A.H.M. Mustain Billah

RESOURCE ACCOUNTING AND ITS IMPLICATION FOR SUSTAINABLE DEVELOPMENT: A LESSON FOR BANGLADESH

Abstract

The System of National Accounts (SNA) is the standard framework used for measuring macroeconomic performance, analyzing trends of economic growth, and providing the economic counterpart of social welfare. Presently the concept of capital maintenance applies only to physical capital; little account is taken of the contribution of natural resource and environment to economic activity. National income should be measured correctly to indicate sustainable income. Revenues derived from resource extraction have the potential to finance investment in other sectors of the economy. The study applied user cost method to estimate resource depletion. It suggests that the positive trend of adjusted Gross Domestic Product(AGDP is a good indicator of economic sustainability). Two alternative sustainability indicators confirm the economic sustainability of Peninsular Malaysia with respect to forest resource depletion. A similar study for natural resource accounting of Bangladesh may enable the estimation of resource depletion and the examination of their impact on sustainable economic development.

A.H.M. Mustain Billah, Ph.D. is a Senior Assistant Secretary, Ministry of Establishment, and formerly, a Senior Assistant Secretary, Ministry of Environment and Forest. The paper is a revised version of a presentation at the IX Pacific Science Inter-Congress S-III-2, *Economics of Sustainable Development: Linking Economics and the Environment*, held at The Institute of Economics, Academia Sinica, Nankang Taipei on 16-19 November 1998.

INTRODUCTION

The national income accounts provides the most widely used indicator of economic performance, growth and economic development. The System of National Accounts (SNA) provides information to identify a country's assets and liabilities at particular points in time. It also keeps track of economic activities through its ability to measure disparate goods and services using a common yardstick. Thus the SNA has become the standard framework used for measuring macroeconomic performance, analyzing trends of economic growth, and providing the economic counterpart of social welfare. Since early 1940, countries of the world have used the national accounts. The national accounts reflect the aggregate consumption, savings, and investment and government expenditure as defined by the Keynesian macroeconomic model.

National accounts serve two purposes: (i) providing inputs in modeling economic valuations and (ii) monitoring of economy's performance from measures such as gross domestic product (GDP) (Glenn-Marie *et al.* 1994). However, there are several reasons why the SNA may provide a misleading picture of long-term economic performance. For the purpose of economic and environmental planning, the use and misuse of natural resources and the environment is not appropriately measured in the current system of national income accounts. The concept of capital maintenance applies only to physical capital; limited account is taken to the contribution of natural resources and the environment to economic activity; and, finally, no account is taken of human or social capital. The major deficiencies of the system of national accounts can be categorized into two :

- Non-incorporation of the environmental effects of the economic activity. These occur with respect to both the natural resource being exploited and the environment at large. Taking logging as an example, too much harvesting would cause degradation. The quantity and

quality of logs can degrade upon impact of felling trees to the ground which can lead to the eventual use of inferior and damaged logs by wood-based industries. The other is the damage or injury to standing residual trees, from the impact of felling trees.

- Neglect of services of unpriced inputs and unpriced outputs. Unpriced inputs include natural resource and environment while unpriced output may include production of specific attributes of natural resources and environment such as clean water and unpolluted air. These inputs and outputs influence production and consumption decisions in the same way as the services of man-made capital (Peskin, 1989).

The essence of the concept of income has been stated by Hicks (1946) as the maximum value that a person can consume during a time period and still expect to be well off at the end of period as at the beginning. Present economic management requires that Government should know the maximum amount that can be consumed by a nation without causing its eventual impoverishment. It is important, therefore, that national income be measured correctly to indicate sustainable income.

Globally policy makers are coming to realise that economic production cannot be measured without accounting for environmental concerns. While revenues derived from resource extraction have the potential to finance investments in industrial capacity, infrastructure and education, a reasonable accounting representation of the process would recognize that one type of asset has been exchanged for another. If the depletion of natural capital elements can be identified and purged from income measurements, a more accurate level of income would emerge which can better reflect economic performance and can provide an improved basis for policy prescriptions.

Thus, when natural resources and environment are exploited to maintain the economic growth, the country would have to reinvest enough of the derived earnings from other sectors to offset the decline in the natural wealth (El-Serafy, 1989). When natural resources are renewable as in the case of forestry, the resource wealth can be regenerated and even increase over time, if properly managed. This decline and in special circumstance rise in natural capital is not captured nationally in the measurement of net domestic product (NDP) which is derived from the gross domestic product (GDP) after deducting off depreciation allowances for physical capital. The incorporation of natural capital depreciation or appreciation can better provide national economic welfare, in particular its sustainability. The sustainability of the economy, at large, following timber harvesting could be assessed from the trend in the gross domestic product (GDP) after adjusting for positive or negative natural capital consumption allowance.

