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Green GDP calculations in developed and developing countries

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Abstract
The growing concern towards environmental exploitation, depletion of natural resources, diversification of natural balance have been the central point of discussion during the last two decades in national and international forums. Environmental accounts capture the interaction between environment and the economy. Environmental accounting, by working towards valuing depletion and degradation, can help in prioritising the relative importance of environmental issues. This paper aims to shed light on this situation through series of studies that have undertaken by many countries in the development of environmental accounts. It is an empirical attempt to show how in practice one can construct a Mineral Resource accounting according to both academic and practical guidelines using IEEA handbook of National Accounting. It analyses the role of environmental accounting and the policy options available for economic decision makers. Further it reviews the method of valuation of natural resources adopted by various countries. Thus the goal of this study is to see what lesson we can learn from countries that have experienced with environmental accounts and to inform and guide those that have not yet built them.

Keywords: resource accounting, environmental valuation, integrated environmental and economic accounting (IEEA), green GDP, environmentally adjusted GDP, sustainability

1. Introduction
Natural resource accounting is part of the system of integrated environmental and economic accounting, which results in an environmentally adjusted GDP. Natural resource accounting takes into account the costs associated with natural resources and environment, both used and not used in the production process as well as those, which are not yet used. Such an accounting involves the calculation of stock and reserves of natural resources including their changes.
Environmentally adjusted GDP can only be compiled after natural resource accounting of the relevant commodities has been compiled. Natural resource accounting provides a measure of environment degradation and resource depletion, which are used to adjust the conventional GDP. The United Nations has provided a guideline for compiling such a system under the name of "The System of Integrated Environmental and Economic Accounting (SEEA)", developed by the United Nations Statistical Office (1993)
The objective of this paper, is to know the implementation SEEA by different countries to calculate environmentally adjusted domestic product and also to analyze the inclusion of cost of natural resource depletion and environmental degradation that are otherwise ignored by the conventional accounts of net and Gross national products.

1.1. Meaning of Green GDP or Environmental Accounting
Environmental Accounting is a short form of environmental and natural resource accounting (ENRA). It is also known as "green accounting", "resource accounting", and "integrated environmental and economic accounting". It refers to the compilation of data relating to the environment and natural resources into an accounting framework organized in terms of stocks and flows, and the interpretation and reporting of these data.
In terms of measuring the sustainability of development the Green Accounting Aggregate with the most policy relevance is "genuine saving". This represents the value of net change in assets that are important for development - produced assets, natural resources, environment quality, foreign assets and human resource that include returns to education, labour, the strength and scope of social institutions.
To calculate environmentally adjusted GDP and GNP from current GDP we must subtract the value of environmental damages.
According to SNA (System of National Accounts) definition
The Environmentally adjusted Domestic Product identify for the whole economy:
$EDP=\Sigma EVA_i - \Sigma EC_h = NDP - EC = C + CF + X - M - CC - EC$
Defining environmentally adjusted Net Domestic Product (EDP) as the sum of environmentally adjusted value assets of industries (EVA_i), with a further deduction of Environmental Costs generated by Households (EC_h).
Alternatively, EDP can also be calculated as the sum of final uses of consumption (C), environmentally adjusted Net Capital Formation (ECF =CF – CC – EC) and the balance of exports (X) and imports (M)

2. SNA and Environmental Accounting
Natural resource accounting is part of the system of integrated environmental and economic accounting, which results in an environmentally adjusted GDP. Natural resource accounting takes into account the costs associated with natural resources and environment, both used and not used in the production process as well as those, which are not yet used. Such an accounting involves the calculation of stock and reserves of natural resources including their changes.

The System of National Accounts (SNA) consists of a coherent, consistent and integrated set of macroeconomic accounts; balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. It provides a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision taking and policy-making. The accounts themselves present in a condensed way a great mass of detailed information, organized according to economic principles and perceptions, about the working of an economy. In practice the accounts are compiled for a succession of time periods, thus providing a continuing flow of information that is indispensable for the monitoring, analysis and evaluation of the performance of an economy over time

The SNA provides information not only about economic activities, but also about the levels of an economy's productive assets and the wealth of its inhabitants at particular points of time. Finally, the SNA includes an external account that displays the links between an economy and the rest of the world. As already noted, the values of the assets and liabilities held at any moment in time vary automatically whenever any transactions, price changes or other changes affecting the volume of assets or liabilities held take place.

