Center For Economic Research on Africa
School of Business
Montclair State University
Upper Montclair, New Jersey 07043

Forest Resource Accounting in Ghana, 1970-1987

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Ahmet Baytas and Farahmand Rezvani
Department of Economics and Finance
School of Business
Montclair State University
Upper Montclair, NJ 07043
Baytasa@mail.montclair.edu
Rezvanif@mail.montclair.edu

Abstract

Conventional growth accounting has often ignored the issue of social costs. Following Repetto's study of Indonesia, an environmentally-sensitive growth accounting framework is developed and applied to Ghana's system of national income accounts for the period 1970 to 1987. When so included, Ghana's resource-dependent growth patterns are less robust than would be the case under conventional accounting procedures. For African countries seeking to achieve sustainable patterns of economic growth and development, accounting for environmental costs in an operationally consistent manner is a useful first step in fashioning appropriate economic policy.

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1. Introduction

Since the 1972 U.N. Conference on the Human Environment in Stockholm, a new integrated approach to economic development and environment has been gaining increasing credibility. This approach, expounded in recent "ecodevelopment" literature, is based on the premise that programs for the conservation of soil, water, land, forests and wildlife must be combined with economic development[1]. The current economic crisis and environmental deterioration in Sub-Saharan Africa has encouraged a much broader recognition of this link between environmental maintenance and elimination of poverty. Indeed, many economists, ecologists and policymakers, from radical non-governmental organizations (NGOs) to the normally conservative World Bank (1984), have acknowledged the necessity of sustainable development.

Meanwhile, conventional economic theory has been challenged and criticized for “mismeasuring development, underestimating the intangible costs of pollution and ignoring society's responsibilities to future generations” (Passell 1990). There is a growing perception that the conventional income accounts reflect changes in natural resources and environment rather poorly, and as a result, may lead to estimates of income levels or growth rates that are not sustainable (Peskin and Lutz 1990). Hence, a number of international agencies and many governments are currently trying to construct indexes to better represent the quality of life and eventually to replace GNP.

These new indexes would give the sustainability of natural life support systems priority over conventionally measured economic growth, and would include natural resource depletion in national income accounts. On the one hand, these efforts reflect the growing consensus that, in the words of Paul Erlich, "we must acquire a life style which has its goal maximum freedom and happiness for the individual, not a maximum GNP" (Nordhaus and Tobin 1973). On the other hand, they are the recognition of the fact that "oil that is no longer in the ground makes us poorer in the future, as do trees that have been cut for railroad ties or house construction" (Juster 1973).

No generally accepted theoretical framework yet exists for natural resource accounting, though a few pioneering studies have recently been published. In one such study, Repetto and his colleagues at the World Resources Institute have calculated Indonesia's net output by extending conventional accounting methods to include losses from soil erosion, losses of forest resources and depletion of oil fields (Repetto et al 1989). Their conclusion is quite striking: when resource depletion is accounted for,

[1] . For example, see Riddell (1981) and Bartelmus (1986).

Indonesia's spectacular annual average growth rate of 7.1 percent between 1971 and 1984 falls to about 4 percent.

Although narrower in its scope, this study is similar in method to the Indonesian study. It is an attempt to set up both physical and monetary accounts for timber resources of Ghana between 1970-1987[2]. These tables can then be used either as "satellite" accounts or fully incorporated into conventional accounts, depending on the objective. Our primary purpose is to contribute to the development of alternative accounting systems. Especially for a resource-dependent country like Ghana, "failure to extend the depreciation concept when depleting the capital stock embodied in natural resources represents a major flaw of the accounting process" (Lutz and E1 Serafy 1988).

It must be stated at the outset that there are limits to setting up physical accounts and to their monetary valuation. For example, in addition to problems pertaining to the availability and quality of data, where accounting of timber resources is concerned, there are also conceptual problems such as aggregating wood from different species of trees. Moreover, monetary valuation is very difficult, and at times quite arbitrary, chiefly due to the remoteness of at least some of the resources from the market economy. Consequently, some of the procedures used below to construct timber resource accounts may involve somewhat roundabout methods that involve a number of assumptions, some of which might be questionable.

However, natural resource accounting as a field of study is relatively young, and one would expect that as its value and notion are more widely accepted and practiced, improvements in concepts, methods, and data quality will naturally follow. In other words, given the current state-of-the art, we acknowledge that more theoretical and empirical work is needed before conventional measures could be replaced by more sustainable measures of income[3]

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[2] In principle, a comprehensive study would have to include physical and monetary accounts for all important natural resources of an economy, such as wildlife and fish populations and various minerals as well as petroleum and soil resources.

[3] There are also a number of controversial issues in the current system of national income accounting. Conceptual problems from the treatment of leisure and household production to the concepts and measurements of capital and investment are well-known. See, Eisner (1980), Usher (1980), and especially Soladay's (1980) criticism of the current measures of income.

2. The Need for Natural Resource Accounting

As is well-known, the conventional national income accounting system emphasizes the rate of growth of real GNP as the principle indicator of economic growth. However, GNP and other widely used social accounts, i.e., GDP and NNP, ignore the productive role of natural resources[4]. The result, as Repetto et al (1989) argue, is a curious and dangerous asymmetry in the way we measure and think about the value of natural resources.