A list of research works on adjusting national income for natural capital depletion is shown in Table 1. Empirical investigations have been carried out in Indonesia (1989) and Costa Rica (1989) by the World Resources Institute, in Papua New Guinea (1993) and Mexico (1993) by the United Nations, and for several other nations by independent researchers.

Peninsular Malaysia (western part of Malaysia), like many tropical countries has an extensive forest base, that is dwindling with the current rapid pace of economic development. This can be observed from the three forestry inventories so far conducted. Total forest area and trend of forest resource physical depletion in Peninsular Malaysia is quite significant. The permanent forest reserves depleted 23.25% from 7,583 thousand ha in 1972 to 5,820 thousand ha in 1996.

Table 1: Natural Resource Accounting Studies Conducted in the Developing Countries

Countries and Resources	References	Time series	Adjustment of GDP, NDP and Methods used
Costa Rica Forest Soil Fisheries	Repetto *et al.* 1991	1970-80	Trend of ANDP 5% lower than NDP Net Price Replacement Cost Net Price Method
Indonesia Petroleum Forest Soil	Repetto *et al.* 1991	1971-84	Trend of ANDP 9% lower than NDP Net Price Net Price Replacement Cost Method
Mexico Forest Soil Water Air	Van Tongren *et al.* 1993	1980-91	Trend of ANDP 6-13% lower than NDP Net Price and User Cost Replacement Cost Avoidance Cost (AC) to reduce pollution to acceptable level Same as for water
Papua New Guinea Gold, Copper and Silver Forest	Van Tongren *et al.* 1993	1986-90	Trend of AGDP 3.7-10.3% lower than GDP User Cost User Cost
Thailand	Sadoff 1993		Trend of AGDP 1.45% and ANDP 2.27% lower than GDP Replacement Cost (User Cost) and Depm. Respectively
Malaysia Forest Minerals Fisheries	Vincent *et al,* 1995 Tai *et al.* 1996	1971-1989 1969-93	Trend of Per capita GDP growth 3.7% and ANDP 3.2% (Net Price) Net Price User Cost
Philippines Forestry Fisheries`	Angeles *et al.* 1991 Padilla *et al.*1994	1971-88 1948-91	Trend of ANNP (-6.2%) in Net Price, (-0.22%) PV method. User Cost
Ecuador Forestry Petroleum	Kellenberg 1995	1970-90	Depreciation method : Trend of ANNP(4%) as against GDP(5.3%) User Cost : Trend of AGDP (0.7%) as against GDP (2.2%) in 1990

The continuous depletion of natural resources like forestry may reduce the country's long run economic growth if enough reinvestment in the physical and human capital is not undertaken. The Government does acknowledge the long run adverse consequences of over exploitation by introducing sustainable annual production cycles by parceling logging areas over the cutting cycles ranging from 30 to 55 years depending on the quality of the forest. Further, in a bid to ensure sufficient log inputs to meet domestic requirement, there was a step-wise imposition on log export restriction, which ended in a total ban in 1985. As a result, the area logged and timber production both decreased substantially and forest rehabilitation activities were stepped up. The logged area decreased from 424 thousand ha in 1972 to 164 thousand ha in 1996. But log production increased from 8,920 thousand cubic metres to 8,418 thousand cubic metres during the same period. It is acknowledged that the intervention in resources use may not necessarily be efficient in terms of its effects on domestic prices and allocation of resources, but it may have effects on the long-term sustainability of the resource use and the economy at large. To this effect, a forest resource account can help in ascertaining the status of economic sustainability in the country.

This paper evaluates the extent of resource depletion and its impact on the national economic sustainability. This study can help ascertain whether the forest resource management practice is working towards sustainable timber production and whether the returns generated are working as fuel for growth. National resource account (NRA) plays this vital role by quantifying the amount of capital generated by resource utilization and also provides information on the conversion of natural wealth to financial wealth. Specifically, a natural resource account is generated for forestry to account for changes in the physical stock of resources as well as changes in their values. The impacts of the changes in the capital stock in the economic variables of the national economy such as GDP for the forestry sector and the whole economy are estimated with the objective of ascertaining economic sustainability. It is contended

that as long as human activity is at the level below the regeneration capacity of natural environment there is no secular decline in the quality of these forest resources. In order to maintain this balance, a measurement of income where degradation of the natural resources and preservation of these resources become necessary. This is the key point stressed by Daly and El-Serafy respectively(1989,1991).