A recommendation that integrated environmental and economic accounting should be done in satellite (i.e. supplementary) accounts that are linked with the main (or 'core') accounts of the SNA. A full integration of integrated environmental accounting into the main accounts was not considered feasible because of the limited work done up to that time and also due to outstanding conceptual valuation issues. These capabilities notwithstanding, there are certain limitations of the central framework of the SNA.

An inherent limitation of the SNA is its inability to account for natural assets that fall outside its assets boundary. In the SNA, natural assets are included only if they provide economic benefits to the owner through the control of an institutional unit. This would mean explicit ownership that is subject to government regulations and availability of market price. Services provided by the environment, such as fresh air, sink of wasted, natural filtration and detoxification of soil, water and air, are likewise not covered by the SNA.

Environmentally adjusted GDP can only be compiled after natural resource accounting of the relevant commodities has been compiled. Natural resource accounting provides a measure of environment degradation and resource depletion, which are used to adjust the conventional GDP. The United Nations has provided a guideline for compiling such a system under the name of "The System of Integrated Environmental and Economic Accounting (SEEA)", developed by the United Nations Statistical Office (1993).

There are now three main approaches to environmental accounting, and they complement and overlap each other. The first one generally referred to as natural resource accounting, focuses on accounts in physical terms. The second approach, which is linked to national accounts and is in monetary terms and generally called monetary satellite accounting. It identifies the actual expenditures on environmental protection and deals with the treatment of environmental cost to natural and other assets caused by production activities in the calculation of net product. Monetary satellite accounting is generally more limited in coverage of environmental concerns than physical resource accounting. The third approach is a welfare-oriented one. It deals with the environmental effects borne by individuals and producers other than the producers causing these effects. The latter effects may often be much larger than the cost caused and do not affect net product but rather net income through transfers of environmental services.

Repetto introduced the welfare approach (World Resources Institute (1989). This approach aims at examining the extent of natural resources stock including the changes, both in physical and monetary terms. Physical accounting is important for the management of relevant natural resources. Monetary accounting, on the other hand, is most useful for overall development planning, which utilizes the calculation of the environmentally adjusted gross domestic product. The welfare approach, therefore, is most useful for resources management planning in line with sustainable development plans.

The income approach was due to. This approach attempts at integrating several types of natural resources and environment in one monetary form. Thus, it does not put more emphasis on the physical account. It emphasizes input and output flows and the size of product and income created in one period. In addition to the conventional production sectors (household, business, and government), it introduces natural production sectors, which consist of natural resources and natural services to process waste. This approach is most useful for evaluating whether the use of natural resources shows a tendency for depletion or conservation.

The income approach does not include calculation of the availability of resources. The welfare approach, on the other hand, does not account for the environmental factor. The welfare approach uses "unit rent" in the construction of monetary accounts, hence, in calculating the present value; it assumes a zero interest rate. The income approach applies the present value method and hence employs positive interest rates. Several countries, including Indonesia, Costa Rica, and China use the welfare approach. United Nations Statistical Division also employs this approach for Mexico and Papua New Guinea.

In environmental accounting the asset boundary is defined to be much wider. In principle, all natural assets are accounted for including those needs in the production activities and those that may be affected by economic activities. The SEEA (United Nations(1999), for example, does not distinguish between natural assets that are economic assets as defined in the SNA and those are not, focusing on environmental impacts regardless of institutional ownership or control.

Effectively, The SEEA asset boundary differs in two ways from that of SNA. First, the SEEA recognizes a much broader range of land and natural resources than the SNA. In the SNA, only those land areas of natural resources that bring economic benefits to the current population are recognized as assets. In contrast, the SEEA considers the future benefits that could be derived from a particular resource is identified as a asset, whether for current or future generations. This way, the SEEA effectively incorporates the basic principles of sustainable development. This would imply that, for example, possible or speculative sub-soil reserves would be considered as environmental assets under SEEA, whereas the SNA recognizes only the proven sub-soil reserves as assets.

The second way in which the SEEA asset boundary is distinguished from the SNA is the extension to include eco systems in addition to land and natural resources. Eco systems

are included because they provide a variety of services that bring indirect benefits to humans such as cleansing of polluted air and water.