Capital goods like machinery, tools, and equipment are valued as productive capital, and are written off against the value of production as they depreciate. This practice " recognizes that a consumption level maintained by drawing down on the stock of capital exceeds the sustainable level of income" (Repetto et al 1989). Natural resources, however, are not so valued. For a country could fell all its forests, erode its soils, deplete its oil reserves, exhaust its mineral resources and yet measured income would not be affected--though such losses would clearly decrease potential output in the future,. just as the depreciation of man-made capital would.

Under the current system, if a nation like Ghana uses the revenue from its timber sales to finance current consumption--an ultimately unsustainable path--national income would show a gain, not a loss in wealth. Such an approach would be appropriate only in a universe in which natural resources are so abundant that they have no marginal value (Lutz and E1 Serafy 1988). Perhaps even for a nineteenth century neoclassical economist or Marx such disregard of natural resource scarcity was understandable, given the historical circumstances. Today, however, especially in low income countries, natural resources are under such pressure from human activities and have deteriorated so much that many consider large areas in Africa as environmentally bankrupt or refer to it as "a continent on the brink" (Timberlake 1985). Therefore, to rephrase Repetto et al (1989), how could a country like Ghana, Nigeria or Gabon, which depend largely on natural resources for employment and income, use a system for national income accounting that ignores their principle assets?[5]

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[4] So does the neoclassical production function, where output is related to two inputs only, labor and capital. Natural resources are considered "free gifts of nature."

[5] Note that our work focuses on resource accounting and not on environmental accounting. For the discussion of the latter, which is more relevant to industrialized nations, and which is primarily concerned with the measurement of the effects of pollution, see Moss (1900) and Lutz and Munasinghe (1991).

Moreover, this practice of treating natural resources and manmade capital differently gives false signals to policymakers by reinforcing "the false dichotomy between the economy and the environment" (Repetto et al 1989). It also contradicts the most widely accepted Hicksian definition of income as the amount one could consume in a given period without reducing the amount of possible consumption in some future period (Lutz and Munasinghe 1991). This definition of income encompasses the concept of sustainability and implies that depreciation of all resources must be excluded from total current income.

Many efforts to improve conventional measures of income are already under way. In 1986 OECD decided to include more accurate resource accounts, and a year later a report of the World commission on Environment and Development stated that "in all countries, rich or poor, economic development must take full . account in its measurements of growth of the improvement or deterioration in the stock of natural resources" (Repetto et al 1989). Both the United Nations and the World Bank have also encouraged the inclusion of environmental variables and resource depletion in the income accounts and proposed that a set of environmental "satellite" accounts be created to accompany the conventional accounts[6].

Meanwhile, a number of industrialized countries have already begun official attempts at setting up systems of environmental accounts. For example, Norway's resource accounts include petroleum, forest products, fish and various minerals. Amore ambitious set of physical resource accounts is being developed by France under the system of Natural Patrimony Accounts. Canada, Germany and the Netherlands are seriously considering the development of satellite resource accounts[7]

3. Ghana’s Timber Resource Accounts

3.1. Ghana's Forest Resources

Throughout much of the low-income regions rapid deforestation is laying waste to valuable economic assets, destroying fragile soils and accelerating desertification. About 20 million hectares of forest, mainly tropical moist forest, are lost each year (World Bank

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[6] Economists like Repetto at the World resources Institute and Lutz at the World Bank argue that depletion accounts must be brought into the main national income accounts, rather than relegating them to "satellite accounts." For details, see Repetto et all (1989) and Lutz and E1 Serafy (1988).

[7] For details and survey of resource and environmental accounts in industrialized countries, see Peskin and Lutz (1990).

1991a). Forests are also deteriorating in quality; each year more than 4 million hectares of virgin tropical forests are harvested, becoming secondary forests. In Africa, between 1950 and 1983, forest and woodland areas dropped 24 percent (Repetto 1988). Over half of the forest loss in Africa occurred in the West African countries of Ivory Coast, Nigeria, Liberia, Guinea, Gabon, and Ghana, where the rate of forest loss is seven times the world average (World Resources 1986). These countries account for virtually all exports of tropical hardwood products from Africa (Repetto 1988).

In Ghana natural forests covered almost one third of the country at the beginning of this century. By 1980 virgin forest had all but disappeared. According to estimates, well over 60 percent of Ghana's forest has been destroyed in the search for agricultural land, firewood, minerals, and logging for timber. Logging and cocoa production were most responsible for the loss of closed forests until the mid-1960s. The principal sources of more recent deforestation in Ghana, however, have been shifting cultivation and fuel wood harvests, both of which are driven by poverty. Fuel wood consumption, which grew sharply after 1970, reached 906 cubic meters per capita per annum in by 1983, one of the world's highest (Gillis 1988). As we shall see below, fuel wood harvests, about four times the volume of industrial log harvests in the early 1970s, are now more than 10 times larger than the latter.