THEORY OF RESOURCE RENT AND SUSTAINABILITY

Hotelling Rent and Hartwick's Rule

Hotelling (1931) demonstrated that current net price does indeed equal the user cost when markets for non-renewable resources are efficient. User Cost refers to the present value of all future sacrifices (including foregone use, higher extraction cost, increased environmental costs) associated with the use of a particular unit of an *in situ* resource. In other words, the user cost measures the future benefits that are given up by extracting resources in the current period. Market efficiency means resources are extracted optimally, whereby the discounted sum of resource rents is maximized. If the current and discounted future net prices are not the same, the pattern of extraction overtime is not optimal because the net present value of aggregate resources rent can be increased by changing the allocation of extraction between present and future. Current extraction should be increased if current net price exceeds discounted future net price, and future extraction should be increased if the opposite is true. Extraction levels can be adjusted until current and discounted future net prices are equal that is until current net price equals the user cost. Marginal cost must be used in calculating net price, because it is discounted values of marginal, not average, cost of extracting resources that are equalized across time periods when resources are extracted optimally. Using average cost to calculate net prices overstates the user cost and therefore, the depletion allowances, because average cost tend to be less than marginal costs in an attractive industry.

The diagram shows incremental production cost in a given period by an upward sloping marginal cost curve implying escalating costs per unit of output as production rises. For most goods, the production level is determined by the intersection of price and marginal cost curves. However, for natural resources, optimally the production point falls to the left of this point, as resource producer must take into account not only the direct production cost but also the opportunity cost associated with foregoing production in the future periods. The latter (opportunity cost) is termed as user cost. Since the user cost is not actually incurred by the present generation producer so, total rent is above the MC curve (direct production cost) not above MC′ curve (Figure 1). The marginal cost curve can be decomposed as (UC + MC = MC′). The total resource rent is the area above the marginal cost curve (MC), below the price line but to the left of the production level.

The total resource rent divides into two components. The first on the top is the rectangle given by the product of per unit user cost and the amount produced. This rectangle is termed as the total "Hotelling rent". The second component is known as "inframarginal rent" that can be used for consumption. Hartwick's Rule states that the total Hotelling rent must be invested in order to sustain consumption, inframarginal rent is the portion that can be used for current consumption.

Natural resources typically can earn return over and above what is necessary to cover opportunity cost in order to exploit them. The resource value (return) is an economic surplus (i.e. total revenue over total cost) that a country potentially uses to finance either investment or consumption or a mix of both. The basic issue lies in how this resource value (return) will be allocated in order to ensure economic sustainability.

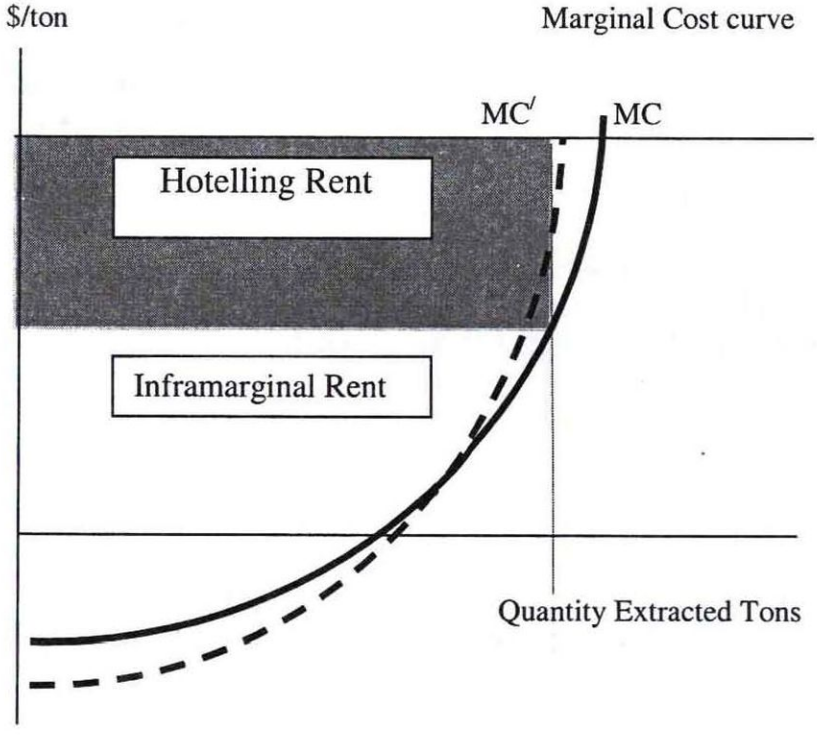

Figure 1: Disaggregating Hotelling Rent from Total Rent

Source: Adapted from Vincent *et al.* (1997)

Hartwick (1978) identified the theoretical condition linking resource rent to economic sustainability. He considers a hypothetical country that has only non-renewable resource and investment fund coming only from this resource rent. He demonstrated that even in such an extreme case a country could maintain a constant level of per capita consumption in perpetuity by ensuring that certain portion of its resource rents is invested in reproducible physical capital. This portion represents the inter-temporal scarcity value of exploited resources. The asset value liberated when natural resources are exploited must flow into capital investments.