3. Policy options and Environmental accounting

National Accounts helps in policy making through the direct use of indicators in order to bring about future development and policy decision-making. These accounting indicators helps the policy makers try to interpret the data. The main objective of the integrated environmental and economic accounting is to measure the sustainability of performance of a country. It also brings about an interaction between environments and economy and thereby to analyse the cause of non-sustainability's of development. Further it helps in the assessment of the sustainability of a nation's past performance, taking into account the environmental impacts.

Environmental accounting was triggered by the realization of the inherent weakness of the SNA to generate indicators useful in monitoring the sustainability of a countries development gains. It can play two broad roles (Lange 2000)

a. A purely technical role, providing essential information to technical experts for monitoring and policy analysis; and
b. A broader, institution building role by providing the framework and information system for more effective dialogue throughout government and society about environmental- economic possibilities.

Environmental accounts thus carry strong potentials as a policy tool, but being in an initial stage of methodological development, the foundation of environmental accounting is statistically weaker than conventional SNA. Nonetheless, it is crucial to disseminate environmental accounts to explore important policy questions, to create additional political and social support for institutionalising the accounts and to improve the data support.

A system of environmental accounting was developed in order to incorporate the environmental accounting in the economic decision-making. For example, system of environmental accounting would explicitly demonstrate the economic importance and value of environmental policies and encourage decision makers to adequately consider environmental dimensions in to the economic policy making processes.

Environmental accounting can be categorized into three types: adjustment of national account, satellite account and natural resource and environmental dimension into the framework of the national account.

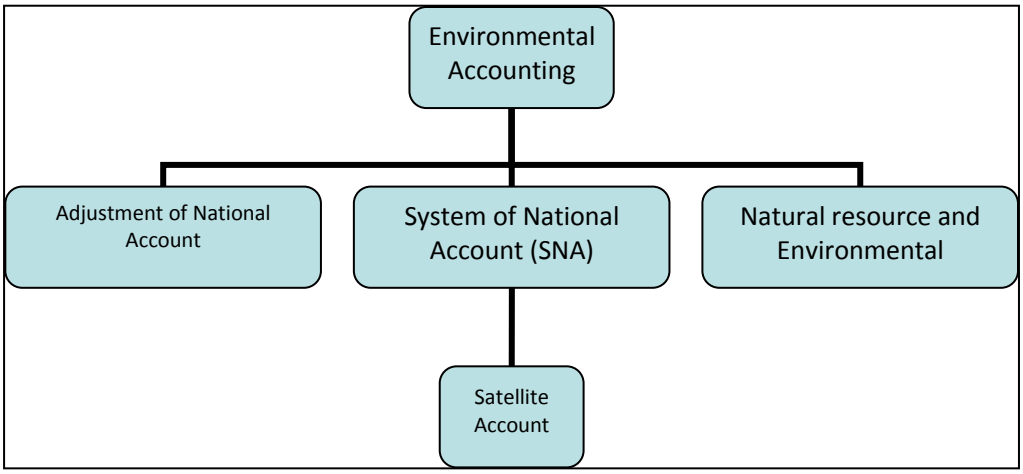

Fig 1

Adjustment of national accounts is an attempt of incorporating environment dimension into the framework of national account. This is a modified version of national accounting, which also considers accounting of the values of environmental damages environmental services, stock of natural capital and environmental expenditure. Adjustment of national accounts include environmental costs benefits and the net change in all assets, including natural resources would be used to arrive at a "green" national product.

Satellite accounts model is a separate accounting framework, which records environmental matters without integrating them into the core account. The satellite account is a complement to the system of national accounting (SNA) without modifying it. Satellite accounts combine physical information from environmental statistics and natural resource accounts to provide holistic economic valuation of the environmental dimensions of economic activities.

Three principal functions of satellite accounts:

- Disaggregating SNA with regard to environmental aspects;
- Valuation of stocks of natural resources and of non-market services of the environment;
- Valuation of environment damage due to economic activities.

Natural resource and environmental accounts is an accounting of stocks of natural resource, both in monetary and physical terms, independently from the national account. They describe the state of natural resources and their evolution. Primarily in physical terms, they describe the stocks and flows of resources, the flow of resources within the economy. The general purpose:

- To provide policy makers with an information base on natural resources:
- To contribute in raising awareness on the environmental issues at each level of decision making.