It must be noted that the contribution of Ghana's forest sector to GDP has been relatively stable since 1965, with the value added in the forest sector varying between 4.9 percent and 6.2 percent of the declining GDP[8]. Even this low figure overstates this sector's contribution in income since, as we shall see below, a substantial proportion of value added should be regarded as depreciation of natural capital stock rather than income. In any case, it is well-understood that only in species poor ecosystems on good soils, as in temperate forests, does logging appear to be an ecologically and economically sound form of exploitation (Jacobs 1988).

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[8] The value added in the forest sector averaged only 3.3 percent of GDP in a 1980 sample of African countries. See, Repetto (1988).

Table 1 summarizes Ghana's forest resources at the end of 1980.

Table 1.
Ghana Forest Endowments 1980
(thousand ha)

Total Land Area	23,850
Closed Forests(a)	1,718
a. Virgin	0
b. Productive (Managed) (b)	1,167
c. Unproductive (c)	551
Open Forest (d)	6,975
Plantation (e)	75
Other Wooded Area (f)	9,480

Sources: World Resources Institute Data Tapes and Gillis (1988).

a. Closed forests are those where trees cover a high proportion of the ground and grass cover does not form a continuous layer on the forest floor.

b. Productive (managed or logged) forests are those that have some control of use such as harvesting regulations and/or silvicultural treatments.

c. Unproductive forests refer to those forests used for protection (watershed management or soil stabilization) or conservation in national parks.

d. Open forest is mixed forest or grassland with at least 10 percent tree cover and a continuous grass layer.

e. Plantation refers to forest stands artificially established for harvest.

f. Other wooded area includes forest fallows and shrubs.

4. Physical Accounts

Physical stocks of timber and annual changes in these stocks are recorded in table 8 in cubic meters of available wood. The basic accounting identity is that opening stocks plus all natural growth and reforestation less total roundwood production (industrial extraction plus fuelwood harvest), logging damage, and deforestation as a result of shifting or permanent cultivation as well as transfers of forest lands to other uses (e.g., road construction) equals closing stocks. These accounts do not represent the full value of a country's forest resources, which yield many important non-timber commodities such as rattan, resins, oils, foodstuffs, and which provide habitat for forest dwellers and for plant and animal species, watershed services, protect soils, prevent desertification and regulate climatic patterns. In other words, "the value of a rainforest is greater than the value of all its salable hardwoods" (Peskin and Lutz 1990).

4.A. Total Growing Stock

We have the estimate of the total growing timber stock in physical units for 1980, the benchmark year. Stock estimates for the remaining years in our sample are computed using the annual additions and reductions. The measure of stocking volume used is VOB, "volume over bark," which is the "gross volume in m3 per hectare over bark of free bole (from stump or buttresses to crown point of first main branch) of all living trees more than 10 centimeters in diameter at breast height" (Repetto et al 1989). There have been a number of attempts to measure the total growing stock in West Africa's tropical forests. The results differ enormously. For example, a FAO (1983) study suggests VOB of 250-600 m3/ha in closed hardwood forests in Africa, whereas another FAO (1976) paper suggests stocking rates of 100 m3/ha to 800 m3/ha in tropical African rainforest.

Solid wood volume estimates in open forests are also variable. Estimates in Cameroon vary from 12.6 m3/ha to 21 m3/ha; in Burkina Faso from 21.4 to 32.1; in Central African Republic from 9 m3/ha to 57 m3/ha; in Mali from 17 m3/ha to 46.5 m3/ha; and, in Nigeria from 19.6 m3/ha to 50 m3/ha (FAO 1989). A more recent and more detailed survey of broadleaved forests in Africa gives estimates of stocking rates at the end of 1980 as follows: 256 m3/ha in virgin forests, 138 m3/ha in productive closed forests, 117 m3/ha in unproductive closed forests and 28 m3/ha in open forest (FAO 1982). These rates are used to calculate the total growing stock. No estimates of the stocking rate in Ghanaian plantations were available. We use an estimate of 100 m3/ha, based on the rate employed in the Indonesian study (Repetto et al 1989) .

Table 2 shows that the total growing stock at the end of 1980, i.e., the closing balance in physical accounts, comes to 428,313 thousand m3. This implies an overall average stocking rate of 48.8 m3/ha and average stocking rate in closed forests of 131.3 m3/ha[9].

[9] In Indonesia's tropical forests stocking rates Repetto et al (1989) uses are 323 m3/ha for virgin forests, 204 m3/ha for productive closed forests and 198 m3/ha for unproductive forests.

Table 2
Estimation of the Total Growing Stock
1980

Forest Type	Area (000 ha)	Stocking Rate (m3/ha)	Total Stock (000 m3)
Closed productive	1,167	138	161,046
Closed unproductive	551	117	64,467
Open	6,975	28	195,300
Plantation	75	100	7,500
Total	8,768		428,313

4.B. Growth

Physical accounts reflect the annual growth in the volume of trees in natural forests[10]. It is well-known that African rainforests, although relatively poor in species compared to the tropical forests of South America and Asia, still contain between 80 to 200 species per hectare. Moreover, no two hectares have exactly the same species composition and a high proportion of species is found only once even in a large plot (Jacobs 1988). These characteristics make estimation of growth rates in tropical forests relatively difficult compared to more uniform temperate forests.