SUSTAINABILITY INDICATORS ADJUSTING GDP

Standard calculations of national income impute and subtract the depreciation of fixed capital from gross domestic product (GDP) to arrive at the net domestic product (NDP). The same should be done for natural capital depletion, allowing for the calculation of adjusted domestic product measurement. By charging the economy for the consumption of its resource endowment, the adjusted domestic product would give a more meaningful indicator of the annual contribution to economic well-being (Solow 1993).

Repetto (1989) does the adjustment of the national income from NDP since he estimated a natural capital depletion along the same line as depreciation of physical capital. A fundamental limitation in the net price method is the ignorance of future regenerative ability of forest resources. In employing Hartwick Rule, the Hotelling rent as a measure of user cost, to be reinvested to sustain the economy and not used for current consumption. Thus, in the user cost approach of natural resource accounting, the Hotelling rent is deducted to obtain the adjusted Gross Domestic Product (AGDP). Repetto's depreciation method emphasizes the economic value of current natural resource loss, where as the user cost focuses on losses in future income resulting from the decline in natural capital productivity. In short, the user cost values natural capital as a function of the sum of the present value of foregone future income from the sacrificed resource extraction. This approach is an effective way of impressing upon resource dependent countries that natural capital is being exhausted (El-Serafy 1989).

The user cost approach explicitly separates capital consumption from recorded income and production to isolate a true sustainable income stream. The premise of this approach is that revenues from resource-based activities include a component, which represents the final sale of a natural assets, a component that is not value-added, but rather disinvestment. El-Serafy (in Ahmad *et al.* 1989) argues that if the owner of natural assets is to consume only his true income, he must lend or

invest a portion of his current revenues that would be capable of generating income to compensate the inevitable failure of revenues from his wasting of assets in the future.

The basic formula for computing the resource depletion using the user cost method is as follows:

$$USC(t) = V(t) - V(t+1) \quad \text{----------(1)}$$

Where,

$USC(t)$ is the user cost in year t;

$V(t)$ is the capitalized value of the forest asset in year t

$V(t+1)$ is the capitalized value of the forest asset in year (t+1).

DATA PROCUREMENT AND METHOD OF ESTIMATION

This paper reports on the estimation of resource depletion by using the user cost method for the natural forest, rubber holding and plantation forest of Peninsular Malaysia. In the case of valuation of timber resources, the present study takes into account the variations of resource rents among different group of species and diameter sizes. Log production from the natural forest after 1997 is assumed to have come from second cycle harvesting. Thus the yield is forecasted using a logistic growth function at a growth rate of 2.75 m^3/ha / year for all species >30cm dbh(diameter at breadth). This leads to an accrued growth rate of 43.87m^3/ha at a cutting cycle of 30 years. This is lower than the average yield of about 50-60 m^3/ha from harvesting virgin and secondary forests in the nineties. The forest plantation in Peninsular Malaysia is mainly planted with *Acacia mangium* at a rotation of 15 years. The annual growth rate is 10m^3/ha. Rubber holdings are established with the primary purpose of latex production by the estate companies and individual smallholders. When the rubber trees are due for replanting at the age averaging 25 years, timber is made available. Timber volume in estates averaged at 220 m^3/ha while in smallholdings a lower volume of

180 m^3/ha is obtained owing to poorer management practices. The logging cost was obtained from field survey while log prices are obtained from published sources.

The forest resource accounts was derived over a period 1972-2026, which included a second 30 year cutting cycle after 1996. The objective of extending the period to the second cycle is to incorporate the expected decline in timber productivity in subsequent logging cycles.

RESOURCE DEPLETION TRENDS

Trends in natural capital depletion vary among the three forest resources. In the case of the natural forest resource, the depletions were positive in the seventies, but were negative and on a declining trend during the eighties, only to pick up from the nineties onwards. Timber production from rubber holdings began in the eighties only with the introduction of rubberwood in the market as a substitute for Ramin and owing to its easy wood machining characteristics. While the establishment of commercial forest plantation started in the eighties with early production in the middle of the nineties. Resource depletion did not occur in the rubber holdings and is anticipated to occur only until late in the first decade of the 21st century. While resource depletions in forest plantations have happened in the early nineties and are expected to increase in the first two decades of the 21st century.

The above resource depletion trends are related to several factors that can influence the trade off between current and future value rents. If rents are declining in the future, and if current extraction rates are quite excessive such as to diminish subsequent harvests of the future rents, then the current level of depletion would be high and can be expected to remain so if the circumstances persist. Declining future rents can be caused either from decreasing real prices or declining quality of future harvests. This can explain the high depletions in the seventies for natural forests.