4. Green GDP accounting in Developed and Developing countries

Having set the stage with regard to the policy uses of natural resource and environmental accounting, the nest step is to

assess some of the empirical efforts that have been published. By now most of the developed countries have official general accounting efforts with the view to publish a variety of resources and environmental accounts. In the developing world many studies to date have been carried out by the researcher rather than statistical office.

4.1. Developed countries

This section reviews the empirical experience in different developed countries and also the application of satellite accounting framework.

Attempts to calculate a 'green' GDP by taking into account of the use of renewable and non-renewable resources use in production. The extraction of non-renewable resources is a larger component of economic activity in Australia. He used Repetto treatment of discoveries i.e. allowing adjusted GDP to be greater than conventional GDP in a year. This is indeed found to be the case in all but two of the years during the period covered (1980-1989). Young says that this would provide very poor signals for environmental and resource management. This need not lead to a rejection of resource accounting, but to more recognition that there are methodological issues to be resolved such as the treatment of discoveries. In addition, Young appears to include price changes in the adjustment, whereas these are usually presented in reconciliation accounts or balance sheets as capital gains/loss. Young also makes several suggestions to improve the usefulness of adjusted accounts.

a. Given a population growth rate of 2% in Australia, GDP per capita should be stressed (Of course this tells us nothing concerning how this GDP is actually distributed).
b. National accounts deal mainly with marketed activities. As such they are an indicator of the level of economic activity and not a measure of welfare. Social costs and benefits should not be neglected where the non-marketed value of service from the environment might be expected to be significant.

Presents pilot physical and monetary accounts for forest resources in Alberta, covering a period 1964-1990. The intention is to gain information on the sustainability of the services that natural capital (i.e. here, the stock of Alberta's forests).

The construction of physical accounts involves the calculation of opening stocks.

(Area X volume per unit area). The relevant flows are a mean annual increment (MAI), harvest, natural loss and afforestation. The trend of the net closing balance is shown to have been increasing steadily over the period, where the closing stock in 1990 was 8% greater than in 1964.

These accounts can be further linked to the conventional SNA through valuation of physical volumes and flows. The price of timber is subject to large fluctuations and this is reflected in the values obtained for the stocks and flows measured. The value of closing stocks therefore fluctuated year to year, although in each year (apart from1980 and 1981) the value of harvest exceeded by the value of growth. In this sense, Alberta's forest resources have been managed sustainably, although the value of this growth is not a component of currently measured domestic income accounts in Alberta. Values for non-marketed services are also considered, although no calculations are undertaken in this study.

Reports on the work of Statistics Canada to develop natural resource accounts in quantity and value, physical resource use and pollution emission accounts, and environmental protection expenditure accounts. With exception of natural resource accounts, which will be embedded in the national balance sheet account of the SNA, these are viewed as adjuncts to the standard national accounts, and there are no plans to produce a green GDP.

Most of the policy uses of the accounts to date reflect the components that were available first, those concerning greenhouse gases. The greenhouse gas emission accounts constitute an inventory that is being used to track progress towards Canada's commitment to stabilize greenhouse emissions at their 1990 level by the year 2000. They have also been used in an Input-Output (I/O) modeling exercise examining policy options for reaching this goal. The energy use flow accounts underlying the greenhouse gas accounts have been used by the Department of Finance in a computable general equilibrium model to examine the level of carbon tax required to achieve stabilization.

Peter Bartelmus and Jan Van Tongeren (1994) [2] made an attempt to implement the recommendations of SEEA and to illustrate the key steps that need to be taken in implementing the recommendations by United Nations Statistical Division. They provided a more concise guide through the intricacies of integrated environmental and economic accounting. They discussed the step-by step the ways and means to implement the SEEA.

The SEEA accounting was used to calculate the subsoil assets in Papua New. Guinea (PNG). They have taken into consideration the assets of copper, gold and silver mines in PNG. For the years 1986-88 the following table (2) presents the measurement of the assets in PNG.

Table 1: Accounts for subsoil assets in PNG (Million Kina)

	1986	1987	1988	1989	1990
Opening stocks	1750.0	2648.7	3683.7	1584.4	-154.7
Depletion	-126.8	-209.7	-106.3	-25.2	-180.7
Other volume changes	9.0	122.8	175.6	-383.3	0.0
Revaluation	1016.5	1121.9	-2168.6	-1330.6	n.a.
Closing Stocks	2648.7	3683.7	1584.4	-154.7	n.a.

