow costs and benefits are made to the current accounts (e.g. GDP, etc.). Note that some of the information needed for the flow accounts will be provided as part of the assets accounts (e.g. timber harvesting, etc.). Flow benefits for most non-timber G&S might not be available for a long series of years, especially direct harvesting from indigenous forests.

1.1.2 Monetary Resource Accounts

Establish values for the various entries of the physical and determine the magnitude of the monetary contributions and state of forest resources. While market prices ruling at the time of transaction are used to value flows of costs and benefits, asset valuation methods, such as the resource rent and stumpage values are used to value timber stocks. On the other hand, various non-market valuation methods are usually needed to value non-market benefits and costs of woody resources.

1.1.2.1 Valuation of Standing Timber Stocks

Various measures have been used in the literature to estimate the value of natural assets. The two most commonly used methods for calculating asset values are the net price (NP) and the change in asset value (CAV). Valuing timber assets is based on determining a value for the standing stock of trees. This value is considered the measure of forest *resource rents* and generally referred to as the *"stumpage value"* (the value of the tree standing on the stump in the forest). A number of methods can be employed to determine the forest *resource rent* or *stumpage value*. However, most studies on renewable resources and particularly timber, employed the NP method (Hamilton and Lutz, 1996).

1.1.2.2 The Net Price (NP) Method

The NP method derives the *stumpage value* (*resource rent*) as the residual of the selling price of harvested timber (P_t) after deducting all production (silvicultural costs for cultivated plantations), harvesting, transport and capital costs (C_t). This method calculates net accumulation or depreciation of asset values (D_t) as the following simple product of the NP (P_t - C_t) and net change in standing stocks (S_{t+1} - S_t = G_t - H_t, e.g. additions minus extractions):

$$D_t = (G_t - H_t) * (P_t - C_t) \qquad (1)$$

Where P_t and C_t refer to per unit resource price and extraction costs, respectively, S_t is the stock of the asset at t, G_t denotes growth from natural regeneration and other additions and H_t refers to extraction (harvesting, damage, etc.).

Because renewable assets such as biological resources complete a growth cycle over a length of time before reaching maturity, the standing stock of such biological resources at any point in time consists of a mixture of different age groups. This is typical to forest resources, where there is a long lag between planting or regeneration and maturity for harvesting. Accordingly, the NP method, which does not distinguish between age groups in terms of maturity (quality) and hence value and applies one price to all standing timber volumes, may generate biased estimates of renewable assets' values. As net prices reflect values of mature timber harvested and traded in the market, it is considered inappropriate to use the same price to value immature timber that is not immediately available for use. This is because of either a quality differential or the opportunity cost (time value) of the need of immature timber to grow to maturity. An alternative more accurate method for calculating change in asset values (CAV) was derived based on present value criteria (Vincent, 1999).

1.1.2.3 The Change in Asset Values (CAV) Method

This is considered the correct version of the net price (net depletion) method applied to non-renewable resources as it provides for variations due to natural regeneration and time to maturity in the case of a renewable resource like forests. Economic depreciation (or net accumulation) of timber resources (D_t) is measured by:

$$D_t = V_{t+1} - V_t \qquad (2)$$

Where V_t is the capitalised value of the asset at time t defined as the sum of the discounted net returns (resource rents) it generates over time[3]. To allow for the age effect (remaining time in years to maturity) in the case of forest resources a distinction is made between mature and immature forests as follows (Vincent, 1999):

$$V_T = (P_T - C_T)\,Q(T) / [1-(1+r)^{-T}] \qquad (3)$$

$$V_t = (P_T - C_T)\,Q(T)(1+r)^{t-T} / [1-(1+r)^{-T}] \qquad (4)$$

Where T is terminal time, which is the time when the resource is exhausted in the case of non-renewable resources, or time of maturity (or rotation length) for renewable resources (mature and ready for harvesting). Hence, V_T is the asset value of mature forests (e.g. V(0) capitalised value at initial period) and V_t is the capitalised value of immature forest assets. Q(T) is the harvest volume at maturity (optimal rotation). P_T and C_T are per unit resource price and per unit extraction costs at maturity. The above formulation of net accumulation allows for addition to timber stocks through growth in immature forests D_t and reductions due to harvesting of mature timber D_T. Similar treatment of asset reductions due to natural factors (fire and disease) is used to adjust stocks of standing timber. For instance, fire damage to a standing stock of immature forest of age t reduces the capitalised value of that asset to zero (e.g. losing asset value V_t).

1.1.2.4 Valuing Other Benefits and Costs of Forests

In addition to timber, forests and woodlands provide other tangible and intangible benefits (as well as costs). Various methods are utilised to account for the values of such costs and benefits. Carbon storage accounts, for example, are usually calculated based on timber volumes. Specific conversion models and data on variables included in the models' equations are typically needed for construction of the carbon storage accounts. Similarly, a number of cost and benefit-based approaches as well as other non-market valuation methods will be employed to account for the value of the other flow benefits of forests and woodlands in the subsequent sections.

3 For proper social welfare considerations, this should include all other benefits derived from forests such as intangible, non-market non-timber products and environmental benefits.

4. NATURAL RESOURCE ACCOUNTS FOR CULTIVATED PLANTATIONS

Cultivated plantations covered more than 6% (110,000 ha) of the total land area of Swaziland, which amounts to 14% of the total forest area of the country in 1999 (Danced, 1999). As discussed in section 2, this sector makes significant contributions to the national economy in terms of income and employment. It also supports major timber processing activities adding substantial value to the country's GDP, employment and foreign exchange earnings. More than 90% of the total area of plantations in Swaziland is owned and managed by three major plantation companies (Saapi, Mondi and Shieselweni Forest Company) and the rest is managed under a number of small growers. There are currently six major companies engaged in wood processing contributing more than 11% of the GDP and 14% of export earnings in 1998 (refer to Table 2). Pulp production mainly for export markets is the major wood processing activity in Swaziland utilising 64% of the total round wood production followed by sawlogs processing using another 30% of total round wood (CSO). The rest of the timber grown domestically is utilised for production of mining timber, poles and droppers and firewood.

While the contribution of these commercial forest and forest products' activities are accounted for in the SNA as part of current income, a number of important benefits and costs of growing exotic plantations do not enter the national accounts. For example, cultivated forests' assets such as timber and carbon stocks do not enter the assets accounts' balance sheets as part of national wealth. Accordingly the effect of net accumulation or depreciation in these assets on net national savings and capital formation is not captured. More over, cultivated forests replace natural vegetation such as grassland and hence alter the original ecosystem and its ecological functions. This has important consequences for water yield (runoff), biodiversity, as well as other ecosystems' functions of the replaced vegetation. The value of such environmental externalities and costs are not accounted for in the SNA. This section makes an attempt to establish some of the said values currently missing from the national accounts. This study focussed on net accumulation in timber and carbon stocks and hence could not measure other environmental values such as water abstraction and biodiversity loss caused by cultivated plantations.

Using the forest resource accounting framework described in section 3, this section constructed both physical and monetary asset accounts are constructed for cultivated forest plantations. The fact that flow benefits of cultivated forests and their forward timber processing activities form part of the formal economy and reported in the national accounts caused lower emphasis on flow accounts. The major source of the data employed in the analysis presented in this section came from the CSO annual Timber Statistics reports (CSO). Financial data and other information were also compiled from secondary sources such as timber production and processing companies.

1.1 The Physical Asset Accounts

This section develops physical accounts for timber and carbon assets of cultivated plantations and traces timber and timber products' flows through the economy.

