CHAPTER II
SCENE OF ENVIRONMENTAL ACCOUNTING - AN OVERVIEW

Environment

The Rig Veda reflects that environment is to be valued like parents and loved like children.

Environment is a very wide term which includes everything in all its manifest forms, on the earth, inside the earth and above the earth. It is meant to serve and support human society, providing essential raw materials and inputs, and irreplaceable life-support functions such as the ozone layer. It absorbs and recycles—normally at little or not cost to society—the waste products of economic activity and protects human kind from damages caused by various types of economic activity, enabling coexistence in harmony the other life forms.

In short, it includes all living and non-living things on the earth, inside the earth and above the earth (Sun, Moon, Air, Ozone Layer, etc) provided by the nature and/or created by the God.

National Accounts

Economic data has been in existence in the form of statistics or accounts, in one form or the other, all over the world. National governments and international bodies

* DATA AND INFORMATION PRESENTED IN THIS CHAPTER ARE SECONDARY COLLECTED BY THE RESEARCHER
have found such data indispensable in planning, development, policy making, monitoring implementation and measuring economic success.

Such data has been eventually known as National Accounts.

National Accounts estimate gross national product (GNP) and net national product (NNP).

At present, besides GNP and NNP, other economic data such as prices and employment statistics are also widely used to judge the economic performance of a country.

In a country, two types of assets are used:

a. Man-made assets which include fixed assets (both tangible and intangible), and floating assets including liquid assets held in Indian and foreign currency.

b. God created assets called as natural assets or environmental assets which include air, water, sunlight, rivers, lakes, sea and sea products, mines, oil, ozone layer, biodiversity, wildlife, woodlands, eco-system, grass-lands and all others provided by the nature.

In all such economic estimates of an enterprise or a nation, the depreciation, depletion and degradation of man-made assets and appreciation in them are taken into account and are deducted from or added with the income but
the depletion and degradation of environment assets or appreciation in them, loss by environmental pollution, congestion of parks, wilderness area, loss of ozone layer as well as global warming, and so on, are neglected (not included) while determining the net income.

The estimation of environmental assets along with man-made assets in determining the net result of any enterprise or a nation at any time may be termed as environmental accounting in colloquial language.

However, all such macro-economic estimates neglect factors such as environmental pollution, congestion of parks and wilderness areas, depletion of natural resources and the ozone layer, as well as global warming which comprise the unfortunate side of economic growth.

It was only in 1960s and the early 1970s, that the importance of environment highlighted this deficiency in national accounts.

More recent criticism levelled against national accounts accents on the fact that these measure the depreciation of man-made capital such as plant and machinery, but neglect the stock of natural resources as well as environment, and their depletion coupled with the degradation in environmental quality.
Pollution and accumulations such as new finds of sub-soils resources, new uses of environmental assets, etc. comprise significant varieties which cannot be neglected. For example, no adjustment is made for the depletion in petroleum energy stock when oil is extracted and consumed. Logging of tropical forests invites no estimation of the loss of an asset and its effects. Again, when land cultivation increase, no allowance is made for the harmful effects on soil or water storage. When chloro-fluro carbons were first used, no anticipation of the damaging loss to the ozone layer was perceived.

Neglecting the depreciation of natural resources and environment necessarily implies that the net income or product is overstated. It was thus stated by the 1992 Earth Summit in Rio de Janeiro that without better stewardship of the quantitative as well as qualitative changes in natural assets, development will be undermined.¹

GNP and NNP, without showing the effect of deterioration in environment and natural resources, may provide a distorted picture. For instance, any increase in expenditure on medical services, or on household cleaning

due to increased pollution levels will result in an increase in economic activity, and thus, an increase in GNP and NNP, whereas actually speaking, this increase is negated if the social costs are weighed against the social benefits.

Similarly, no single accounting aggregate is entirely satisfactory for measuring economic performance.

In this respect, the views of Robert F. Kennedy are worthwhile to quote:

The gross national product does not allow for the health of our children, the quality of their education, or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country, it measures everything, in short, except that which makes life worthwhile.

**Importance of Natural Resources and Environment**

Neglecting environment and natural resources distorts the picture of production in two ways: (i) it produces undesirable output such as pollution and (ii) it leaves out a number of crucial inputs such as soil, water, forest products, minerals, sea-life, coral (which are often
implicitly valued at zero) provided in the form of natural resources to the production process.