Source: Bartelmus, Lutz and P.1

Kellenberg John (1996) [3] provided the theoretical foundations for natural resource accounting, examined Ecuador's macro-economic performance from 1971 to 1990, and calculated the economic value of natural capital depletion in the petroleum sector. In this study two natural resource accounting (NRA) methodologies are utilized to measure the economic value of natural capital depletion in the petroleum sector.

They are:
a. The Depreciation Method
b. User cost Method

By applying these methods in estimating the environmentally adjusted Domestic Product, it is understood that, with the use of Depreciation Method, Ecuador experienced slower growth in environmentally adjusted Net Domestic Product (ENDP) from 1971 to1990 than conventionally measured GDP. ENDP grew at an annual rate of 5.2 percent during the 1970 and 3.4 percent during the 1980's.

Addresses some of the issues concerning the valuation of forest assets in Australia and their inclusion on the balance sheet. The paper proposes the inclusion of a memorandum item in the balance sheet because the qualitative aspects of a forest are not attributed to separately identified assets but they are of interest for particular uses.

Following assumptions were made in this study;

- The value of quantitative use is either timber from forests available for production or tourism from forests unavailable for production.
- The qualitative (or social) value per hectare from forest not available for production is at least equal to the quantitative value per hectare of forests available for production. Accordingly, the qualitative value of forests not available for production could be taken to be the rent expected from one rotation of a forest's life, regardless of when the rent may be earned or paid.

4.1.1. Methods adopted to estimate the value of the standing timber resource

The method used to estimate the timber resource is the net present value approach (NPV). It involves calculating the expected future income flow generated by the asset (its economic rent), and then discounting this flow over the life of the asset. The formula for the net present value approach is:

$$NPV = S \sum_{t=1}^{T} \frac{RRtQt}{(1+r')} t$$

NPV	=	net present value
RR	=	resource rent
r'	=	rate of discount
Q	=	quantity of the resource extracted in time t
T	=	forest life (i.e., term to maturity/ harvesting)

The resource rent can be derived in a variety of methods. The most common are from stumpage fees /prices and the net price approach. The stumpage are imposed when the charge or levy on logging activities is set by the government; stumpage prices represent logging rights set by a market, should one exist. Because in Australian context, government, and these assets owned most timber valued in the balance sheet, the stumpage fee is artificially determined.

Further in Australia the stumpage fees used were timber from publicly owned forest, which may not equal returns to privately owned forest, which may not equal to privately owned forests. Further, the Australian Bureau of Agriculture and Resource Economics (ABARE) estimated market prices of logs using three different valuation methods: residual pricing, log auction and tender prices, and use of long term harvesting rights (discounted expected net present value of the license) as proxy. In each cases the stumpage fees was lower than the estimated market prices. This outcome was due to the result of setting stumpage fees to cover whatever level of forest management that is undertaken and also to encourage employment and economic benefits in the log processing industry.

The other ways to derive rent on the forest resources are referred to as Net Price I and Net Price II. Net price method I assumes that rent is equivalent to the difference between the log price at the mill door less all costs of operation, including transportation, labour, site costs, and a "normal" return on the capital employed but excluding any payments of stumpage fees.

Made an empirical attempt to show how in practice one can construct EDP by using the theoretical and practical guidelines of UN handbook. Sweden was the first industrialized country in the world to construct EDP. They followed the accounting scheme of "Polluter Pays Principle". The Swedish environmental protection Agency and Swedish Ministry of the Environment have set up 15 national environmental quality objectives. It describes the sustainability standard set by the Swedish environment department on consideration about the production of natural resources, the promotion of human health recreation, and the protection of biological Diversity (DE facto 1998).

By following the SNA framework the partially environmentally adjusted net national product was calculated as follows:

1. Capital depreciation will be subtracted from GDP to construct a NDP- the net domestic product.
2. The resource rent, as apart of value added in extractive sectors (Mainly mining) was considered as depletion of natural capital and not part of the production value.
3. All changes in the natural capital stocks originating from external effects from production and consumption, affecting production and
4. And consumption possibilities in the future should be quantified.
5. They also considered the external effects affecting future productivity to not only to natural capital but also to other capital as well. Derek ton of real capital is accelerated by environmental factors such as acid rains, real estates losses etc.,
6. All societal activities that are incorporated in the GDP as final use of produced goods and services, which aimed at improving the natural capital, should be valued according to their effects on productivity.
7. All damages on ecosystems, materials and human health, arises due to negative environmental effects will be corrected for by the "polluter Pay principle".
8. The negative effect arises due to welfare losses should also be considered.