1.1.1 Timber stock accounts

Data on cultivated plantations and timber processing activities are compiled through an annual survey administered by the CSO. The annually published *Timber Statistics* reports provide information on areas under the different tree species by age class (CSO). Pine, eucalyptus and wattle trees are grown for two timber production regimes: pulp and sawlog rotations. This data provided the basis for construction of the physical accounts documenting changes in the standing stocks of timber in cultivated plantations and there utilisation (harvesting, damage by natural hazards, etc.). The available series start from 1988, when the said surveys where first initiated and the last year published was 1999. Accordingly, the constructed accounts covered only the 1988-1999 period.

Timber growth models are available for the three main tree species grown in Swaziland plantations (Sappi). Growth models (see Appendix 1) were used to derive standing timber volumes for the various age classes under the different species. Using available data on actual areas' under each age class for each species in the base year (1988), opening stocks of standing timber in the base year were derived. Opening stocks were then adjusted for annual additions (growth and new plantings) and withdrawals (harvesting and damage caused by fire and other natural factors) to calculate closing timber stocks. New growth was generated using the yield simulation models and actual data available on new plantings, harvesting and damage were used to account for these changes. This was then repeated for all the years under study to derive the complete physical timber accounts based on the opening stocks of 1988. The detailed accounts are presented in Appendix 1 and summarised in Table 3.

The physical timber accounts summary of Table 3 shows that timber stocks in plantations have accumulated volume at an average rate of approximately 84,000 m^3 per annum. This in spite of the fact that total area harvested (61,000 ha) during that period exceeded replanted areas (43,000 ha) leading to a decline in total plantation areas (Figures 3 and 4). This gain in average timber accumulation during the study period however, is mainly attributed to early expansions in area compared to steady harvesting before 1991, when large accumulation of timber is observed (Figure 4). Standing timber volumes continued to decline after 1991 as total area harvested continued to exceed new planting (figure 3) and hence new growth could not compensate for new withdrawals (harvesting and damage). Softwoods, which have higher timber density and volume growth than hardwoods dominated Swaziland plantations occupying two thirds of the area under cultivated forests. Accordingly all gains (accumulation) or losses (depletion) are highly influenced by the rates of harvesting and replanting of soft wood species.

Area under softwoods however, has steadily declined since 1991 at an average annual rate of 3.4% with an average annual harvesting rate (3708 ha) that is more than double average annual replanting rate (1820 ha). Contrarily, hardwood areas grew over that period by about 20% as average annual harvesting (1338 ha) was about 75% of average annual replanting (see Appendix 1 for more physical accounts details).

1.1.2 Carbon stock accounts

Atmospheric carbon is absorbed by plant vegetation in the form of stored carbon C. As C storage densities vary between different vegetation types, net C storage can be calculated as the difference between C densities in standing biomass of cultivated plantations and the vegetation type it replaced. Cultivated plantations are mainly established on previous montane grasslands. As the total biomass of tree plantations is higher than that of the montane grasslands it usually replaces, forest plantations thus store more carbon than grasslands. C storage in forests can be estimated either for the standing biomass of trees or for the semi-permanent timber products extracted from standing tree stocks[4]. Various methods were used in the literature to calculate C storage densities (IPPC/OECD, 1994, Harmon *et al*., 1990, Schroeder, 1992, Winjum et al., 1993). This study employed a dynamic method, which provides for variability in C densities of forest biomass of different age groups to calculate C storage in industrial plantations in SA. Methods that use final (peak) carbon densities at maturity or the mean carbon storage over the full rotation are simple static alternatives to the dynamic method (Christie and Scholes, 1995).

[4] A minimum life cycle of 20 years is considered as a permanent sink of carbon for C-containing products (IPCC/OECD, 1994)

Table 3. Timber physical asset accounts for cultivated plantations in Swaziland (1998-99)

Year	Opening Stocks		New Planting	Growth	Harvesting		Damage		Closing Stocks	
	000 ha	Million m^3	000 ha	Million m^3	000 ha	0000 m^3	000 ha	000 m^3	000 ha	Million m^3
1988	101.4	18.3	4.5	1.7	3.5	1160.5	0.3	35.7	102.1	18.8
1989	102.1	18.8	2.2	1.8	3.6	1055.6	0.2	23.2	100.5	19.6
1990	100.5	19.6	2.2	1.6	3.8	1180.5	0.6	99.2	98.3	19.9
1991	98.3	19.9	3.7	1.8	6.7	2141.3	0.7	130.2	94.6	19.5
1992	94.6	19.5	3.4	1.8	4.1	1528.9	2.0	365.6	91.9	19.4
1993	91.9	19.4	3.8	1.8	5.7	1733.6	0.0	2.2	90.0	19.5
1994	90.0	19.5	5.1	1.9	5.1	1595.1	0.4	64.3	89.6	19.7
1995	89.6	19.7	4.2	1.9	6.0	1815.1	1.9	338.7	85.9	19.4
1996	85.9	19.4	4.3	1.9	5.3	1697.0	1.7	322.7	83.2	19.3
1997	83.2	19.3	4.3	1.9	6.3	1901.4	0.3	52.4	80.9	19.3
1998	80.9	19.3	2.6	1.8	4.8	1490.5	0.4	56.2	78.3	19.5
1999	78.3	19.5	2.7	1.9	5.6	1632.7	0.2	32.0	75.2	19.8
AVERAGE			3.583		5.0458					

Figure 3. Harvesting and replanting of cultivated timber (000 ha)