This lack of full accountability of all types of inputs and outputs complicates the nation's economic and environmental policy. And the loss of environmental capital, if not taken into account, now, will eventually reflect itself in income and production measurement.

Besides this, even if environmental deterioration does not reach life-threatening levels, it still can result in a substantial decline in the quality of world we live in.

It is, therefore, necessary to find a way to enable all people, now and in the future, to enjoy clean water, clean air and fertile soil. Decreasing availability of water has now been realised by the nations. The awareness expressed in this regard by the President of India Shri. K.R. Narayanan, at the Joint Session of Parliament on 25th October 1999 is worth citing.¹

The Government will present a water policy that will facilitate creation of appropriate administrative, commercial and technological solutions to ensure that the present and future generations are not deprived of this life sustaining resource.

¹ Hindustan Times, October 26, 1999
This can be achieved if the needs of the present generation are met in a manner so as to enable the coming generations to live in conditions, which at least do not spell further depletion and degradation, if no improvement.

The availability of key environmental and natural resources plays an important role in determining whether the economic goals will be reached, especially, in the less-developed countries whose economies depend on primary production such as mining, forestry, fishing etc.

Consider this, total understanding of the response of agricultural sector to agricultural policies is difficult without a complete accounting of all the important inputs (soil and its nutrients, water etc) and outputs (erosion, salinisation, water logging etc) that are involved in agricultural production.

It has also been realised that a nation with marketable natural resources is better off than those without such resources. Overall, a balance between economic growth and care of environment and natural resources is needed in all nations, especially, in the under-developed and developing.

In fact, maintenance of proper accounts on environment and natural resources will check their depletion
and degradation and ultimately, protect the loss of economic growth and public health; and assist to measure economic performance more accurately.

As such, economic growth as measured through the prevailing system of national income accounting is far from reality and is overstated since it does not take into account the amount of natural resources used, the damage caused and the changes incurred by their use in economic growth. Decision based on GNP and NNP are far from reality.

Deficiencies in national accounting vis-a-vis the importance of natural assets have led to a recognition of the value of environmental resources and services, and efforts to evolve methods to overcome the drawbacks.

Environmental accounting, one of the methods, takes into account environmental resources and services, and changes therein, and measures their effects on GNP and NNP to reveal true maximum income (True Net Capital Formation) which a nation can consume while maintaining a sustainable development and growth without jeopardising the interests of the present and the future generations, as well as of our neighbours.
UNDERSTANDING AT A GLANCE (ALL IMAGINARY)

Illustration to grasp the Environmental Accounting at a Glance (Hypothetical)

**Particulars Relating to an Enterprise (firm):**

<table>
<thead>
<tr>
<th>Debit Balances</th>
<th>Credit Balances</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Amount</td>
</tr>
<tr>
<td>Fixed Assets</td>
<td>30000</td>
</tr>
<tr>
<td>(Man-made)</td>
<td></td>
</tr>
<tr>
<td>Tubewells</td>
<td>10000</td>
</tr>
<tr>
<td>Live stock(horses)</td>
<td>5000</td>
</tr>
<tr>
<td>Staff quarters</td>
<td>10000</td>
</tr>
<tr>
<td>Mfg. Costs, office costs and others</td>
<td>5000</td>
</tr>
<tr>
<td>Fuel and Power</td>
<td>5000</td>
</tr>
<tr>
<td>Stock at the beginning of the period</td>
<td>5000</td>
</tr>
<tr>
<td>Cash/Bank and Debtors</td>
<td>10000</td>
</tr>
<tr>
<td>Purchases</td>
<td>20000</td>
</tr>
<tr>
<td></td>
<td>100000</td>
</tr>
</tbody>
</table>

Stock at the end of the period 5000

Depreciate fixed assets, Tube well and staff quarters by 10%
Horses valued at 4000

**ENVIRONMENTAL INFORMATION**

Water would last in the tube well for about 20 years (if obtained from Govt. supply, it would cost for the period 3000).

Contamination of surroundings by the residuals (sweeping costs and depreciation of the treatment plant, if installed, would cost for the period 2000).
Air pollution by the smoke of the factors (Estimated cost to make it ineffective for the period 2000).

Loss of forests and bio-diversity (to revive it, it would cost 20000, to be amortised over 20 years).