From GDP to NDP

Deducting the depreciation of the man-made capital from GDP yields NDP. The calculations are based on SNA procedures.

Table 2: Swedish (partly) environmentally adjusted NDP in 1993 and 1997: all values expressed in millions of year 2000 dollars

	1993	1997
NDP	180550	202470
Total adjustments	-1960	-1900
Depletion of metal ores	-135	-160
Depreciation of ecosystems	-200	-190
Exploitation of living resources	-15	-15
Increased depreciation of real capital	-270	-205
Expenditures aiming at Maintaining natural capital	-1340	-1330
EDP	178590	200570

Source

4.2. Developed Countries

This session gives an overview of initiatives taken by developing countries in the area of calculation of environmental accounting.

Lo Fu-Chen Yu-Quing Xing. (1999) [5] made a detailed study on China's environment. Since China's environment has undergone tremendous stress in the course of the country's rapid industrialization and development. In China, environmental issues generally result from economic activities, such as industrialization and human habitation. China's most serious environmental problems are water pollution, especially in rivers, urban and indoor air pollution, desertification and ecological stresses.

Based on SEEA framework many countries followed their own satellite account to calculate Green GDP. The green GDP can be estimated according to the following formula:

Green GDP = NDP- Imputed Environmental costs

Where

NDP = GDP – the depreciation of man-made capital.

Imputed Environmental Costs = the degradation and depletion of natural resource asset.

They estimated Green GDP for China based on SEEA framework in 1992 and in the calculation of Green GDP China considered the imputed costs as economic cost induced by natural resource depletion, destruction of the eco system, degradation of natural assets, as well as air and water pollution. For the resource depletion, they considered four natural resources: coal, oil, natural gas and forests, and calculated the cost of depletion is set equal to the reproduction cost of the net reduction of the resources.

They applied the user cost method to estimate the costs of non-produced economic assets. The user cost is defined as the difference between the rent of the resource exploitation and the external rent if we could exploit resource forever. The user cost of non-produced resource, UC can be defined as

$$UC = R_c - R_e$$

Where R_c denotes the current annual rent of the resource exploitation and R_e represents the annual rent if we could exploit the resource infinitely Based on the above formula, they found out that the cost of coal depletion amounted to 0.03 billion Yuan. Oil depletion was 0.02 billion Yuan and natural gas was 9.17 billion Yuan. The total depletion of sub-soil resources in 1992 amounted 9.22 billion Yuan, in which the depletion of natural gas attributed more than 99 percent.

Regarding imputed environmental costs for degradation of natural assets; they considered two categories of natural assets. One is the economic asset including forests, grasslands and cultivated lands. According to the above estimates for these two categories, the imputed environmental costs in 1992 equated 117.48 billion Yuan. This was equal to 4.8 percent of China's GDP, or 5.61 percent of China's NDP.

The following table No.3 presents the aggregated imputed environmental costs from all natural resources, which were considered for the estimate of Green GDP.

Table 3: The imputed Environmental Cost (IEC) in 1992 (Billion Yuan)

Category	Depletion (A)	Degradation (B)	IEC= A + B
Water	-	36.95	36.95
Air		17.72	17.72
Forests	16.55	36.56	53.11
Land		0.46	0.46
Grasslands		0.02	0.02
Sub-soil Resource (Coal, oil& gas)	9.22		9.22
Total	25.77	91.71	117.48

Source: China's Sustainable Development framework Lo Fu Chen *et al.* (1999) [5].

The above table shows that depletion and degradation of the forest accounted for more than 40 percent of the total imputed environmental costs. It was the largest source of environmental damage for China.

Based on the above method China's Eco domestic product or Green GDP

In 1992 was 2193.21 billion Yuan. This can be very well understood from the following table.