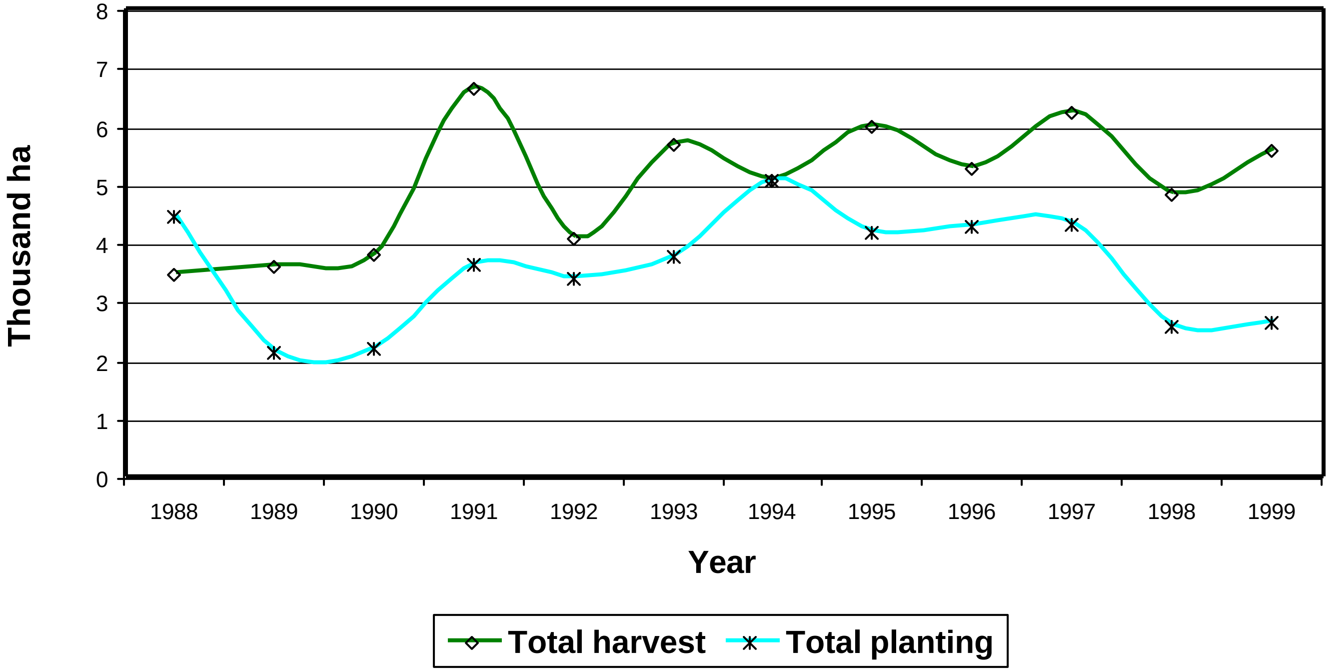
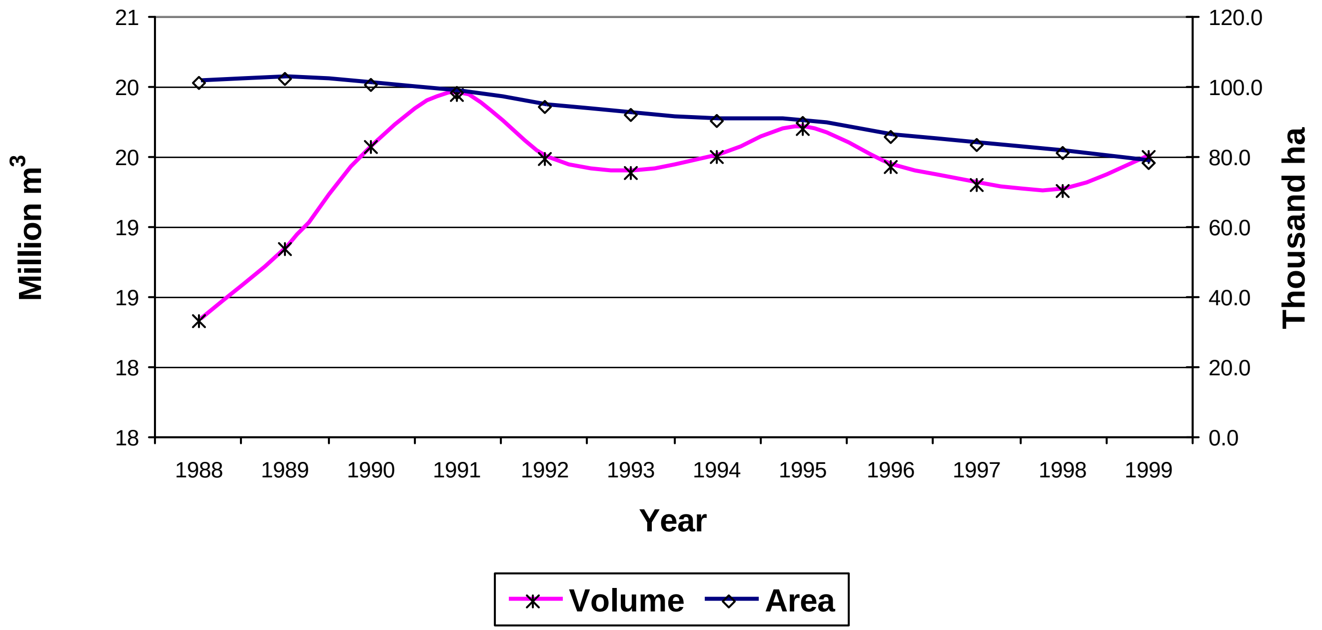


Figure 4. Area (000 ha) and volume (million m^3) of standing timber stocks of plantations



The following dynamic method is used to estimate C densities stored in standing industrial plantation stocks in SA:

$$S_t = \sum C_{tj} A_{r-t,j} - C_g A_r \quad (1)$$

Where

S_t	Is net difference in total C stored in year t in Mg C
C_{tj}	Is C density per ha of plantations of age t and type j
$A_{r-t,j}$	Denotes area of type j planted in year r-t
C_g	Is C density per ha of the preceding land use
A_r	Area of previous vegetation type at time r (time of conversion)

To avoid double counting, the study calculated C densities using annual net growth (net depletion) of standing forest stocks in the respective year for different age classes in the specific forest rotation type. That means, timber volumes harvested or damaged in year t are reduced from growth and new plantings in the subsequent year (t+1).

The same timber growth functions used earlier for pine, eucalyptus and wattle species (Sappi) were employed to estimate growth in standing timber volumes at different ages. The calculated timber volumes in m^3/ha were then converted to C densities in Mg C/ha using the following conversion function:

$$C = V_s * D_w * F_c / F_s \quad (2)$$

Where

C	Tree biomass C density in Mg C/ha
V_s	Stem wood volume in m^3/ha
D_w	Density of wood in Mg/m^3
F_c	Fraction of oven-dry mass that is carbon
F_s	Fraction of whole tree biomass per ha in stemwood

This study borrowed estimates of the above model parameters for different plantation species and rotations from corresponding South African data (see Appendix 1). Incremental C densities (over and above C in original vegetation – grassland) stored in industrial plantations in Swaziland averaged 41,000 Mg C/annum over the study period 1988-98 (Table 4). Carbon densities of the original vegetation (montane grassland) replaced by industrial plantations was estimated to be 6 Mg C/ha (Christie and Scholes, 1995). Our calculations excluded C in root biomass, which is estimated to be equivalent to 15% of aboveground biomass- Christie and Scholes (1995) and also did not include soil C.

1.2 The Monetary Asset Accounts for Timber and Carbon

To estimate the value of timber assets we applied the two valuation methods described in section 3: the net price (NP) and change in asset value (CAV). Financial data on timber prices and production costs have been obtained for a few years in the late 1990's from plantations' companies in Swaziland and from CSO. On the other hand, estimating a value per unit of C released or sequestered is usually a difficult task. This study used the value of US$ 5.2/ton of C estimated for South Africa at 1995 prices (Hassan, 1999)[5]. The carbon price and net prices of timber for the limited range of years were then adjusted for the rest of the period under study using the PPI of South Africa.

Results of the monetary accounts show that accumulation of natural capital in terms of timber stocks was about 1.9% of total gross national savings on average during 1988-98 (Table 5). Cultivated plantations also contributed an extra 0.16% of gross savings to national wealth formation in the form of increased carbon storage capacity. When current measures of savings were corrected for the excluded value of net accumulation in both timber and carbon asset stocks in cultivated plantations, national savings (genuine savings 2) improved by about 2.3% (Table 5). These results indicate the high magnitude of underestimation of the contribution of plantation forestry to national wealth and capital formation in Swaziland. One should note however, that this study did not correct for the negative externalities of plantation forestry such as water abstraction and erosion of biodiversity.

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[5] This compares well with Nordhaus (1994) global estimate of $ 5.2/ton of C in 1994. The common practice in the literature is to borrow global value estimates such as those generated by climate change impact models (Nordhaus, 1994). In countries where an environmental carbon charge is levied, such as Sweden, the used charge is applied (Hulkrantz, 1992). Figures used in the literature to value carbon covered a very wide range between US$ 5 to US$ 130 per ton of C.

In this study, carbon storage has been treated as a stock variable. Accordingly net accumulation in carbon stocks was calculated for making the necessary adjustments to national savings and asset accounts. Alternative treatments of carbon sink functions consider this to be a flow service by forestry to receiving sectors (e.g. sectors supplying atmospheric carbon emissions or sectors benefiting from reduced carbon concentrations). The later treatment assumes that climate-sensitive industries (e.g. agriculture) derive indirect benefits from carbon sequestered in forests mitigating the climate change impacts of higher concentration of atmospheric carbon and its negative environmental consequences. When carbon storage services are treated as flow benefits, the value of the service estimated need to be reallocated from source sectors to forestry.