Fall in health of the habitats (to cure it, dispensary costs would be for the period 5000).

(i) The Periodical Financial Statement under usual P and L account and B/S to know the result would be as follows:

**Profit & Loss Account for the period**

<table>
<thead>
<tr>
<th>Debit balances</th>
<th>Amount</th>
<th>Credit balances</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Stock (beginning)</td>
<td>5000</td>
<td>By Sales</td>
<td>50000</td>
</tr>
<tr>
<td>Purchases</td>
<td>20000</td>
<td>Stock at the end</td>
<td>5000</td>
</tr>
<tr>
<td>Mfg. costs, office costs and others</td>
<td>5000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel and power</td>
<td>5000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed assets</td>
<td>3000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tube well</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Staff qrs.</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livestock</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit</td>
<td>14000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Profit</strong></td>
<td><strong>55000</strong></td>
<td><strong>Profit</strong></td>
<td><strong>55000</strong></td>
</tr>
</tbody>
</table>
Balance Sheet of the Enterprise as on the Date of the period

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Amount</th>
<th>Assets</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>30000</td>
<td>Fixed Assets</td>
<td>30000</td>
</tr>
<tr>
<td>Profit</td>
<td>14000</td>
<td>Less Dep.</td>
<td>3000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tubewell</td>
<td>27000</td>
</tr>
<tr>
<td>Loans and</td>
<td></td>
<td>Less dep.</td>
<td>10000</td>
</tr>
<tr>
<td>Creditors</td>
<td>20000</td>
<td>Staff qrs.</td>
<td>10000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Less dep.</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Live stock valued at</td>
<td>9000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cas/Bank and debtor</td>
<td>9000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stock at the end</td>
<td>10000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>64000</td>
<td></td>
<td>64000</td>
</tr>
</tbody>
</table>

(ii) Profit and Loss account and the Balance sheet under Environmental Accounting.
### Profit and Loss Account under Environmental Accounting for the period

<table>
<thead>
<tr>
<th>Debits</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>To Depletion of water</td>
<td>Profit as per business P and L account</td>
</tr>
<tr>
<td>Pollution of surroundings</td>
<td>3000</td>
</tr>
<tr>
<td>pollution of air</td>
<td>2000</td>
</tr>
<tr>
<td>Destruction of forests and biodiversity</td>
<td>2000</td>
</tr>
<tr>
<td>Loss of health of habitats</td>
<td>1000</td>
</tr>
<tr>
<td>To environmentally adjusted domestic product (EDP)</td>
<td>5000</td>
</tr>
</tbody>
</table>

(it may be called as in colloquial language - Profit after environmental depletion, degradation and costs)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>14000</td>
<td>14000</td>
</tr>
</tbody>
</table>

### Balance sheet under Environmental Accounting as on the date of period ended

<table>
<thead>
<tr>
<th>Liabilities</th>
<th>Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital</td>
<td>30000</td>
</tr>
<tr>
<td>EDP (Profit under Environmenal Accounting)</td>
<td>Total Assets as per business balance sheet 64000</td>
</tr>
<tr>
<td>Loans and creditors</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Less Environmental depletion, Degradation, damages</td>
</tr>
<tr>
<td></td>
<td>1. Depletion 3000</td>
</tr>
<tr>
<td></td>
<td>2. Degradation in atmosphere, air and surroundings 4000</td>
</tr>
<tr>
<td></td>
<td>3. Damages to forests and bio-diversity 1000</td>
</tr>
<tr>
<td></td>
<td>4. Mitigation of loss of health of habitats 5000</td>
</tr>
<tr>
<td></td>
<td>51000</td>
</tr>
</tbody>
</table>

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>51000</td>
<td>51000</td>
</tr>
</tbody>
</table>
The Environmental accounting reveals that the firms should make appropriation of 13000 to mitigate losses to the environment by the enterprise.

**SUSTAINABLE DEVELOPMENT**

In the preceding pages it has been stated that environmental accounting should aim at achieving sustainable development. In this study, the term sustainable development has been used in a technical sense.

Sustainable Development was brought in use by the World Commission on Environment and Development (The Brundtland Commission) in 1987.¹

Nature has provided resources to be used, not only by the present generation but also by the generations to come in the future. Moreover, knowledge about environmental conditions and stocks are inadequate due to conceptual problems (e.g., how to define soil depletion, loss of natural habitats, air pollution etc). If these are used without care, they will fully deplete, and nothing would be left for the future generations.