Table 4: China's Green GDP in 1992 (Billion Yuan)

GDP	2664.43
Fixed capital Depreciation (FCD)	353.74
IEC	117.48
Green GDP=GDP- FCD-IEC	2193.21

Source

Has prepared an explanatory report on natural resource accounting for the Indian Ministry of Environment and Forests. A framework is established which suggests assessing the physical environmental impacts of selected production and consumption activities, including the informal sector, and physical accounts for soil, air, water, forests, biodiversity and various non-renewable resources. After that, economic valuation would be investigated with the aim of ultimately constructing integrated economic accounting (IEEA), as called for in chapter 8 of Agenda 21.

The purposes of the exercises are listed as:

a. To keep track of the resource base and the state of the natural environment a general monitoring function: and
b. To remind people of the environmental consequences of economic activities and hence to alter our perception of what kind of development is desirable and, in turn, the policy choices we make as persuasive function.

Van Tongeren *et al.* 1991 [2] carried out a case study for Mexico in 1990 and 1991 jointly by the United Nations Statistical Office (UNSO). It was the first empirical experience with overall analytical framework developed in UNSO's Draft Handbook on Environmental accounting (United Nations, 1990), providing two measures for the environmentally adjusted net Domestic Product (EDP) for the year 1985.

The System of Economic and Environmental Accounts for Mexico (SEEA) was constructed by an expansion of the conventional structure of the National Accounts. The innovation is the enlargement of the assets boundary, including oil depletion, degradation concerns (water and air pollution, soil erosion, ground water use and the deposition of solid wastes), land use concerns and deforestation. The EDP measures are obtained by deducting the cost of resource depletion from NDP (EDP1) and environmental degradation (EDP2)

Three approaches were used to value the accounts in physical units. The depletion figures were obtained by calculating the value of the stock of assets by the net price method, i.e. the market value minus cost including normal profit. Alternatively same figures are presented by employing the user cost approach. Finally, the avoidance cost approach was used for the valuation of quality changes in natural assets stocks.

Analyses how Green national accounts capture the interaction between environment and economy. He also made an attempt to put monetary value on the loss or impairment of environmental services as a first step towards 'internalizing' these 'externalities' into the budgets of enterprise and households. He focused on the pragmatic approach to SEEA implementation as reflected in its operational manual. In this the production and consumption boundaries are maintained while allowing for the introduction of natural assets and asset changes in both asset production accounts. This was achieved through the following steps;

- The transfer of assets from the environment to the economy- accounted for as ' other change in the volume' in the assets accounts are not affected;
- Costing permanent, i.e. non-sustainable, depletion or degradation of economic assets; the values of depletion and degradation are shifted from 'other changes in volume' of the conventional asset accounts to the production and income accounts as natural capital consumption;
- Accounting for 'non-economic, or environmental' asset stocks in physical terms only, but applying maintenance cost valuation to permanent, i.e. non-sustainable, losses of environmental functions of waste absorption and other environmental services.

Bartelmus *et al.* (1994) [2] made an attempt to implement the recommendations of SEEA and to illustrate the key steps that need to be taken in implementing the recommendations by United Nations Statistical Division. They provided a more concise guide through the intricacies of integrated environmental and economic accounting. They discussed the step-by step the ways and means to implement the SEEA.

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	1986	**1987**	**1988**	**1989**	**1990**
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Revaluation	1016.5	1121.9	-2168.6	-1330.6	n.a.
Closing Stocks	2648.7	3683.7	1584.4	-154.7	n.a.

Source: Bartelmus *et al*. 1994 [2].

Reductions in capital productivity are reflected in the overall capital –output ratios (NDP or EDP over CAP). Mexico indicated an overall reduction in capital efficiency from 37% to 10% resulting from natural resource depletion only. Considerable fluctuations among the different economic sectors indicated a quite different picture of capital efficiencies if natural capital is used and accounted for in different production processes.

One of the best-known natural resource accounting studies is the pioneering exercise by the World Resource Institute for Indonesia. They considered the changes in the stocks of natural resources (oil, forests and soil) in the capital and flow accounts.

The valuation principle assumed for oil and forests (timber) is the net price method: rents are determined by the international resource commodity price less all factor costs incurred in extraction. This implies that domestic and international markets for these resources are assumed to be perfect, and optimal paths of extraction follow Hotelling Rule. Opening and closing stocks in each period are multiplied by the respective rent, and variation between each represents the disinvestments in natural capital.