Table 4. Carbon physical asset accounts for cultivated plantations in Swaziland (1998-99)

Year	Carbon in standing timber stocks			Carbon in Grassland	Net Carbon Storage	Net change in C storage	Price of Carbon	Net Accumulation of Carbon
	Soft wood	*Hard wood*	*Total*					
	Mg C million	Mg C million	Mg C million	Mg C million	Mg C million	Mg C million	E /Mg C	E million
1988	6.68	1.57	8.25	0.61	7.64	0.00	8.82	0.00
1989	6.91	1.66	8.57	0.60	7.97	0.33	10.68	3.52
1990	6.98	1.75	8.73	0.59	8.14	0.17	11.07	1.92
1991	6.71	1.82	8.53	0.57	7.97	-0.18	12.40	-2.19
1992	6.51	1.98	8.49	0.55	7.93	-0.03	13.45	-0.43
1993	6.48	2.05	8.53	0.54	7.99	0.06	16.18	0.93
1994	6.47	2.15	8.62	0.54	8.08	0.09	18.46	1.67
1995	6.28	2.22	8.50	0.52	7.98	-0.10	19.80	-1.97
1996	6.10	2.34	8.44	0.50	7.94	-0.04	24.63	-1.04
1997	5.99	2.43	8.42	0.49	7.93	-0.01	27.73	-0.20
1998	5.96	2.56	8.52	0.47	8.05	0.12	34.96	4.02
1999	5.98	2.65	8.63	0.47	8.16	0.11	36.71	4.09
Average			8.51	0.54	7.97	0.04		0.62

Table 5. Adjusting national accounts for net accumulation in timber and carbon assets in cultivated plantations (1988-98)

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Average
Gross domestic savings (E million)	**353.7**	**424.7**	**454.3**	**136.4**	**63.9**	**38.2**	**142.3**	**65.3**	**-301.8**	**220.7**	**245.3**	**148.93**
Net accumulation in timber stocks (E million)	0.0	10.4	17.7	9.4	-12.0	-2.9	3.5	7.2	-9.5	-5.0	8.9	**2.76**
Accumulation of timber % of savings	0.00	2.44	3.89	6.91	-18.83	-7.64	2.45	11.00	3.15	-2.25	3.63	**1.86**
Genuine savings 1 (E million)	*353.7*	*435.1*	*472.0*	*145.8*	*51.9*	*35.3*	*145.8*	*72.5*	*-311.3*	*215.7*	*254.2*	**151.69**
Net accumulation of carbon (E million)	0.00	3.52	1.92	-2.19	-0.43	0.93	1.67	-1.97	-1.04	-.2	4.2	**0.25**
Accumulation of carbon % of savings	0.00	0.83	0.42	-1.61	-0.67	2.43	1.17	-3.02	0.34	-0.09	1.71	**0.16**
Net accumulation of timber & carbon (E million)	0.0	13.9	19.6	7.2	-12.5	-2.0	5.2	5.2	-10.5	-5.2	13.1	**3.41**
Accumulation of timber & carbon % of savings	0.00	3.27	4.31	5.31	-19.50	-5.21	3.62	7.98	3.48	-2.34	5.34	**2.29**
Genuine savings 2	*353.7*	*438.6*	*473.9*	*143.6*	*51.4*	*36.2*	*147.5*	*70.5*	*-312.3*	*215.5*	*258.4*	**152.34**
Percent Change	0.00	3.27	4.31	5.31	-19.50	-5.21	3.62	7.98	3.48	-2.34	5.34	**2.29**

5. FLOW BENEFITS AND ASSET VALUES OF NATURAL FORESTS AND WOODLANDS

Natural forests and woodlands support the livelihood of large segments of the population of Swaziland, especially in rural areas where 75% of the population reside (MTEC, 1999) and where poverty is very high. It has been estimated that 55% of the rural population in Swaziland (estimated at approximately 88,000 households) are classified as poor living on a per capita income of E 76 at 1998 prices (UNDP, 1998; Atkins and Dlamini, 1999; Danced, 2000b). The vast majority of the rural poor highly depends on and derives many direct and indirect use and non-use benefits from natural forest and woodland resources. Unlike the case of cultivated forests where only asset values are not accounted for, both flow benefits and asset values of natural forests and woodlands are not captured in the SNA. This is mainly due to the fact that most of the direct and indirect benefits derived from these resources are not commercially supplied and traded in the market. This section attempts to measure the value of major flow benefits and asset values of natural forest and woodland resources and their true contribution to economic welfare in Swaziland. The study focused on establishing values of major tangible direct use products (firewood, timber and non-timber products) and timber and carbon asset stocks of natural forests and woodlands. Given the time and resources available for this study, it was not possible to measure and establish values for a number of other use and non-use benefits from these resources such as ecosystems' services (e.g. pollination, biodiversity, nutrients recycling, etc.). However, the study made attempts to generate qualitative as well as quantitative information on selected indirect use values (recreational - tourism), ecosystem services (carbon sequestration) and non-use values (religious and social) as data availability permitted.

1.1 Data Sources

The following analysis was based on various sources of factual information. Primary data on resource utilisation and harvesting rates and products' prices were collected from sample surveys of communities relying on the resource base for various uses. Three surveys were conducted, a household survey, a market survey and survey of traditional healers. The household survey design and sample structure is provided in Table 5.

Table 6. Design of the natural forests and woodlands household surveys (no of households and sampling fractions)

	Ecological Regions						
	Highveld	*Middleveld*	*Lowveld*	*Lubombo*	*Total*	*Sample*	*Percent of*
Vegetation Types							
Dense montane and highland forest	9				9	***7.6***	***1.33***
Open montane and highland forest		9			9	***7.6***	***0.11***
Riverine forest							***3.20***
Dense moisture savanah		6		4	10	***8.4***	***6.72***
Open moisture savanah	7	7			14	***11.8***	***14.80***
Dense accacia savanah			10		10	***8.4***	***1.31***
Open accacia savanah		5	8		13	***10.9***	***21.31***
Dense dry accacia savanah							***0.19***
Open dry accacia savanah			8		8	***6.7***	***4.17***
Dense bushland			8		8	***6.7***	***7.06***
Open bushland	1	9	21		31	***26.1***	***22.48***
Plantations - pine and gum							***13.98***
Wattle	7				7	***5.9***	***3.35***
Total	***24***	***36***	***55***	***4***	***119***		
Percent sample fraction	***20.2***	***30.3***	***46.2***	***3.4***	***100.0***	***100.0***	***100.00***

A multistage simple stratified random sampling approach was adopted for surveying communities' utilisation of the resource. The capacity of various forests and woodland vegetation to provide the many goods and services needed by communities vary significantly depending on their ecological characteristics and plant species' endowments. Some vegetation types have better resources to support timber products used for energy and construction purposes. Other plant resources are richer in edible products (wild food and drinks) or more suitable for harvesting thatch and other materials for medicinal use or handcrafts. More over, different vegetation types face different levels of stress and pressure from human communities depending on population densities of user communities and how accessible the resource is to those users. Accordingly, vegetation types provided the first layer of stratification in order to capture such variability in their natural capacity and human impacts. Out of the twelve natural (unmanaged) vegetation types of the country (excluding commercial plantations), only ten were surveyed. Riverine forests and the dense dry accacia were excluded from the survey due to their relatively small size and the difficulty with sampling within them.

The second layer of stratification was based on the countries' four ecological regions to capture variability in climatic and socio-economic conditions between those regions across the country. Accordingly, sampling fractions were designed to represent the 10 selected vegetation types and the four ecological regions. Only rural communities were included in the survey due to the low dependence of urban populations on direct harvesting from natural forests and woodlands. Variable sampling fractions were allocated among the ten vegetation types in proportion to their size (percent of total forest area – Table 6). Simple random sampling was applied utilising random number tables to select survey sites from the CSO enumeration areas' (EA) sampling framework. Given the time and budget available for the study, a total of 15 EAs were selected and an average of 8 households were sampled from each EA. In addition, market surveys covering vendors of handcraft products and traditional healers were conducted in all the four ecological regions. The surveys were administered with structured questionnaires during July-September 2001.