The future generations would like to live in at least in the way the present one is living, if not better. Sustainable development requires to meet the needs of the

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present generation without compromising the needs of the future generations i.e., the future generations are not deprived of the resources provided by nature.

It does not mean that we should not have economic growth or progress. A trade off has to be struck between economic growth and sustainability. The economic system should be so designed as to sustain progress.

Therefore, attention has been drawn to recognise the value of environmental resources and services and changes therein and to find a method to improve the national accounts in such a way that they not only measure the present income but also give due regard to the needs of the future generations.

This can be achieved if the method provides information that will permit continuing improvement in the quality of life with a lower intensity of resource use, thereby leaving behind an undiminished, or even enhanced, stock of natural resources and other assets for the future generations.

Sustainable development has become all the more important with the use of a nation's natural resources by other countries in an imprudent or excessive manner; or by spoiling the environment in another country by shifting
pollution-prone industries or exporting waste without any regard to the sustainable development and growth of the other country.

As such, 'sustainable development' as defined in the handbook issued by UNSO.¹

An increase in (real) domestic product, duly allowing for the consumption of produced capital and the depletion and degradation of natural capital, taking into account the past trends of depletion and degradation that can be offset or mitigated by technological progress, substitution and new discoveries of natural resources, or new additions to them, and changes in consumption patterns.

Sustainable development does not prohibit the use of natural resources but restricts their use in such a way that enough, or as much as possible, is left for the future generations; not only for future but even for day to day use.² It can be achieved by increasing efficiency or cutting

¹ Peter Bartelmus (UNSTAT) Ernst Lutz (World Bank), Jan van Tongeren (UNSTAT) Environmental Accounting with an operational Perspective, p.35.
² Justice K. Balakrishnan Nair observed while delivering the judgement on a petition filed by the Panchayat: Ground-water under the land of the company (COCA COLA) does not belong to it. Normally every landlord can draw REASONABLE amount of groundwater which is necessary for its domestic and agricultural requirements. But, here 510 kilo litres, of water is extracted per day, converted to products and transported, thus breaking the natural water cycle." The Economic Times, 17.12.2003.
down on waste or by adopting other methods such as imposing a tax on environmental use, as well as using non-traditional sources of energy.

**Technology**

National Accounts, conventional national accounts or core accounts: All these terms can be interchangeably used. They are prepared as required by the country's system of national accounts. The measure national income by indicating GNP and NNP. In this study, SNA means national accounts.

Satellite Accounts: Supplementary accounts relating to the environmental and disclosing environmental costs are termed as satellite accounts.

Satellite accounts for the environment represent a compromise in that they will not change the core of the SNA and the relevant time series, yet they will provide countries with a set of supplementary accounts and indicators and will encourage them to compile relevant information in the area of natural resources and the environment. They will also make it possible to compute an EDP and ENI.

Green Accounting Satellite accounts linked with national accounts are termed as green accounting. In other words, these comprise the integrated environmental and
economic accounting or environmentally adjusted economic accounting, also termed as environmental accounting. The method is termed as a system of integrated environmental and economic accounting (SSEA).

Gross National Product (GNP) Total of goods and paid-up services plus (exports-imports) is known as gross national product (GNP). It is also known as the gross national income (GNI) or gross domestic product (GDP).

Net National Product (NNP) After deducting depreciation of fixed assets (man-made capital) and value of non-current assets from the GNP, the figure arrived at is known as Net National Product (NNP). In other words, it means, total consumption of goods and services plus net capital formation plus (exports-imports) minus depreciation. It is also known as net national income (NNI) or net domestic product (NDP). It is expressed as follows:

$$NDP = C + I + (X - M)$$

where,

C = Consumption of goods and services excluding depreciation
I = net capital formation or investment after depreciation
X = exports
M = imports
Depreciation has already been deducted from GDP to arrive at NDP.