Although no detailed information is available on growth rates of tree species in Ghanaian forests and woodlands, a FAO study suggests an average growth of 1.3 m3/ha/yr in most tropical forests and some other estimates in Indonesia put the growth rates of commercial species between 1 to 2 m3/ha/yr (Repetto et al 1989). Another FAO (1982) survey of productive tropical forests gives a growth estimate of 1-5 m3/ha/yr in gross volume. The same FAO study suggests the average annual productivity in Africa's open forests to be between 0.8 and 1.2 m3/ha/yr[11]. Based on these estimates, we will assume increments of 1.5 m3/ha/yr in productive closed forests, 1.27 m3/ha/yr for

[10] Only in virgin (undisturbed) forests no increment to volume should be expected, since these forests have already reached their climax equilibrium. As was noted above, in Ghana no virgin forests remain.

[11] Another FAO (1989) study shows that growth rates in open forests are quite variable, depending, among other things, on the location of the plots and tree species in the sample. For example, case studies yielded an estimate of 0.9 m3/ha/year in Nigeria, 3 m3/ha/year in Central African Republic and 3.2 m3/ha/year in Cameroon.

unproductive closed forests and 1 m3/ha/yr for open forests[12]. As table 3 shows, these figures yield an annual increase of 9,426 thousand m3 in the volume of timber in Ghana. This amount is entered into the physical accounts under "growth" for each year.

Table 3
Annual Growth in Volume of Trees

Forest Type	Area	Growth Rate	Annual Gross Increment
	(000 ha)	(m3/ha/yr)	(000 m3/yr)
Productive Closed	1,167	1.5	1,751
Unproductive Closed	551	1.27	700
Open	6,975	1	6,975
Total			9,426

4.C. Reforestation

Ghana's plantations for both industrial and nonindustrial uses covered an area of 75 thousand hectares in 1980, with average annual reforestation rate of 2 thousand hectares between 1981 and 1985 (World Resources Institute 1992). No estimate of annual growth in plantation was available; we use a growth of 10 m3/ha/yr[13]. Assuming a constant rate of reforestation every year in our sample, we calculate the annual increments to plantations by multiplying the plantation area in a given year by 10 m3/ha. The results are entered under "reforestation" in physical accounts.

4.D. Harvesting

The figures for total round wood harvests in Ghana are given in table 4. Total round wood refers to all wood in the rough, whether destined for industrial or fuel wood uses. These figures are entered directly into the physical timber resource accounts. The data indicate the increasing relative importance of harvesting for fuel wood relative to timber production for industrial uses and exports. Industrial log production is generally lower in the 1980s than it was in the 1970s and is expected to disappear soon, since, according to the World Bank (1991), less than 1 percent of the world's tropical forest is managed in a way that will lead to sustainable timber production. Fuel wood consumption, however,

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[12] Since stocking rates are lower in unproductive forests compared to productive ones, gross annual increment to volume must also be proportionately lower.

[13] This figure is the same as the mean annual increment to plantations in Indonesia. See, Repetto et al (1989).

has nearly doubled between 1970 and 1987. Deforestation due to fuel wood harvests is a serious problem not only in Ghana but throughout the less-developed regions. FAO estimates that worldwide nearly 1.5 of the 2 billion people who rely on fuel wood are cutting wood faster than it is growing back (World Resources Institute 1990). For example, consumption now exceeds natural regeneration by 70 percent in Sudan, 150 percent in Ethiopia and 200 percent in Niger (Repetto 1988).

Table 4
Round wood Production in Ghana
(thousands of cubic meters)

Year	Fuel wood	Industrial	Total
1970	7750	1920	9670
1971	7950	1691	9641
1972	8179	1979	10158
1973	8421	2476	10897
1974	8650	1841	10491
1975	8848	1708	10556
1976	9014	1971	10985
1977	9158	1511	10812
1979	9462	1271	10733
1980	11951	981	12932
1981	12440	931	13371
1982	13535	791	14326
1983	15253	955	16208
1984	15430	984	16414
1985	15459	1081	16540
1986	15483	1101	16584
1987	15724	1101	16825

Source: World Resources Institute Data Tapes.

4.E. Deforestation

Deforestation refers to cleaning of forestlands for various uses, including settlements, permanent or shifting agriculture, reservoirs, estate crops and development projects. Taking into account all causes, FAO has estimated annual deforestation rates in many parts of the world. The deforestation rates of closed forests in a sample of West African countries are given in table 5. Shifting cultivation is the most important cause of deforestation in Ghana. Over nine million hectares had come under shifting cultivation by 1980, 40 percent of the total land area and eight times the area of the remaining productive forest (Repetto 1988).

Table 5
Deforestation in Tropical West Africa

Country	Closed Forest Area 1980 (000 ha)	Annual Rate of Deforestation 1981-85 (%)	Area Deforested Annually (000 ha)
Nigeria	5950	5.0	300
Ivory Coast	4458	6.5	290
Liberia	2000	2.1	42
Guinea	2050	1.8	36
Ghana	1718	1.3	22
Zaire	105750	0.2	160
Cameroon	17920	0.4	80
Gabon	20500	0.1	15

Source: World Resources Institute Data Tapes.