For soil erosion, the loss of potential future farm income is considered equivalent to the depreciation of an economic asset. Incremental erosion due to human intervention is estimated in physical terms by the difference between per-hectare loss on forestland and on dry land farming. Yield erosion relationship is also estimated, with the farm income declining linearly as erosion increases. The one-year costs of erosion are then capitalized to obtain the total present value of future stream of productivity losses associated with erosion in that year, which is considered to be the economic measure of soil depreciation

The results from the three resource accounts are aggregated into one measure of 'natural capital domestic investment' (NDI), which is added to GDP (Table 4). The new aggregate is named 'NDP', but it is still an incomplete measure of net domestic product because it ignores the depreciation of produced assets.

Table 6: GDP, Resource Depletion and "NDP" Indonesia-1971 to 1984 Constant 1973 Rupiah, billions

Year	GDP	Resource Depletion	NDP
1971	5545	+1126	6672
1972	6060	- 100	5967
1973	6753	- 279	6474
1974	7296	+2650	9901
1975	7631	-1121	6510
1976	8156	- 684	7472
1977	8882	-1711	7171
1978	9567	-1607	7960
1979	10165	-2219	7946
1980	11169	-2663	8506
1981	12055	-2215	9840
1982	12325	-1764	10561
1983	12842	-2870	9972
1984	13520	-2330	1118

Source

Made an attempt to demonstrate the possibility of arriving at adjustments to the corresponding State Domestic Incomes for the states falling in the Yamuna Sub-basin in India. The Yamuna sub-basin covers four states – Haryana, Himachal Pradesh, Uttar Pradesh and Rajasthan.

The accounting year for forest resources are considered as 1995-1996, the SDP for individual states have been projected using regression trend techniques. They used the parameters like annual forest degradation rate, Shadow value of degradation, regeneration rate, extraction rate, total dense forest area, shadow price of stock of forest resources and the preservation value per year.

The data on SDP in Himachal Pradesh between 1980-1981 and 1988-1989 shows that income from forestry and logging dominated the total SDP (77%in 1980-1981, 69% in 1988-1989). Because of such dominance, any depletion of forests in this state would mean considerable impact on the SDP. If the SDP of Himachal Pradesh were ever to be adjusted, on account of excessive extraction over and above regeneration,

The adjusted income can go down by as much as 68.64%. The estimates of adjustments for other states are -0.64 for Rajasthan, -0.632% for Uttar Pradesh and +0.03 for Haryana. Despite data availability problems and problems related to the method of estimation, each country needs to start taking appropriate measures to deal with environmental issues and to compile environmental statistics. Availability of environment statistics is a necessary condition for compiling environmentally adjusted GDP, which should be considered the ultimate goal. Without some form of environmentally adjusted GDP, sustainable growth is only an illusion

5. Conclusion

Recently, environmental issue have been receiving more and more attention. A number of measures have been taken by both developed and developing countries to reduce the environmental costs of development. In the field of statistics, however, many things still need to be done. This is very challenging, realizing that many developing countries still do not have good vital statistics, let alone environment statistics.

The environmental adjusted domestic product is an emerging aspect of accounting environmental aspects that will influence, in the near future, the countries. The adoption of basic elements of green accounting will portray the role of environment in the economy as well as render easier the analysis of macro economic questions with the help of accounting information system and thus, lead the economy to a vital path.

The United Nations has provided some guidance for compiling environment statistics as well as the System of Integrated Environmental and Economic Accounting. In the absence of emission coefficients, the rapid assessment procedure can be applied. Estimation techniques can be learned from countries, which have some experience in compilation. What is important is the political will to start making an inventory of the relevant statistics, and to conduct relevant studies. And it is the time to start to do the work gradually and consistently.

6. References

1. Bartelmus P. towards a Framework for indicators of Sustainable Development. DESIPA Working Paper Series No. 7, New York: United Nations, 1994b.
2. Bartelmus, Jan van Tongeren. Environmental Accounting, an Operational Perspective, DESIPA Working Paper Series No. 1 New York: United Nations, 1994.
3. Kellenberg John. Accounting for Natural Resources in Ecuador: Contrasting Methodologies, conflicting Results. The World Bank. Washington 1996.
4. Lange. Policy Applications of Environmental Accounting: Institute for Economic Analysis, 2003.
5. Lo Fu- Chen *et al*. China's Sustainable Development Framework UNU / IAS, 1999.