Net Capital Formation: It is equal to the figure of the NDP minus final consumption minus (exports minus imports). It is expressed as follow, contraplating the above equation, $NDP = C + I + (X - M)$ it would be

$I$, i.e. $NCF = NDP - C - (Exports - Imports)$

where,

$C =$ consumption of goods and services excluding depreciation

$I =$ net capital formation after depreciation

Environmentally adjusted Net Domestic Product (EDP). It is obtained by deducting environmental costs from NCF. It is as also known by the names of environmentally adjusted net income (ENI) or environmentally adjusted net domestic income (EDI). It is expressed as follows:

$EDP = NDP - C - Environmental Costs - (X - M)$

i.e. $EDP = NCF - Environmental costs$

Sustainable Gross Income: With due regard to the treatment of natural depletion, some writers have started using the word 'sustainable gross income' instead of gross income. It means gross income less environmental outlays less current consumption of natural resources.
ENVIRONMENTAL ACCOUNTING

Definition

There is no standard definition of natural resources and environmental accounting. The term environmental accounting could, in a general sense, be used to indicate taking account of the environment and changes in it, and integrating the results with the system of national accounts (SNA) so as to provide a valuable information base for planning and laying policies for the integrated sustainable development and grown of the nation.

There are three terms — (i) Environmental accounting (Already stated above in detail)

In short, it measures in terms of money the amount of loss which has been done to the environment by the habitants, and what are its effects on national income or enterprise income to take remedial steps.

2. Environmental Management: A deal with how the environment should be managed using optimum efforts to reap its maximum benefits.

3. Environmental Science: It is a positive science concerned with finding out the Truth of the proposition for its own
sake. In simple words, it is related to find out with certainty the precise knowledge (Truthfulness) related to environment (Bio-diversity).

Objectives
1. Taking the total stock of assets or reserves related to environmental issues, and changes therein.
2. Estimation of the total expenditure on protection or enhancement of environment.
3. To identify that part of the gross domestic product which reflects the cost necessary to compensate for the negative impact of economic growth, i.e. the so-called defensive expenditure to protect environment.
4. Assessment of environmental costs and benefits:
   a. the decrease (depletion) in natural resources due to their use in production and final demand and
   b. the changes in environmental quality, resulting from pollution and other impacts of production and consumption and other natural events on one hand, and the expenditure for environmental protection and enhancement of the environment, on the other.
5. Elaboration and measurement of indicators, relating to environmentally adjusted product and income which are disclosed by Environmentally Adjusted Net Domestic
product (EDP), i.e. Net Domestic Product minus Environmental costs.

6. Analysis of EDP: It is to plan the use of resources by squeezing them and reducing waste to attain sustainable development.

ACCOUNTING ISSUES vis-a-vis ENVIRONMENTAL ACCOUNTING

The above objectives will cause to face the following issues and problems to be dealt with while preparing Environmental Accounts. Efforts have been made to deal with them, as far as possible, with a constraint to the availability of the subject matter.

a. Recognition of environmental assets—their measurement and assignment of values, enumeration and recording them in environmental accounts.

b. Changes occurred in their quantity and quality due to depletion, degradation and uses and appreciation, from period to period, and their measurement and recording the changes in environmental accounts.

c. Presentation of above with all details in the Statement of accounts.

d. Expenditure incurred in acquiring, preserving and protecting them. Treatment of expenditure as capital or revenue. If capital, how to amortise them. Western corporations
are amortising them over a period of ten years. Though it fails to meet the Concept of Prudence but is considered a practical solution.

e. Making distinction between environmental expenditure and business expenditure.

f. Separate environmental accounts or incorporation with business accounts (Traditional accounts).

g. Recognition of environmental related contingent liabilities. How to treat the loss to the environment by the enterprise—as contingent liability, create a fund or neglect it. If considered as contingent liability—how to show them in accounts—separately or combined with business contingent liability under a separate head.

h. Costs benefits analysis. Costs compared with merits and damages.

Necessary guidance is necessary from the authorities or the nation to achieve standardisation.

Origin and Development

Keeping in mind the deficiencies of national accounts vis-a-vis the importance given to environmental resources and services, people felt the need to recognise the value of natural resources and environment and changes therein, and realised that decisions based on national
accounts without considering these, are far from reality and misleading.

They began to ponder what should be done to overcome this problem. It was thought that if the value of natural resources and environment, and the cost of changes therein, was injected into income estimation arrived at through national accounts, the problem could be overcome to a large extent as better information would lead to better management.

Based on the work on this concept since 1983, the World Bank encouraged that environmental issues be considered in the system of national accounts. As an interim measure, it proposed that a set of satellite accounts (supplementary accounts relating to environment) be prepared to accompany the SNA framework. This was accepted by SNA expert group meeting held in January 1989.