Based on FAO and other studies, Gillis (1988) gives estimates of deforestation rates in Ghana's closed forests for the 1970-75 period as 45,000 ha/yr and 1976-80 as 27,000 ha/yr. The decline in deforestation to 22,000 ha per year between 1981-85 does not reflect changes in forest use policies; but "rather there is little left to deforest" (Gillis 1988)[14]. Using the average stocking rate of 131.3 m3/ha for closed forests, we arrive at following estimates of deforestation to be used in physical accounts: 5,909 thousand m3/yr from 1970 to 1975; 3,545 thousand m3/yr between 1976-79; and, 2,889 thousand m3/yr during 1981-87.

Deforestation rate is estimated to be 50,000 ha/yr between 1981-85 in open forests in Ghana (World Resources Institute 1992). Assuming the ratio of closed and open forest clearing was stable, we obtain deforestation rates of 102,000 ha/yr between 1970-75 and 61,000 ha/yr between 1976-80. In order to estimate the timber loss in open forests, we multiply the deforestation rates just cited by the stocking rate of 28 m3/ha. The estimates are 2,856 thousand m3/year between 1970-75, 1,708 thousand m3/yr between 1976-80, and 1,400 m3/yr from 1981 to 1987. These figures are entered into timber accounts.

[14] We assume the same rate of 22,000 ha per year during 1986-87.

4.F. Logging Damage

Various forms of degradation, including overgrazing, fires and even insects and wildlife bring about a progressive depletion of the growing stock. Although these effects are difficult to quantify, forest deterioration due to logging is included in our physical accounts. In fact, logging damage is by far the most important form of closed forest degradation. As Jacobs (1988) put it, "a logged forest can aptly be compared to a bombed city."

Various estimates of logging damage in tropical forests are available. For example, according to Guppy (1984), in many parts of the world's tropical forests, most of the species with commercial value (usually about 10 to 20 percent of standing volume) but typically another 30 to 50 percent of the trees are destroyed or fatally damaged during logging. Jacobs (1988) cites a study which concludes that in Malaya when 10 percent of the standing stock of trees were harvested another 55 percent were lost. Jacobs also refers to a finding that only 21 percent of forest was still intact after the extraction of 6-8 trees in a hectare of land in Sarawah. In all cases, most of the logging damage is due to breakage and construction of logging roads. It is estimated that intensive logging has damaged up to 40 percent of the residual trees in Indonesia, which comes to about 79 m3 per hectare. Based on these figures, Repetto et al (1989) estimate that 1.98 m3 is damaged for every cubic meter harvested. In this study, we assume a ratio of 2 m3 damaged for every cubic meter harvested in closed forests which provide nearly all the industrial timber output. So multiplying the industrial round wood production given in table 4 by 2 m3 we estimate the logging damage in each year.

5. Monetary Accounts

Monetary accounts for timber resources can be developed directly form physical accounts by assigning appropriate values to timber stock levels and changes in these levels. The concept of economic rent is used in timber resource valuation. Economic rent is "the return to any input over the minimum amount required to retain it in its present use" (Repetto et al 1989). It is similar to the classical notion of differential rent where rents to natural resources such as timber would arise from their scarcity as well as from advantages in location and productivity. In forest economics, economic rent is widely referred to as the stumpage value, i.e., the international timber price less all factor costs incurred in extraction, including a normal return to capital, but excluding taxes and royalties. For example, if one m3 of timber can be sold for $20 and costs a total of $12 to cut and bring to market, a rent of $8 would be assigned to each m3 of timber. Note that under ideal market conditions, this stumpage value of $8 per m3 would be equivalent to the present value of expected future net income that one cubic meter of timber would yield. Of course, under competitive conditions and with full knowledge of timber resource, stumpage value would be the maximum amount concessionaires would pay for harvesting rights (Repetto et al 1989). However, since the rent capture rates in Ghana are very low (Gillis 1988), stumpage value must be estimated by the method just described--by subtracting costs of extraction and transportation from the export value of timber.

The export price is measured by the free on board (f.o.b.) export unit value, which is the ratio of gross export revenue to the volume of log exports. This value is applied to timber extracted for any other use as well since it is the appropriate measure of the opportunity cost. The volume of Ghana's log exports and export revenues from 1970 to 1987 are given in table 6.

Table 6
Ghana's Timber Exports

Year	Round wood Exports (000m3)	Round wood Exports (000$)
1970	601	19,480
1971	707	19,304
1972	747	32,141
1973	856	77,039
1974	434	49,002
1975	440	42,719
1976	345	41,265
1977	454	49,680
1978	312	38,386
1979	198	18,573
1980	105	12,398
1981	54	4,391
1982	53	3,469
1983	62	4,311
1984	70	5,140
1985	130	9,550
1986	177	18,440
1987	319	39,505

Source: Various issues, FAO Yearbooks: Forest Products.

Some estimates of rents in logging tropical forests in West Africa are given by country and species in table 7. As can be seen, timber rents could be as high as $79 in Ghana in the early 1970s. Considering too that the government captured only 16.5 percent of these rents between 1971-74 (Repetto 1988), it is not surprising that logging was very profitable and played a significant role in the deforestation in Ghana, especially in the 1960s and 1970s[15].