1.2 Flow Accounts and Direct Use Values of Natural forests and Woodlands

The surveyed communities were found to utilise the natural forests' resources for a wide range of uses. Six major direct uses have been reported, namely timber for firewood and construction, food products, medicinal plant materials, thatch and raw materials for making of handcrafts and domestic tools. The said products were harvested from different forest resources with some variation between vegetation types (see Appendix 2). The survey found that more than 90% of the rural households collect firewood, 56% harvest timber for construction purposes and 40% obtain thatch for houses from the natural forests and woodlands of the country (Table 7). Moreover, about 30% of the rural households depend directly on these resources for food items and about one third directly harvest timber for physical household structures (23% for Kraals and 19% for fences). Although only 8% harvest medicinal products for direct use, most rural households rely on traditional healers, who use natural forest and woodland resources for medical treatment.

Table 7. Products harvested for various uses by ecological region (% of households)

	Highveld	Middleveld	Lowveld	Lubombo	Total
Firewood	91.7	91.7	94.5	100.0	93.3
House construction	66.7	52.8	52.7	50.0	55.5
Kraal construction	8.3	16.7	32.7	25.0	22.7
Fence construction	8.3	19.4	23.6	25.0	19.3
Thatch	45.8	44.4	32.7	75.0	40.3
Edibles	20.8	27.8	34.5	25.0	29.4
Medicinal	4.2	2.8	12.7	0.0	7.6
Craftwood	4.2	8.3	0.0	0.0	3.4
Weaving grass	12.5	8.3	3.6	0.0	6.7

Estimates of utilisation of natural forests' products by communities in Swaziland are summarised in Tables 8 and 9. The sample estimates of the levels of use of the 9 products reported in the table varied across ecological regions (Table 8) and vegetation types (Table 9). The most exploited resource was firewood at an average of 506 kg/person/year followed by timber for construction of houses (55 kg/capita). Most households used head loads, each measuring kg 15 on average, to gather firewood. The average rural household size in Swaziland of 7.6 (CSO, 1995) was used to derive per capita consumption figures from the household survey estimates. Our estimate of annual per capita consumption of firewood (ranging between 317-749 kg) very much in line with those of the FPLP estimates for 1999, which ranged between 356-769 kg (Danced, 1999). On the other hand, construction timber for houses, kraals and fences was transported on cart loads each measuring kg 710, on average. The survey estimates showed that three carts loads are generally required for construction of a house unit and two carts loads for construction of kraals and fences. All structures are commonly replaced every five years. Thatch is also used for roofing of houses at an average kg 10/person/year based on a requirement of 30 head loads of thatch of kg 12 each per house unit (refer to Appendix 2 for units of weight used for the different products and collection methods).

Food items were collected from the wild at an average of kg 28/person/year. Each member of the rural households used kg 32 of medicinal products of forests per year, on average. The survey also estimated average consumption levels of kg 12 and kg 37 per person per year of craftwood and weaving grass, respectively. The study estimates compare well with figures reported in similar studies in southern Africa (Cavendish, 1999; Shakleton et al., 20001, Mabugo and Chitiga, 2001; Danced, 2000b).

Table 8. Utilization of direct use products of forests and woodlands in Kg/person/annum by ecological region (2001)

	Highveld	Middleveld	Lowveld	Lubombo	Average
Firewood	510	317	450	749	506
House construction	63	58	71	28	55
Kraal construction	19	21	22	19	20
Fence construction	19	19	19	19	19
Thatch	9	9	16	5	10
Edibles	26	11	52	24	28
Medicinal	19	71	38	0	32
Craftwood	19	31	0	0	12
Weaving grass	82	38	28	0	37

Table 9. Utilisation of direct use products of forests and woodlands in Kg/person/annum by vegetation type (2001)

	Montane highland		*Moist mixed woodland*		*Open accacia*	*Dry accacia woodland*		*Bushland*		*Wattle*
	Dense	Open	Dense	Open	woodland	Dense	Open	Dense	Open	
Firewood	234	288	510	218	677	725	429	272	274	1154
House construction	93	84	64	123	101	140	168	184	112	252
Kraal construction	0	0	44	37	37	56	37	50	37	37
Fence construction	37	37	37	37	37	37	37	37	37	0
Thatch	13	0	12	16	11	28	28	33	38	32
Edibles	20	0	43	12	27	43	0	12	124	189
Medicinal	0	71	0	0	12	0	208	6	12	19
Craftwood	0	0	24	38	0	0	0	0	0	19
Weaving grass	0	0	38	88	0	19	38	0	0	19

Price information was collected from the household and market surveys to derive values of the harvested resources (Table 10). The results showed that on average, rural communities in Swaziland derive a total value of E 428 per person every year in the form of timber and non-timber products of natural forest and woodland resources. This amounted to about 44% of the average rural household consumption expenditure in the country at 2001 prices[6], suggesting a very high reliance of rural communities in Swaziland on these resources for their livelihood. According to Table 10, the highest contribution to rural households' budget came from the value of firewood. We consider our estimates to be conservative as a number of other benefits derived by rural population from natural forests and woodlands are not captured in this study. Examples of important direct use and non-use benefits include livestock grazing, tourism, etc. When only livestock benefits were added using estimates of E 127/person per annum livestock grazing values derived for South Africa (Shackleton et. al, 2002), the total contribution of natural forest and woodland resources to rural household income in Swaziland jumps to 57%. It is also important to note that our estimates of medicinal benefits were based on estimates of direct harvesting by rural households for own use (including in the sample collection by traditional healers). This however, excludes the value of services provided by healers (Sangoma and Inyanga[7]) to thousands of people who do not directly collect and use medicinal products. Other studies indicated that the value of medicinal use benefits in Swaziland range between E 4 – E 35 million (Danced, 2000b), which are way above our conservative E one million (Table 11). One should further remember that this contribution excludes the value of indirect benefits and ecological services provided by these resources, such as watershed protection, nutrients supply, pollination services, carbon sequestration and biodiversity.

Per capita value estimates were combined with *user population* figures in the four ecological regions to derive an estimate of the total contribution of natural forest and woodland resources to the economic wellbeing of rural communities in terms of flow benefits. To derive national estimates, user population and not total population figures were used to aggregate per capita values (Table 10). User populations were derived based on percentage rural households harvesting the product (Table 7). It was also assumed that the urban segments of the population harvest these products at half the rural user population factors (see Appendix 2). As mentioned earlier, although livestock grazing represents an important benefit of natural forests and woodlands to rural households, this study could not directly measure livestock grazing values. However, this study used livestock grazing values estimated for South Africa to calculate total flow benefits. Natural forests contributed a total value of E 229 million at 2001 prices to rural communities' consumption expenditure, i.e. income (Table 11). Only rural households though were assumed to enjoy livestock grazing benefits.

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[6] Represent the CSO 1995 household income and expenditure survey estimates adjusted for inflation to year 2001.

[7] While Inyanga refers to traditional healers who use forest products for strictly medical treatment purposes, Sangoma refers to those traditional healers who combine forest products with spiritual and religious processes for healing.