In the absence of an international consensus on how to incorporate environmental assets and the costs and benefits of their use in national accounts, the Statistical Commission of the United Nations requested statistical division of the United Nations Statistical Organisation (UNSTAT) to develop a satellite (supplementary) system for integrated accounting rather than to modify the core system of SNA itself.
This approach was confirmed by the Earth Summit of United Nations Conference on Environment and Development held at Rio de Janerio in June 1992. It concluded that development would be undermined without better stewardship of the environmental resources and services and the changes therein.

In 1993, the UN Statistical Commission adopted a revised system of national accounts altering the accounting procedures for member countries. It was suggested that although the countries would not be required to fully integrate environmental concerns into their core accounts, they should prepare satellite accounts in both physical and monetary units consistent with the core accounts.

In December 1993, the UN Statistical office, which was working on this project in collaboration with Carsten Stahmer, issued a handbook on integrated environmental and economic accounting, providing detailed guidelines under the title 'The Handbook of Integrated Environmental and Economic Accounting. This has been subsequently named System of Integrated Environmental and Economic Accounting (SEEA).

In short, these comprise the environmentally adjusted national accounts, or environmental accounting, which requires: Taking account of the natural assets and
changes therein, and integrating the results thereof with the system of national accounts to provide valuable information for planning and laying policies on integrated sustainable development and growth.

It needs to be made clear that environmental accounting is not entirely new. A few countries have been actually keeping accounts of the extraction of natural resources and recording of pollution abatement expenditure, and the like, since long (in Norway, since early 1970s) but they do not take into consideration other matters relating to natural resources and services, and changes therein.

It is expected that with the introduction of the SEEA as suggested by UNSO, the deficiencies and shortcomings of national accounts will be automatically overcome.

The results so arrived at will have a practical utility for the nations by revealing the true maximum income which a nation can consume without depleting environmental resources and services, and also without jeopardising the interest of the present and the future generations as well as its neighbours.

Environmental accounting will act as bridge between environment and development planning.
ACCOUNTING FOR NATURAL RESOURCES AND ENVIRONMENT IN OTHER COUNTRIES

Many of the methods are in their initial stages and are undergoing continuous revision. The methods adopted in various countries can be classified under four groups:

a. Keeping records of pollution abatement and other environmental expenditure: This is in use in the US, France and Canada;

b. Keeping accounts of the stock of natural resources: This record is maintained for flows as well as changes in stock of important natural resources in physical units. It is in practice in Norway, France and Canada.

c. Adjustment made in gross national product (GNP) and net national product (NNP): The depletion of natural resource is subtracted from GNP and NNP. This is applied in Indonesia. Work is in progress in China, Costa Rica and Holland.

d. Comprehensive resource and environmental accounting: Such accounts are maintained both in physical and value terms.

Peskin (1989)\(^1\)

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\(^1\) Henry M. Peskin, He developed improved measures of economic and social performance by expanding the national income and product accounts of the US under the title, Environmental Accounting for Sustainable Development, Washington DC World Bank.
Repetto (1989)\textsuperscript{1} and United Nations Statistical Office (UNSO) have suggested such methods. Present efforts by the Dutch are somewhat along these lines. While work on resource and environmental accounting, led by Roefie Hueting has a long history in the Holland (Netherlands), official efforts to adjust the GNP for environmental losses and resources depletion have only just been initiated.

The intended approach is to subtract from GNP environmental damages, measured by the costs of technical procedures and reductions in economic activity necessary to attain a sustainable use of environment. The concept of sustainable use refers to the ability of the environment to provide useful functions for the present, and into the future. Countries are adopting them either in one form, or the other, as a combination.

A final decision to adopt the method has been based on considering the country's needs, policy and future development.

**Systems in Norway and France**

The systems prevalent only in two countries—Norway and France, that are described here. Systems

\textsuperscript{1} Robert, Repetto, He and his colleagues are working at World Resource Institute, Washington, DC on natural resources in the national income accounts.
prevalent in other countries have not been discussed here as most are basically keeping records of pollution abatement expenditure, or the like, or the system itself is under consideration. The system suggested by UNSO has been described in detail in the next section.