Fairly reliable estimates of timber rent as a percent of the value of log output in Ghana were made by Page, Pearson and Leland (Gillis 1988). They defined rents as the residual after all production costs, including normal return to capital, are subtracted from the value of timber output[16]. They found that Ghanaian timber rents, on the average, were 26 percent of the log output value in the early 1970s, although for some very desirable species rents were as high as 80 percent of the log value. Thus in this study we assume that rents are 26 percent of f.o.b. value in each year.

Table 7
Rents in Log Harvesting
($ per m3)

	Value of Species		
	Highest	Middle	Lowest
1973-74			
Liberia	89	58	25
Ivory Coast	47	31	17
Gabon	89	54	22
Cameroon			
a. Douala	61	32	14
b. Pointe Noire	52	23	7
1971-72			
Ghana	79	28	
1979			
Liberia	98	41	

Source: Repetto (1988).

[15] As was noted above, rent capture rates remained very low throughout the 1970s and 1980s. See, Gillis (1988).

[16] The normal return to capital is assumed to be 15 percent.

As Repetto et al (1989) observe, the rental value of harvested timber and mature forest stands cannot be applied to the other elements of the timber accounts without modification. This is because reforestation, deforestation and degradation in our timber resource account refer only to secondary forests. More specifically, we expect that the value of each m3 of timber initially harvested from an area of virgin forest exceeds that of the remaining timber and of subsequent harvests from the logged over forest. Therefore, lower rent values should be assigned to changes in timber resource levels that are due to growth, deforestation and degradation in secondary forests. The study on resource accounting in Indonesia assumes that average resource rent in secondary forests equal to 50 percent of the rent obtained from timber harvest (Repetto et al 1989).

We apply this principle of valuation to timber in Ghana, where no virgin forest remains. Thus we assign the timber harvested for industrial use (much of which is exported) the full rent, called "primary rent." We then assume, somewhat arbitrarily, that the "secondary rent" is equal to 25 percent of the primary rent and applies to the valuation of other elements of timber accounts, such as growth, deforestation and degradation. Most of these activities take place in forests previously logged or open forests, where generally less desirable species are found and degradation due to overgrazing and fuel wood harvests is greater. For example, in monetary accounts in table 8, for the year 1980, growth, deforestation and logging damage are each valued at $7.68 per m3, while industrial round wood production component of the total timber harvest of 12,932 thousand m3 is valued at $30.70 per m3, and the fuel wood harvest component at $7.68 per m3.

Table 8
Ghana Timber Resource Accounts

Physical Units (Thousand Cubic Meters)	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Opening Stock	553,126	540,827	529,035	516,170	50,159	488,710	476,049	465,965	55,607	446,656	438,284	428,313	418,987	409,006	396,835	382,452	369,737	356,958
Additions																		
Growth	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426	9,426
Reforestation	550	570	590	610	630	650	670	690	710	730	750	770	790	810	830	850	870	890
Reductions																		
Harvesting	9,670	964	10,158	10,897	10,471	10,556	10,985	11,179	10,812	10,733	12,932	13,371	14,326	16,208	16,414	16,540	16,584	16,825
Deforestation	8,765	8,765	8,765	8,765	8,765	8,765	5,253	5,253	5,253	5,253	5,253	4,289	4,289	4,289	4,289	4,289	4,289	4,289
Logging Damage	3,840	3,382	3,958	4,952	3,682	3,416	3,942	4,042	3,022	2,542	1,962	1,862	1,582	1,910	1,968	2,162	2,202	2,202
Net Change	-12,299	-11,792	-12,865	-14,578	-12,882	-12,661	-10,084	-10,358	-8,751	-8,372	-9,971	-9,326	-9,981	-12,171	-14,383	-12,715	-12,779	-13,000
Closing Stock	540,827	529,035	516,170	501,592	488,710	476,049	465,965	455,607	446,656	438,284	428,313	418,987	409,006	396,835	382,452	369,737	356,958	343,958
Unit Values (US $/m3)																		
FOB Export Price	$32.41	$27.30	$43.03	$90.00	$112.91	$97.09	$119.61	$109.43	$123.03	$93.80	$118.08	$81.31	$65.45	$69.53	$73.43	$73.46	$104.18	$123.84
Costs	$23.98	$20.20	$31.84	$66.60	$83.55	$71.85	$88.51	$80.98	$91.04	$69.41	$87.38	$60.17	$48.43	$51.45	$54.34	$54.36	$77.09	$91.64
Primary Rent	$8.43	$7.10	$11.19	$23.40	$29.36	$25.24	$31.10	$28.45	$31.99	$24.39	$30.70	$21.14	$17.02	$18.08	$19.09	$19.10	$27.09	$32.20
Secondary Rent	$2.11	$1.78	$2.80	$5.85	$7.34	$6.31	$7.78	$7.12	$8.00	$6.10	$7.68	$5.29	$4.26	$4.52	$4.78	$4.78	$6.78	$8.05
Monetary Accounts (US $ Thousands																		
Opening Stock	-	$2,942,445	$2,427,826	$3,727,537	$7,573,462	$9,258,386	$7,752,986	$9,351,750	$8,365,359	$9,220,199	$6,898,077	$8,485,540	$5,716,219	$4,492,735	$4,629,525	$4,712,333	$4,557,615	$6,290,829
Additions																		
Growth	$19,889	$16,778	$26,393	$55,142	$69,189	$59,478	$73,334	$67,113	$75,408	$57,499	$72,392	$49,864	$40,155	$42,606	$45,009	$45,009	$63,861	$75,879
Reforestation	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Reduction																		
Harvesting	$32,538	$26,157	$45,046	$107,201	$117,543	$98,941	$131,427	$122,702	$122,745	$88,718	$121,901	$85,489	$71,122	$86,210	$92,540	$94,541	$134,801	$162,578
Deforestation	$18,494	$15,602	$24,542	$51,275	$64,335	$55,307	$40,868	$37,401	$42,024	$32,043	$40,343	$22,689	$18,271	$19,386	$20,501	$20,501	$29,079	$34,526
Logging Damage	$4,051	$3,010	$5,541	$14,485	$13,513	$10,778	$15,335	$14,390	$12,088	$7,753	$7,534	$4,925	$3,370	$4,317	$4,704	$5,167	$7,465	$8,863
Net Change	-$35,194	-$27,991	-$75,129	-$117,819	-$126,202	-$105,548	-$114,296	-$107,380	-$101,449	-$71,015	-$97,386	-$63,239	-$52,608	-$67,307	-$72,736	-$75,200	-$107,484	-$130,088
Closing Stock	$2,942,445	$2,427,826	$3,727,537	$7,573,462	$9,258,386	$7,752,986	$9,351,750	$8,365,359	$9,220,199	$6,898,077	$8,485,540	$5,716,219	$4,492,735	$4,629,525	$4,712,333	$4,557,615	$6,240,829	$7,146,433