If rents are expected to rise in the future, provided that current extraction rates are not too excessive such as not to diminish subsequent reaping of the future rents, then the current level of depletion would be negative (asset appreciation) and increasing. In the second half of the eighties and nineties, real timber prices were rising which cause an appreciation of the asset value of forest resources and future harvests. The high growth in real prices has gone with the current economic crisis. Hence it is not surprising that resource depletions are expected to rise into the next century.

The trend in resource depletion in the rubber holdings is following similar pattern as the natural forest. The probable reasons can be linked to the scaling down of replanting of rubber areas and in the letdown of prices in the near future. The rising resource depletion in forest plantations is related more to the poor financial feasibility. The cost of establishment is high while the species planted are not popular yet in the market and of general utility timbers, which cannot fetch good prices owing to poor market acceptance. With the continuing high cost and low profitability scenario, the asset value is not expected to rise leading to a persistent depreciation. The circumstances would change with global economic recovery and the establishment of fibre consuming industries such as medium density fibreboard.

Summing up the depletions of all three forest resources led to a trend very much influenced by that of the circumstance in natural forest resources.

SUSTAINABILITY MEASURES WITH AN ADJUSTMENT OF GDP

The above information on resource depletions enables the adjustment to be made to GDP, both at the forestry sectoral level and the economy at large. Table 2 classifies the GDP and its adjustment into three periods, 1972-1980, 1981-1990, and 1992-96. The analysis ends in 1996 since no forecasting is made of GDP to the next century.

As the user cost decreased and becomes negative over time, the forestry sector AGDP trend exceeded that of GDP all through the 1980s and 1990s. The average AGDP trend was higher than that of GDP by 23% and 9% in the eighties and nineties respectively. Similarly it was found that the lower average per capita AGDP trend relative to that of GDP in the seventies has been compensated by higher average levels in the eighties and nineties.

In the seventies, where the economy is dependent on natural resource extraction, forest resources were extracted exceeding the long run regenerating potential of the resource. The country has been extracting timber excessively by borrowing from the future. This trend can be substantiated by the high hectareages of forest opening during the seventies. But owing to increasing conservation awareness, export trade restriction on primary logs and rising real prices in the eighties and nineties, the current high rents more than compensated the reduction in quantity extraction rates. Forest opening for timber extraction was more conservative at rates below the increase in present values of future rents (current saving of rents for the future).

Table 2 : Average GDP and AGDP for the Forestry Sector during the Three Decades (RM 1978)

Income/ Year	1972-80	1981-90	1991-96	1972-96 Annual Average
GDP million	664	715	769	716
User Cost million	126	-161	-63	-32
AGDP million	538	876	832	748
Per Capita GDP	2811	3573	5673	3972
Per Capita AGDP	2518	3586	5678	3975

The above trend implies that the extraction of timber from the forest resources is sustainable with current rents derived not affecting future harvest opportunities owing to reinvestments into the sector. But this information merely provides the performance within the forestry sector. To evaluate the economy-wide impact to the country, the adjustment of income and investment parameters ought to be evaluated at the national

level. However, it should be noted though that since the sectoral GDP has not been reduced by the forest capital depletion the same likely impact is expected for the whole economy.

Pearce Atkinson Measure (PAM) of Sustainability

The PAM indicator of sustainability plots the percentage value of natural capital depletion (forestry) over GDP against the percentage net savings over GDP. It was found that with the exception of 1973, the percentages of net savings over GDP were above the 45° line or indicator of marginal or "knife-edge" sustainability. This demonstrates that the economy of Peninsular Malaysia is sustainable.

Genuine Savings

"Genuine savings" which is computed as the GDP minus the sum of public and private consumption, physical capital depreciation and natural capital (forestry) depreciation, serves as an indicator of efforts for new wealth creation. The "genuine savings" remain positive throughout the three decades but fell sharply in 1973, 1976, and from 1984 to 1988. Nevertheless, since no negative percentages were obtained, the economy can be said to remain on a sustainable path.

LESSONS FOR BANGLADESH

Like many other developing countries wood energy constitutes a major source of energy in Bangladesh. Total fuelwood consumption increased sharply overtime by 75% from 22 million cubic meters in 1980 to 30 million cubic meters in 1994. Figure 2 states the continuous increase of fuelwood consumption. It is projected to increase from 34 million cubic meters in 2000 to 42 million cubic meters in 2010.

The FAO study in 1997 showed that the share of fuelwood in total energy consumption decreased very slightly from 51% in 1980 to 47% in 1994.