Table 10. Total value of products harvested for various purposes by ecological region (E/person/year)

	Price (E/kg)	Highveld	Middleveld	Lowveld	Lubombo	Average	% of total
Firewood	0.57	291	181	257	427	289	40
House construction	0.43	27	25	30	12	24	3
Kraal construction	0.32	8	9	10	8	9	1
Fence construction	0.32	8	8	8	8	8	1
Thatch	2.5	23	24	39	12	24	3
Edibles	0.34	7	3	13	6	7	1
Medicinal	0.8	6	24	13	0	11	2
Craftwood	1.25	15	25	0	0	10	1
Weaving grass	0.25	103	47	36	0	46	6
TOTAL						**428**	100

Table 11. Total value of products harvested for various purposes by ecozone type (E million)

	Highveld	Middleveld	Lowveld	Lubombo	Total
Firewood	71.4	53.8	47.1	20.5	192.7
House construction	3.9	4.3	3.3	0.3	11.9
Kraal construction	0.5	0.7	0.4	0.1	1.6
Fence construction	0.4	0.5	0.3	0.1	1.3
Thatch	2.4	3.0	3.1	0.2	8.7
Edibles	0.5	0.3	0.7	0.1	1.6
Medicinal	0.1	0.6	0.2	0.0	0.9
Craftwood	0.1	0.3	0.0	0.0	0.4
Weaving grass	1.8	1.0	0.5	0.0	3.3
Livestock	2.0	2.2	1.5	0.4	6.1
TOTAL					228.5
TOTAL at 2000 prices					212.5
% of total GDP					2.2
% of agriculture GDP					19.8
% of plantations GDP					439.4

The contribution of natural forests and woodlands in flow benefits was equivalent to 2.2% of the total GDP, 20% of agriculture's GDP and 439% of the contribution of forestry reported in the formal national accounts for 2000[8] (Table 2). This provides another evidence of the massive value of natural forests and woodland resources missing from the SNA in Swaziland. If one considers other direct and indirect use values (e.g. tourists' recreation, full medicinal use benefits, etc.) and ecological

[8] Since national accounts' figures for Swaziland were not available for the current year, study estimates of flow benefits for year 2001 were adjusted using the inflation rate to compare with the available 2000 data.

services (watershed protection, nutrients supply, pollination services, carbon sequestration and biodiversity, etc.) this value will even be higher by many folds. Whereas the value of carbon sequestration services is captured as asset values through net accumulation in carbon stocks, the following section attempts to provide information on some of the said indirect use and non-use values of natural forests and woodland resources.

1.3 Indirect Use and Non-Use Values of Natural Forests and Woodlands

As mentioned earlier, a number of other benefits of natural forests and woodlands could not be adequately measured by this study due to time and budget constraints. However, an attempt is made here to illustrate and provide qualitative information on such values. When data allow, the study derived crude quantitative estimates of some of the said values, in particular recreational values (tourism).

1.3.1 Social and cultural values. While religious activities and ceremonies contribute significant social and cultural values to the welfare of the Swazi people, the role of forests in religious practices is not well documented. In many traditional and religious customs such as the Sangoma and Inyanga initiations, funerals and weddings in Swaziland people use various forest and woodland products such as plants and timber. There are also national annual customs such as the Incwala and Reed Dances[9] for which dancers collect and use (in large quantities) parts specific plant species such as the reed (for the Reed Dance) and *dichrosachys* (Lusekwane for Incwala ceremony).

The study estimated through informal surveys that Incwala dancers spend approximately half an hour each in collection of the Lusekwane plants to use for the ceremony. About 10-12 thousand males participate in the dance every year. Since the Lusekwane shrub is considered one of the commonly used firewood types in rural Swaziland one can use the average firewood price to place a value on this social service of forests and woodlands. The alternative is to derive a value for the opportunity cost of males' time spent on collection of this product. Using an average wage rate in rural areas of E 2 per hour and the total time spent by 12,000 males we arrive at a total time value of E 12,000 of Lusekwane for the Incwala ceremony. Using the average firewood price of E 0.57/kg and an average of 3 kg of Lusekwane per person, the study derives a total value of E 20,520.

The study also estimated that about 20,000 girls participate in the Reed Dance every year during which each spend approximately one hour in collection of reed. Using the same average rural wage rate this gives a total value of time of E 40,000 for the forest and woodlands resources (reed) used in the Reed Dance. While these figures represent insignificant monetary values the social and cultural values of the two ceremonies are

[9] The Incwala is an annual males' ceremony in Swaziland performed in December/January of every year and is associated with royal cleansing. The Reed Dance is a traditional Swazi ceremony performed by girls during August/September of every year during which reed is collected for renovation of the fence of the royal residences.

certainly much higher given the social meaning of participating in these customs for unmarried young girls and boys. Unfortunately the present study could not establish such social value.

1.3.2 Recreational values. Nature-based tourism is an important economic activity and source of income and foreign exchange in Swaziland. Nevertheless the economic value of the contribution of the natural environment to this activity (scenic beauty) is already (at least partially) accounted for in the SNA. This is because the value of what tourists pay for visiting such sites within the country is captured as income by a number of sectors and activities servicing the tourism industry, such as hotels, restaurants and transport sectors. Implicit in that value is some marginal contribution of the natural environment (forests, rivers, wildlife, mountains). Decomposing total tourism values captured in the SNA to isolate the contribution of forests and woodlands was beyond the means of this investigation in terms of budget and time. However, Tables 12 and 13 provide an indication of the contribution of the tourism industry to national income and welfare in Swaziland.

Table 12 shows the significant contribution of tourism to national income and export earnings. Expenditure by tourists represents the demand for tourists' service, which include the value of natural scenery. Unfortunately, the tourism activity is normally not included as one of the traditional production sectors in the SNA. The value of (income from) tourism is usually allocated to sectors other than nature in the SNA such as the services sector (hotels, transport, etc.). Table 13 indicates the economic importance of such sectors of the economy of Swaziland.

Table 12. Swaziland Tourism Statistics (1988 – 2000)

Year	Number of tourists	Expenditure per tourist	Average length of stay	Total Expenditure	GDP	Tourists' expendit. as % of GDP	Exports	Tourists' expendit. as % of exports
		E/per night	Nights	E million	E million		E million	
1988	201,438	65	1.7	22.293	1,828	1.22	1,059	2.10
1989	257,997	78	1.4	28.137	2,224	1.27	1,207	2.33
1990	287,997	104	1.2	35.942	2,428	1.48	1,464	2.46
1991	289,493	86	1.1	27.482	2,765	0.99	1,712	1.60
1992	268,171	123	1.2	39.614	3,225	1.23	1,894	2.09
1993	287,023	141	1	40.413	3,771	1.07	2,203	1.84
1994	320,097	158	1	50.703	4,596	1.10	2,808	1.80
1995	299,822	170	1	51.060	5,073	1.01	3,146	1.62
1996	314,921	180	1.1	62.424	5,686	1.10	3,571	1.75
1997	269,113	258	1.1	76.433	6,612	1.16	3,569	2.14
1998	284,116	268	1	76.086	7,449	1.02	5,303	1.44
1999	264,746	272	1	71.879	8,410	0.85		
2000	324,894	184	1.6	95.545	9,673	0.99		

Table 13. Tourism and GDP in Swaziland in E million (1988 – 2000)

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Hotels and Restuarants	22.9	23.3	24.4	18.1	21.5	22.3	26.1	28.5	28.2	29.3	29.9	31.0	31.1
Growth rate		1.7	4.7	-25.8	18.8	3.7	17.0	9.2	-1.1	3.9	2.0	3.7	0.3
Share of GDP	1.3	1.0	1.0	0.7	0.7	0.6	0.6	0.6	0.5	0.4	0.4	0.4	0.3
Transport	37.8	40.0	42.5	49.0	54.0	55.0	52.5	53.9	52.5	52.8	54.0	57.5	61.1
Growth rate		5.8	6.3	15.3	10.2	1.9	-4.5	2.7	-2.6	0.6	2.3	6.5	6.3
Share of GDP	2.1	1.8	1.8	1.8	1.7	1.5	1.1	1.1	0.9	0.8	0.7	0.7	0.6
Other Services	23.6	19.0	18.9	19.1	19.4	20.3	21.2	21.9	22.6	23.3	24.0	24.5	25.1
Growth rate		-19.5	-0.5	1.1	1.6	4.6	4.4	3.3	3.2	3.1	2.9	2.3	2.3
Share of GDP	1.3	0.9	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3
G.D.P.	1,828.0	2,224.0	2,428.0	2,765.0	3,225.0	3,771.0	4,596.0	5,073.0	5,686.0	6,612.0	7,449.0	8,410.0	9,673.0

1.4 Asset Resource Accounts for Natural Forests and Woodlands

In spite of their significant economic contribution, there are indications that these valuable forest and woodland resources are not sustainably utilised and face threats of depletion from over exploitation by communities and conversion into other land uses (Danced, 1999 and 2000). This section deals with assessing the condition of standing timber and carbon assets of the resource. Unlike cultivated plantations however, no time series data are available on the state of natural forests and woodlands over time. The two assessments carried in 1990 (GTZ, 1990) and 1999 (Danced, 1999) are the only two data points available as comprehensive forest resources' inventories. Data from the Danced 1999 assessment of forest resources and other sources were combined with our survey data to analyse the condition and pressure on this resource base.