Figure 1

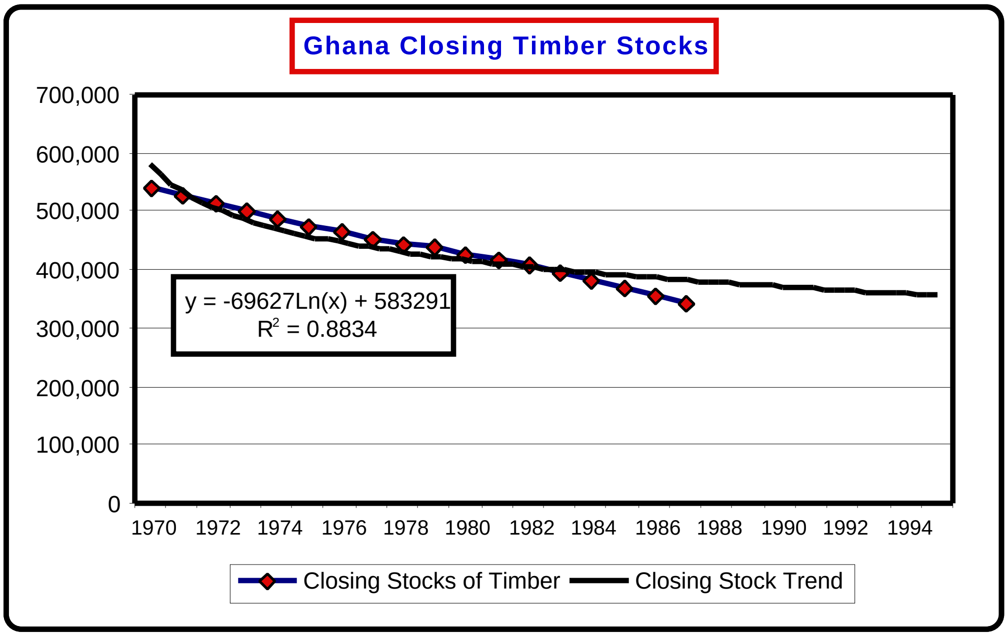


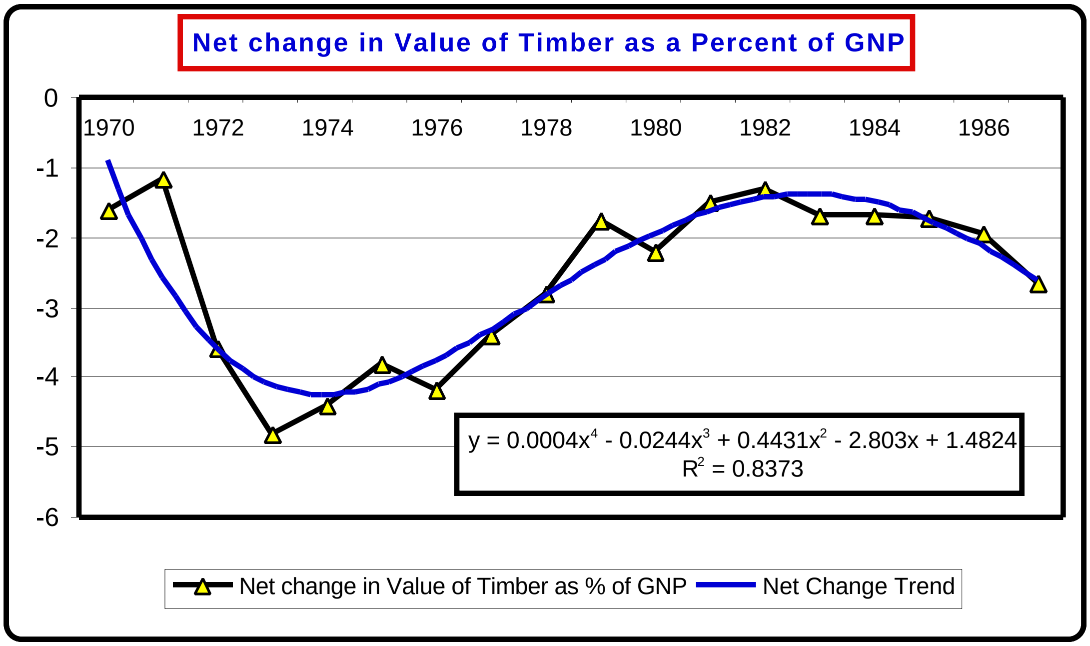
Table 9

Relative Importance of Net Changes in Timber Values in Ghana

Year	Net Change in Value of Timber	Current GNP[a]	Net change in Value of Timber as $ of GNP
1970	-35194	2169640	-1.62
1971	-27991	2383820	-1.17
1972	-75129	2097300	-3.58
1973	-117819	2447110	-4.81
1974	-126202	2874970	-4.39
1975	-105548	2787870	-3.79
1976	-114296	2744960	-4.16
1977	-107380	3178090	-3.38
1978	-101449	3654050	-2.78
1979	-71015	4006130	-1.77
1980	-97386	4426350	-2.20
1981	-63239	4209530	-1.50
1982	-52608	4025490	-1.31
1983	-67307	4021120	-1.67
1984	-72736	4352880	-1.67
1985	-75200	4428590	-1.70
1986	-107484	5586530	-1.92
1987	-130088	4935210	-2.64

(a) **Source** : WRI Data tapes.

Figure 2



6. Interpreting Timber Resource Accounts

Timber resource accounts summarized in table 8 can be interpreted in various ways, depending on the objective. For example, if our purpose were simply to present the national balance sheet of timber accounts, we would observe that, say in 1980, physical stock of timber declined by 9,971 thousand m3 and the net value of the resource increased by $1,587,463 thousand. Although such information might be useful in itself and can be used to supplement the conventional measures of income, our primary objective is to adjust GNP to a net basis by reflecting the resource depletion. Hence, for the year 1980, conventional GNP (or NNP) would have to be adjusted downwards by $97,386 thousand. Note that the amount $1,684,849, the gain in the value of timber due to the increase in the rental rate, is treated as unrealized capital gain, with no impact on current income.

Table 9 presents the value of timber resource depletion in Ghana both in absolute terms and as a percentage of GNP. For instance, in 1980 the $97,386 thousand loss in timber resource would imply a downward adjustment in GNP of 2.2 percent.

There is still a debate on whether to use natural resource accounts as satellite accounts that supplement the currently used measures like GNP or whether to replace such conventional measures by new measures of net income that account for natural resource depletion. It must be noted that even the most ardent environmentalists acknowledge the value of conventional measures in stabilization policies and for indicating short-term changes in the level of economic activity. However, these measures are not very useful "for gauging long-term sustainable growth partly because natural resource depletion or degradation is being ignored" (Lutz and E1 Serafy 1988).