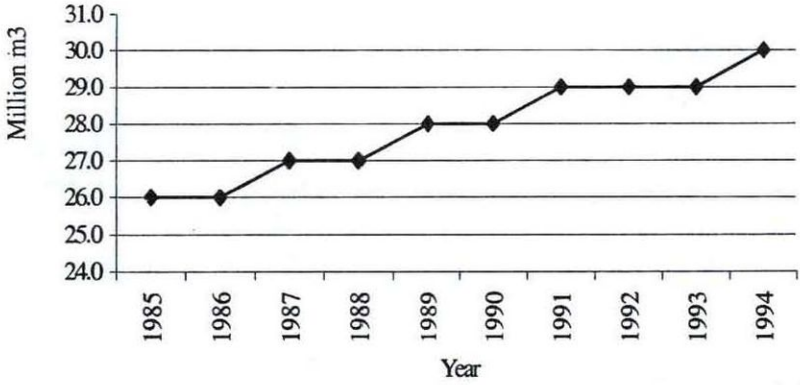

Figure 2 : Total Fuelwood Consumption

Source : FAO Forest Products Yearbook (1980-95)

The Forestry Master Plan study of Bangladesh showed that the gap of supply and demand for timber and fuelwood is sharply rising over time from 6 m^3 million in 1993 to 7 m^3 million in 1998. This gap will continue to increase 8 m^3 million for the year 2008. Gradually, forest product items for export are disappearing from trade list. Wood article and bamboo export increased from Tk 36 million in 1976 to Tk 191 million in 1990. On the other hand the forest product for imports increased from Tk 247 million in 1977 to Tk 2412 million in 1990. Figure 3 shows the export-import gap of forest products in Bangladesh. The continuous growing demand for fuel wood, timber and shortage of supply caused to increase imports that have serious implication for sustainable economic development.

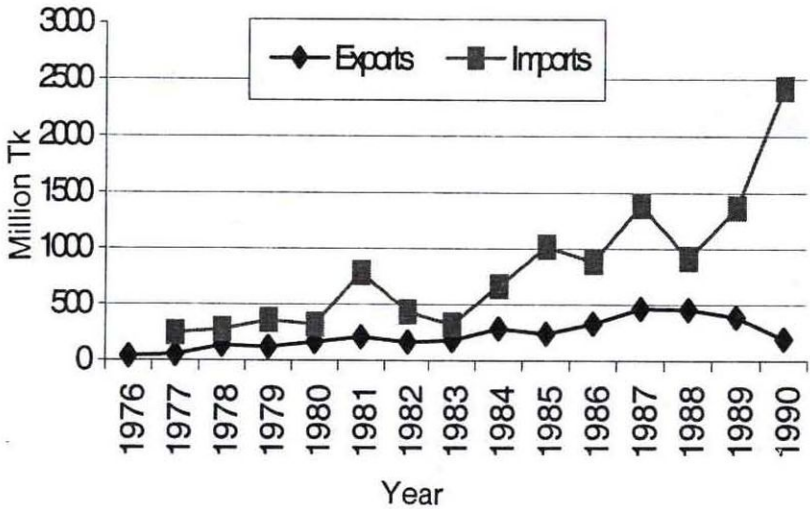

Figure 3 : Forest Product Expart andImports (Ourent Prioce

Source : Forestry Master Plan of Bangladesh

An attempt to review the initiatives on resource accounting in Bangladesh is needed for identifying the constraints and taking necessary measures.

GREEN ACCOUNTING INITIATIVE IN BANGLADESH

United Nations Conference for Environment and Development (UNCED) in its Agenda 21 (Chapter 8) at the Rio de Janeiro summit in 1992 called for establishment of an integrated environmental and economic accounts as a complement to the United Nations system of national accounts. Accordingly the Statistical Division of the United Nations formally approved a Revised Version of the SNA in February 1993. "The revision offers a clear treatment of assets and their

accounting, specifies what constitutes an economic asset in the system, and presents a revised classification of assets and a revised set of accumulation accounts" (Lutz 1993). In response to UN obligation and considering the current growing environmental issues of the country IUCN initiated a project as a part of Global environment accounting initiative with an intention of introducing the concepts of valuation techniques to the Governmental officials, researchers and policy makers (Rahman 1997). In fact, a very few environmental valuation study has been carried out in Bangladesh.