**NORWAY**

The Norwegian system of resource accounting is an example of physical accounting of material resources and environmental resources. Under material resources, accounts are maintained for mineral resources, biotic resources and inflowing resources.

Under mineral resources accounts are kept for iron, titanium, copper, zinc, lead, coal, oil and natural gas; under biotic—forests and fish; and under inflowing resources—hydropower.

Accounts for mineral resources exist for only a few select years while forests statistics are available since the early 1970s.

Environmental resources accounts include land-use statistics, data relating to discharge of air pollutants (SO₂, CO, CO₂, volatile organics, particulates and lead) and water pollutants—nitrogen and phosphorous. No adjustment is made in GNP.
The aim is to help policy makers to manage the natural environment and to reduce air pollution, and to provide data for developing specific resource policies and the Norwegian economic planning process, in general.

As such, the scope of the accounting efforts and the specific contents of individual accounts are determined by political and practical considerations. Emphasis is more on forecasting and policy analysis.

Physical accounts describe levels of stock, discoveries, depletion and deposition of the national resources (degradation is not accounted for). In short, physical accounts are prepared like stock accounts.

The following table describes the general format of the material resource accounts.

**Structure of Material resource accounts**

<table>
<thead>
<tr>
<th>1. Reserve Accounts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Beginning of period</strong></td>
</tr>
<tr>
<td>Resource base</td>
</tr>
<tr>
<td>Reserves (developed, non-developed)</td>
</tr>
<tr>
<td>Total gross extraction during period</td>
</tr>
<tr>
<td>Adjustments of resource base</td>
</tr>
<tr>
<td>(new discoveries, reappraisal of old discoveries)</td>
</tr>
<tr>
<td>Adjustment of reserves</td>
</tr>
<tr>
<td>(new technology, cost of extraction, transport etc. Price of resource)</td>
</tr>
</tbody>
</table>
End of period : Resource base
Reserves (developed, non-
developed)
Net changes during the period

II. Extraction, conversion
and trade accounts

: Gross Extraction (by sector)
   - use of resource in extraction sector(s)
   = Net extraction (by sector)

: Import(by sector) - Export (by sector)
   = Net import (by sector)

Resource for domestic use : Net extraction + Net import (+/-) changes in stock

Part III describes the uses of resources—energy in detail, simple in the case of fish, it is called the consumption account, showing domestic use of energy and fish.

FRANCE

A very ambitious resource and environmental accounting called Patrimoney is maintained in France. It covers economic, ecological and social environment. It has been divided into two parts:

a. Natural Patrimoney: It includes all natural elements which are capable of being transmitted to future generations, or are being transferred.
ii. **Artificial Patrimony**: It includes man-made materials and buildings, etc. They are to be excluded, but if they have a cultural significance (artificial lakes and parks), they are included.

To serve this rule, patrimony accounts consist of a number of separate sub-accounts, all related to each other. These sub-accounts fall into three groups:

a. Physical accounts which describe physical resource stocks and their flows;

b. Geographical accounts which describe physical resources by region, or by ecology or by land classes.

c. Agent accounts which describes utilisation of resource stocks and flows by economic groups. Some of the agent accounts are defined in both monetary and physical units.

While examples of all these different sub-accounts exist for a select group of priority sectors (forest, water, soil, land use and wildlife), the final form of patrimony system is still under development. The intent is to be flexible and pragmatic in order to reflect changing data as well as the needs of policy. Physical accounts are somewhat like the Norwegian resource accounts in content. However, the presentation is different. The French have opted for a double-entry system, showing sources at one side of the account and uses on the other.
### French Physical Account: Stock of Commercial Forests