7. Conclusion

This paper has tried to address the basic deficiency of the current national income accounting system which arises out of the inconsistent treatment of man-made capital and natural capital. As Lutz and Munasinghe (1991) suggested, we need measures which would account for the depreciation of all capital as a result of economic activities. For development strategies that rely on conventional accounting methods are not likely to result in sustainable development. Although we applied the resource accounting methods and techniques suggested by Repetto et al (1989) to timber resources only, national balance sheets can be constructed that include other natural resources. Such tables are indispensable for resource-based economies like Ghana, where sustainable development depends on sound management of natural resources and the environment in general. For natural resource accounts provide a valuable picture of a nation's wealth at different points in time and "enhance the evaluation of a nation's future potential for sustained income generation" (Repetto et al 1989).

Finally, we must mention E1 Serafy's (Peskin and Lute 1990) recent claim that depletions of natural resources may not be welfare decreasing if some of the proceeds are re-invested such as to replace the eventually depleted resource with a new asset of equal value. Therefore, a more complete framework would have to include ownership patterns, rent capture and income from investments of the proceeds from the depletion activity. But we believe that even if timber revenues are invested in productive capital--which, let us assume, would increase future consumption by an amount logging and deforestation decrease it--given the decline in the overall quality of the physical environment, intergenerational ecological, ethical, social and aesthetic questions would still remain. In any case, it is widely believed that Ghana "has not derived many benefits from forest use to offset the heavy economic, social and ecological costs of rapid deforestation" (Gillis 1988). Fortunately, in 1988 the Government of Ghana initiated the Environmental Action Plan, a major effort to combine economic development with the protection of the environment and better management of natural resources.

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