As the natural resources are different in character, their environmental services are also diversified. No single technique is good enough to estimate their environmental benefits or loss. Currently, a good number of techniques are widely used to estimate the resource depletion and value the environmental services. An estimation of forest resource depletion in Bangladesh demonstrates that forestry sector exhibits both depreciation and appreciation depending on the rate of annual increase in the forest for the period of 1972-90. The values vary -0.2 to +19.2 percent of the forestry sector GDP and -0.1 to +0.6 percent of the total GDP (Fahmida 1998). The study was carried out based on three possible arbitrary estimates of mean average increment (MAI) of forest disregarding the diameter size. In her study, no cutting cycle is mentioned for felling. The virgin forest growth rate is equal to mortality rate resulting in zero net change (Vincent and Binkely 1992). Forest growth after felling is taken in account. Forests, like other biological resources, grow in a logistic form. Forest growth in the initial period is very low, because after harvesting trees take three to four years to be stabilized. The assumption of forest growth $0.7m^3$ /ha/year is unrealistic for Bangladesh context. In Fahmida's study, MAI does not vary across types and qualities of trees, which is very crucial in estimating the forest growth. In Malaysia, Ashari (1994) found that the forest growth of diptherocarp and non-diptherocarp is about $0.6m^3$ /ha/year for diameter class of 10cm+ four years after harvesting, despite ASEAN forest resource is much richer than that of Bangladesh. Moreover, the forest below 30 cm diameter size has no economic value.

In the study of Fahmida (1998) to estimate the resource rent the average price of timber is used by ignoring the diameter size and species group. In reality timber prices substantially vary across the diameter size and species group. Similarly, arbitrary assumption of extraction cost is also misleading.

The choice of method for valuation of natural resources depends on the type of resources. In the case of valuation of forest resource, two methods are used, net price methods and user cost method. The user cost method appears to be more appropriate and economic approach. The user cost measures the future benefits foregone due to felling trees in the current period, where as net price method measure the benefits foregone for the current period. Fahmida (1998) applied the later method for the valuation of forest resource in Bangladesh, which is controversial.

The attempts of Green Accounting by IUCN and the estimation of forest resource deprecation by Fahmida can be good guide to identify the major constraints of resource accounting in Bangladesh.

In order to calculate the economic value of natural capital depletion, physical accounts must be created. Changes in natural capital stocks are recorded in physical units appropriate to the particular resource. Regarding the forest resources, Repetto pointed out that the physical accounts may be expressed in hectares, tonnes of biomass, or cubic metres of timber although the last is probably the most important economic measure (Repetto *et al.* I989).

As mentioned earlier, depletion of forest resources expressed in purely physical terms hides important differences in composition, quality, age, and value among timber stands. However, accounting methods for renewable resources are not well developed. Renewable resources like forestry and fishery are more difficult to value for several reasons: (a) these resources often have a commercial value as well as an amenity or a recreational value; (b) ownership rights cannot always be established (e.g., ocean fish stocks); and (c) these resources have the potential to regenerate, so their use does not necessarily result in a net reduction in either the yield or value of the stock (Landefeld and Carson, 1994).

In order to carry out forest resource accounting in Bangladesh urgent attention is needed to generate data on species wise domestic and FOB log prices for commercial species. Primary data for resource extraction cost may be generated through sample survey. Post felling forest growth study will provide species wise growth rate per hectare per year or biomass volume in tonne. For estimating forest management an economic cutting cycle needs to be determined. The valuation of mangrove forest such as non-timber forest products, non-forest products and its value in ecosystem and global warming reduction is equally important to capture. Moreover, the value of forest resource in terms of eco-tourism and medicine needs to be captured. In these cases Travelling Cost Method (TCM) and Contingent Valuation Method (CVM) are quite appropriate.

Similarly in order to carry out gas resource accounting in Bangladesh, like Thailand (1996), urgent attention is required to ascertain current and potential reserves of gas in country with differences in the quality. The unit price and extraction cost in different location are also the vital information to be collected. Gas is depletable resource with supply constraint. Under the given supply situation, a projection of the potential demand with respect to growing population may provide a guess of exhausting the stocks. Thus the information of annual rate of extraction, consumption, demand and supply situation are very crucial to generate for physical resource account. The estimation of physical account is the prerequisite for monetary valuation. The adjustment of resource depletion with national accounts will demonstrate the future economic sustainability. Hotelling rent therefore needs to be reinvested to sustain economic growth of the country.

CONCLUSION

Resource-rich countries can sustain their consumption levels, if they accumulate stocks of reproducible capital at a rate that matches the economic depletion of natural capital. The estimations of AGDP by adjusting for depletion from natural capital stock in three forest

resources, the PAM and the "Genuine Savings" sustainability indicators suggest that the economy of Peninsular Malaysia has managed to remain sustainable. A similar study for the forest resource accounting of Bangladesh will enable the estimation of resource depletion and the examination of its implication on national accounts. The green accounting efforts made in the country may provide a guide in identifying the constraints in the resource accounting. With the initiatives of IUCN awareness has been created among policy makers and multidisciplinary people to realize that the measurement of economic production without accounting for the environmental concern is partial. Attention needs to be paid to develop necessary database for the valuation of resource depletion and environmental services. Adjustments of the SNA with resource depletion will demonstrate a more accurate economic measure.