1.4.1 Physical Asset Accounts

1.4.1.1 Physical timber stock accounts

Net accumulation in timber stocks is measured as the difference between growth and regeneration (or afforestation) and harvesting plus natural damage. Growth and regeneration measure the capacity of the resource to supply the various products and services needed by user human communities. Harvesting represents the demand side together with damage due to natural factors (fire, etc.). Since species composition and other plant community characteristics influence both growth and harvesting patterns, the analysis in this section will be based on vegetation types rather than ecological regions. Growth measured in annual volume increments varies by vegetation. This study used the 1999 FRA of the FPLP (Danced, 1999) estimates of volume increments to calculate annual accumulation in timber volumes for the natural forest and woodland vegetation types surveyed (Table 6).

On the other hand, the study used the survey data to derive levels of utilisation of the various products harvested from the different vegetation types to establish demand quantities. No information was available on natural damage and hence total demand was equivalent to harvesting. Per capita consumption estimates were thus derived for all harvested products from the various vegetation types (Table 9). However, to derive total human demand for timber (and other products), population statistics were needed by type of vegetation. Although the CSO has an enumeration areas (AE) map, that map was not available in digital form to combine with digital vegetation maps and use geographic information systems' spatial analysis facilities to calculate population numbers by vegetation. Nevertheless, the study made an attempt to manually extract crude estimates of population distribution by vegetation by visual inspection and analysis of the two maps. Based on that, total demand for (withdrawal of) timber volumes has been calculated by type of vegetation, again using *user populations* (Table 14). Demand for timber only considered firewood and timber used for construction of houses, kraals and fences. The figures of Table 14 are based only on rural households' *user populations* and did not account for urban use of these products. Total annual extraction by rural households amounted to 0.44 million m^3 with the highest share of harvesting for firewood (0.366 million m^3). Most of the extraction takes place in the open accacia woodland (0.12) and open bush land (0.1), mainly due to the high population density factor (Table 14).

Supply and demand were then balanced for construction of the physical timber accounts in Table 15. Standing timber volumes of natural forests and woodlands show a net positive national annual accumulation of 177,000 m^3 equivalent to 0.26 m^3/ha/annum. However, the distribution of pressure varied significantly between vegetation types. The highest pressures were felt in the open bushland and open woodlands, where population density is high. Net depletion of timber is also observed in the dense portions of bushland, mixed woodland and montane highland vegetation. On the other hand, large surpluses (net accumulation) occur in wattle, open mixed woodland and open montane vegetation.

When urban use is also accounted for (assuming only 25% of the rural user population), the picture significantly changed showing net national annual depletion at 201,000 m^3 (0.3 m^3/ha) of timber stocks (Table 16). All vegetation types are now facing depletion at varying degree except wattle, open montane and open mixed woodlands, where there is net accumulation (gain). Our urban user population factor (25% of urban user population) is low for firewood (comprising 78% of total demand according to Table 15) than other studies' estimates indicating that 50% of urban population use firewood (Danced, 2000b). When one compares the two forest assessment inventories of 1990 (GTZ, 1990) and the FPLP1999 FRA it appears that forest area has increased by 9% between 1990 and 99 (Danced, 1999). This difference however, was considered to reflect variations in technical factors including methods used and mapping detail of the two inventories rather than physical expansion of forest cover. Nevertheless, we examined our results in the context of the results of the 1990 and 1999 forest resource assessments in Table 17.

Differences in the two inventories' estimates of standing timber volumes of natural forests and woodlands were used to calculate an estimate of net accumulation between 1990 and 1999. This gave a figure of negative total net accumulation (depletion) of 1.983 million m^3 of timber over the 9 years period, which gives an average of 220,000 m^3 per annum. This figure compares very well with our depletion estimate of 201,000 m^3, based on total (rural and urban) user populations (Table 16).

1.4.1.2 Physical carbon stock accounts

This study adopted Scholes and Walker (1993) ratio of 45% carbon contents of savannah timber to derive net accumulation of carbon. Applied to the negative net timber accumulation (depletion) of Table 16 (201,000 m^3) a net depletion of carbon stocks of 71,100 ton of carbon in 2001, which is equivalent to a C density of –25.33 g C/ m^3 /year.

Table 14. Total quantities of products harvested for various purposes by vegetation type (000 m3/year) – Rural only

	Montane highland		Moist mixed woodland		Open accacia	Dry accacia woodland		Bushland		Wattle	Total
	Dense	Open	Dense	Open	woodland	Dense	Open	Dense	Open		
Firewood	12.2	7.8	52.6	29.4	104.6	1.3	31.8	14.1	75.8	36.7	366.3
House construction	2.9	1.4	3.9	9.9	9.3	0.2	7.4	5.7	18.5	4.8	63.8
Kraal construction	0.0	0.0	1.1	1.2	1.4	0.0	0.7	0.6	2.5	0.3	7.9
Fence construction	0.4	0.2	0.8	1.0	1.2	0.0	0.6	0.4	2.1	0.0	6.8
Thatch	0.3	0.0	0.5	0.9	0.8	0.0	0.9	0.7	4.5	0.4	9.2
Edibles	0.3	0.0	1.4	0.5	1.3	0.0	0.0	0.2	10.8	1.9	16.5
Medicinal	0.0	0.2	0.0	0.0	0.1	0.0	1.2	0.0	0.3	0.0	1.9
Craftwood	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3
Weaving grass	0.0	0.0	0.3	0.9	0.0	0.0	0.2	0.0	0.0	0.0	1.4
Total demand (000 m3)	15.5	9.3	58.4	41.5	116.4	1.5	40.4	20.9	98.9	41.7	444.7
Rural Population (million)	0.04	0.02	0.09	0.11	0.13	0.00	0.06	0.04	0.23	0.03	0.7593

Table 15. Net accumulation in timber assets of standing natural forest and woodland stocks by vegetation type (000 m3/annum) – Rural only

	Montane highland		Moist woodland	mixed	Open accacia	Dry woodland	accacia	Bushland		Wattle	Total
	Dense	Open	Dense	Open	woodland	Dense	Open	Dense	Open		
Total demand	15.5	9.3	58.4	41.5	116.4	1.5	40.4	20.9	98.9	41.7	444.7
Total supply	10.5	39.1	53.0	116.6	117.6	2.1	6.9	11.1	35.5	230.0	622.4
Deficit/surplus	**-5.0**	**29.7**	**-5.5**	**75.1**	**1.2**	**0.6**	**-33.6**	**-9.7**	**-63.5**	**188.3**	**177.6**
Population density (persons/ha)	4.1	0.9	1.6	1.0	0.8	0.1	1.8	0.8	1.3	1.0	1.1
Area (ha)	10510	26046	52971	116649	168020	10293	34328	55683	177271	26440	678211
Total demand (m3/ha)	1.5	0.4	1.1	0.4	0.7	0.1	1.2	0.4	0.6	1.6	0.7
Total supply (m3/ha)	1	1.5	1	1	0.7	0.2	0.2	0.2	0.2	8.7	0.09
Deficit/surplus (m3/ha)	**-0.47**	**1.14**	**-0.10**	**0.64**	**0.01**	**0.05**	**-0.98**	**-0.17**	**-0.36**	**7.12**	**0.26**

1.4.2 Monetary Asset Accounts for Timber and Carbon Stocks

Net depletion in timber and carbon estimated in the physical assets accounts above are converted to money values to derive the monetary asset accounts. The net price method was used to value timber assets, which is equal to per unit revenue (gross price) minus per unit harvesting costs. A gross price of timber of E 0.54/kg (E 691.3/m^3) was derived as an average of the firewood and construction timber prices using percentage shares in total physical depletion quantities as weight factors. Since own labor is the major input in harvesting of timber from open access resources, it is assumed that the net price of timber is 80% of the gross price (e.g. opportunity cost of labor and other inputs such as tools represents only 20% of the gross value)[10]. This gave a total value of E 111.2 million of the annual depreciation of timber stocks in 2001. The same carbon price used for plantations (E 40.13/ton of C at 2001 prices) was applied to woodlands' carbon stocks to derive a total value of net depletion of carbon of E 2.85 million.