The present study focused on measuring the depletion of timber. It understated the depletion of natural capital for the country. It also ignores the direct consumption values of the environment. Economic development in Peninsular Malaysia is expected to have its toll from rising air and water pollution and diminishing amenity values. Information gaps exist for computing the impacts of timber extraction on non-timber values of goods and environmental services. These values ought to be deducted from national income parameters for more precise estimation of economic sustainability.

Reference

Daly, H.(1990), "Towards A Measure of Sustainable Social Net Product", in Ahmad,Y.J. and S.El-Serafy, E.lutz (eds.) *Environmental Accounting for Sustainable Development,* The World Bank, Washington, D.C.

El-Serafy, S. (1989), "The Proper Calculation of Income from Depletable Natural Resources", in Ahmad, Y.J., S. El Serafy and E. Lutz (eds.), *Environmental Accounting for Sustainable Development*, The World Bank, Washington, D.C.

Fahmida A.K (1998), *Depreciation of Forest Resources in Bangladesh*, Research Report, Bangladesh Institute of Development Studies (BIDS), May 1998.

Glen-Marie, L. & D. Faye, (1994), *Integrated Environmental Economic Accounting, Natural Resource Accounts and Natural Resource Management in Africa,* Environmental and Natural Resources Policy and Training Project Applied Research. Arlington, Virginia. USA.

Harrison,A. (1992), *Natural Assets and Natural Income. Environment Department Divisional,* Working Paper No 1992:34. Environment Department, The World Bank. Washington, D C.

Hartwick, J.M. (1978) "Investing Return for Depleting Renewable Resource Stock and Intergenerational Equity", *Economic Letters. 1,pp. 85-88.*

Hicks, J.R (1946), *Value and Capital,* Oxford, Clarendon Press, 2nd edition, 1946.

Hotelling, H.(1931), "The Economics of Exhaustible Resources", *Journal of Political Economy,* (39):137-175.

Kellenberg, John V. (1995), *Accounting for Natural Resources: Equador (1971-1990)*, Unpublished Ph.D dissertation, The John Hopskins University, Maryland, USA.

Lefevre, L., Todoc. J.L and Timilsina G. R. (1997), *The Role of Wood Energy in Asia. Publisher.*

Lutz E. and M. MunSinghe (1993) "Accounting For The Environment", *Finance and Development*, Vol (28), ISS :I, pp:19-21.

Pearce, D.W., and G.D.Atkinson (1993), "Capital Theory and Measurement of Sustainable Development: An Indicator of 'Weak' Sustainability", *Ecological Economics* 8: 103-108.

Peskin H. M.(1989), *Accounting for Natural Resource Depletion and Degradation in Developing Countries,* Environmental Department Working Paper No.13. Washington D. C.

Rahman, A (1997), "Environmental Economics: Valuation and Green Accounting in the Context of Bangladesh.", *BIISS Journal*, Volume 18, No. 4, 1997.

Repetto, R., W. Magrath, M. Wells, C. Beer, and F.Rossini (1989), *Wasting Assets: Natural Resource in the National Income Accounts,* World Resource Institute,Washington D. C.

Repetto, R.,W., R Cruz., R .Solorzano. R.Woodward, R.de Camino, Woodward, J. Tosi, V. Watson, A. Vasquez, C. Villabos, and J. Jimenez (1991), *Accounts Overdue : Natural Resource Depreciation in Cost Rica,* World Resource Institute, Washington D. C.

Sadoff Cloudia W. (1993), *Natural Resource Accounting : A Case Study of Thailand's Forest Management,* University of California at Berkeley, USA.

Solow, R. (1993), "An Almost Practical Step Towards Sustainability", *Resource Policy,* pp.162-72.

Tai Shzee, Y., H. O. Ishak, V. Kuperan, M. N Kusairi, H. M. Ariff, R. A. Nik Mustafa, and L. T. Tan (1996), *Fishery Resource Accounting in Peninsular Malaysia,*University Pertanian Malysia.

UNDP/FAO BGD88/025 (1992) Forestry Master Plan of Bangladesh.

Van Tongeren, J., S . Schweinfest, E. Lutz, M. Gomez Luna and G. Martin (1993), "Integrated Environmental and Economic Accounting: a case study for Mexico" in E.Lutz (eds.), *Toward Improved Accounting for the Environment,* The World Bank, Washington, D.C.

Vincent, J.R., M. Rozali (1995), *Environment and Development in Resource Rich Economy: Malaysia under New Economic Policy*, Harvard University Press, for Harvard Institute for International Development, Cambridge, Massachusetts.

Vincent, J.R. and C. Binkley (1992), "Forest Based Industrialization: a Dynamic Perspective" in Sharma, N.P. Kendall, Hunt, Dubuque, Iowa (eds.), *Managing the World Forest.*