6. IMPLICATIONS FOR THE NATIONAL ACCOUNTS AND POLICY

The results of the forest resource accounting analysis presented above have important implications for the current measures of social wellbeing and economic performance as well as for policies and strategies for sustainable management and exploitation of the natural resource base. This section corrects the SNA for the value of flow benefits and asset values of forest and woodland resources in Swaziland and derives policy implications.

Measures of domestic income (VAD) and capital formation were corrected in Table 18 for omissions of the forest and woodland resources' values calculated above. Swaziland national accounts for the current year are not out yet and hence adjustments of current accounts (GDP) were done for year 2000 in Table 18, which required that flow benefits of natural forests and woodlands be adjusted to 2000 prices. Since flow benefits of cultivated plantations are already part of the GDP, only benefits of natural forests and woodlands missing from the formal accounts were added. The measure of GDP for 2000 rose by 2.2% when corrected for flow benefits of natural forests and woodlands with timber products making 90% of this increase. The missing flow benefits of natural forests and woodlands were equivalent to about 20% of the contribution of agriculture to GDP and more than 400 times the contribution of plantation forestry to GDP in 2000 (Table 18). The fact that the national accounts include the contribution of plantation forestry as the only value attributed to the forestry sector in Swaziland, indicates the high underestimation of the value of natural forest and woodland resources to the people of Swaziland, especially the rural poor. This omission is the major reason behind underestimating the opportunity cost of

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[10] Resource rents are the proper price to use for valuing natural resources' asset stocks. Theoretically, however, in the case of pure open access and common pool resources such as this, resource rents are believed to be zero, meaning that value added will be equal to the opportunity cost of labor and capital. Nevertheless, there is a net price value of the resource (naturally growing timber) equivalent to revenue minus labor and capital costs as used here.

converting forests and woodlands into other land uses leading to over conversion and excessive removal of the country's tree cover.

More over, the fact that asset values of forest and woodland resources are not captured in the SNA results in generation of incorrect indices and measures of economic performance and wellbeing such as the rate of savings and capital formation, sending wrong signals to policy design and development planning. When net accumulation in asset values was accounted for, the SNA measure of domestic savings dropped by 32.6% as a result of net depletion of natural forest and woodland resources' timber and carbon stocks in excess of net accumulation realised in cultivated plantations (Table 18)[11]. This implies that the country is liquidating its natural capital by depleting its forest resource stocks through over extraction by rural communities, which is another piece of information critical for sustainable management and exploitation of these resources that is missing from the SNA.

The results of this study show very clearly how forest and woodland resources can be mismanaged and over exploited leading to resources' depletion and degradation as a result of excluding or underestimating the true contribution of such resources to human wellbeing. In order to generate proper indicators of welfare change, current measures of income and wealth must be corrected for net accumulation (depletion) in natural resource assets and the total value people directly or indirectly derive from their use. Genuine measures of sustainable income, savings and capital accumulation provide more appropriate information that is crucial for sustainable development planning and design of sound policies for economically efficient and sustainable use of natural resources such as the forests and woodlands of Swaziland.

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[11] Note that because information on cultivated plantations was available only up to 1998, adjustments were made to domestic savings in Table 18 for that year and hence our netaccumulation estimates at 2001 prices were adjusted to the 1998 prices.

Table 16. Net accumulation in timber assets of standing natural forest and woodland stocks by vegetation type (000 m3/annum) – rural and urban

	Montane highland		Moist mixed woodland		Open accacia	Dry accacia woodland		Bushland		Wattle	Total
	Dense	Open	Dense	Open	woodland	Dense	Open	Dense	Open		
TOTAL DEMAND (000 m3)	35.2	32.3	95.9	61.9	166.3	56.4	76.6	47.5	122.6	128.6	823.3
TOTAL SUPPLY (000 m3)	10.5	39.1	53.0	116.6	117.6	2.1	6.9	11.1	35.5	230.0	622.4
Deficit/surplus (000 m3)	**-24.7**	**6.8**	**-43.0**	**54.7**	**-48.7**	**-54.4**	**-69.7**	**-36.3**	**-87.1**	**101.4**	**-201.0**
Area (ha)	10510	26046	52971	116649	168020	10293	34328	55683	177271	26440	678211
Total demand (m3/ha)	3.3	1.2	1.8	0.5	1.0	5.5	2.2	0.9	0.7	4.9	1.2
Total supply (m3/ha)	1	1.5	1	1	0.7	0.2	0.2	0.2	0.2	8.7	0.09
Deficit/surplus (m3/ha)	**-2.35**	**0.26**	**-0.81**	**0.47**	**-0.29**	**-5.28**	**-2.03**	**-0.65**	**-0.49**	**3.83**	**-0.30**
Population density (persons/ha)	4.1	0.9	1.6	1.0	0.8	0.1	1.8	0.8	1.3	1.0	1.1

Table 17. Study estimates of net accumulation in timber stocks (total user population) within the context of the GTZ 1990 and Danced 1999 inventories

	Montane highland		Moist mixed woodland		Open accacia	Dry accacia woodland		Bushland		Wattle	Total
	Dense	Open	Dense	Open	woodland	Dense	Open	Dense	Open		
Study estimates-All user population (000 m3)	-24.7	6.8	-43.0	54.7	-48.7	-54.4	-69.7	-36.3	-87.1	101.4	**-201.0**
Annual net accumulation 1990-99 (000 m3/year)	-16.2	-40.0	-56.4	-124.3	-108.1	8.6	28.7	52.5	167.0	-132.2	**-220.4**
Total net accumulation 1990-99 (000 m3)	-145.4	-360.2	-508.0	-1118.7	-972.8	77.5	258.5	472.2	1503.3	-1189.8	
FRA/FPLP 1999 volume estimates (m3/ha)	17.0	17.0	21.2	21.2	18.3	15.7	15.7	13.4	13.4	19.6	
SGFP/GTZ 1990 volume estimates (m3/ha)	30.8	30.8	30.8	30.8	24.1	8.2	8.2	4.9	4.9	64.6	
Area in 1999 (ha)	10510	26046	52971	116649	168020	10293	34328	55683	177271	26440	678211

Table 18. Accounting for the true economic contribution of forest and woodland resources in Swaziland (E million)

	Cultivated plantations	Natural forest and woodlands	Total
Based on 2000 data			
Total GDP			9,673
Agriculture GDP			1,074
Forestry GDP			48
Flow benefits	4,837	212.5	212.5
Timber products	4,837	193.4	
Non-timber products	0	19.2	
Green GDP			9,885.5
% change			2.2
Missing forest benefits			212.5
% of agriculture GDP			19.8
% of forestry GDP			439.4
Based on 1998 data			
Gross Domestic Savings			245.3
Net asset accumulation	13.1	-93.1	-80
Timber assets	8.9	-90.77	
Carbon assets	4.2	-2.33	
Genuine gross domestic savings			1,65.3
% change			-32.61

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