<table>
<thead>
<tr>
<th>Resource/Asset</th>
<th>Broadleaf</th>
<th>Coniferous</th>
<th>Total</th>
<th>Use</th>
<th>Broadleaf</th>
<th>Coniferous</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of growing stock in 1969</td>
<td>980.1</td>
<td>6526.5</td>
<td>7506.6</td>
<td>Natural reduction (mortality)</td>
<td>5.6</td>
<td>21.0</td>
<td>26.6</td>
</tr>
<tr>
<td>Natural growth of initial stock</td>
<td>401.0</td>
<td>2583.5</td>
<td>2985.4</td>
<td>Accident reduction (breakage &amp; windfall)</td>
<td>9.7</td>
<td>481.2</td>
<td>490.9</td>
</tr>
<tr>
<td>Natural growth by reproduction (recruitment)</td>
<td>41.1</td>
<td>258.4</td>
<td>298.6</td>
<td>Resources extraction (Commercial felling)</td>
<td>92.0</td>
<td>1474.0</td>
<td>1566.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Self consumption</td>
<td>13.6</td>
<td>395.0</td>
<td>408.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Adjustment</td>
<td>-29.4</td>
<td>+1239.2</td>
<td>1209.8</td>
</tr>
<tr>
<td>Volume of growing stock in 1979</td>
<td>1330.7</td>
<td>5758.0</td>
<td>7088.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1422.2</td>
<td>9368.4</td>
<td>10790.6</td>
<td>Total</td>
<td>1442.2</td>
<td>9368.4</td>
<td>10790.6</td>
</tr>
</tbody>
</table>
The geographical accounts assemble data related either to ecosystems such as forests and wetlands or to some other area definition such as geographical regions (eg. coastal lands), political territories (eg. provinces), or abstract concepts such as an imposed grid network. The ecozones could refer to, say, agricultural land, each broken down into three soil classes of different qualities.

Finally the agent accounts refer to all accounting for those activities that link human activity to the natural environment. Agent accounts cover a wide range of stock or flow accounts. Their distinguishing feature is the identification of human owners and users. While certain accounts (eg. water-use accounts and pollution-emission accounts) may be expressed only in physical terms, other accounts may include monetary values along with physical units.

Two simple examples of physical agent accounts are given here. Similar environmental satellite accounts exist for the management of parks, hunting areas, maritime areas, and the generation and disposal of refuse.

The French plan to eventually place similar monetary values on all physical stocks and flows.

The present patrimony accounts themselves do not play a role in the setting of priorities but assist in
### MONETARY AGENT ACCOUNT: VALUE OF FRENCH LAND

<table>
<thead>
<tr>
<th>Area in Million hectares</th>
<th>Average price per hectare</th>
<th>Value in billion francs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural land</td>
<td>32.1</td>
<td>22200 Fr</td>
</tr>
<tr>
<td>Forests</td>
<td>14.6</td>
<td>14000 Fr</td>
</tr>
<tr>
<td>Water, moors, quarries etc</td>
<td>4.3</td>
<td>5300 Fr.</td>
</tr>
<tr>
<td>Recreation land</td>
<td>0.2</td>
<td>68000 Fr.</td>
</tr>
<tr>
<td>Building sites</td>
<td>0.1</td>
<td>1600000 Fr.</td>
</tr>
<tr>
<td>Railroad land</td>
<td>0.1</td>
<td>35000 Fr.</td>
</tr>
<tr>
<td>Undeveloped land</td>
<td>51.4</td>
<td>21900 Fr.</td>
</tr>
<tr>
<td>Developed land</td>
<td>1.5</td>
<td>800000 Fr</td>
</tr>
<tr>
<td>Unregistered land</td>
<td>2.1</td>
<td>000 Fr.</td>
</tr>
</tbody>
</table>
identifying which environment and resource sectors are relatively more important in terms of their effect on the nation's economy.

Unfortunately the incomplete and partial frameworks may not be able to serve this function well because important links between the environment and the economy are missing.

From the above discussion, it appears that the French system is a more detailed one.

**THE UNSO SYSTEM**

The UN Statistical Office (UNSO), in collaboration with Carsten Stahmer, recently designed a system of Integrated Environmental and Economic Accounting (SEEA). They have termed these as satellite accounts which are to be prepared separately. They include environmental concerns in the computation of income.

These are commonly termed as Environmental Accounting. The handbook prepared by them for this purpose, has been titled The Handbook of Integrated Environmental and Economic Accounting.

These accounts are designed for linking with system of National Accounts, measuring national income. After linkage, they will be called Environmentally Adjusted
Economic Accounts to arrive at Environmentally Adjusted Domestic Product (EDP).

Instead of appointing a separate machinery, the present machinery handling SNA should be entrusted with collecting data on environment and natural resources. To achieve this, two key steps would be required for adaptation of national accounts for environmental analysis.

a. Under the first step, changes and amendments have been suggested in the present system of national accounts (SNA) and its balance sheet to include items relating to environment, and classifying all items and heads under them so as to coincide with requirements of environmental accounts and analysis. These have been termed as SNA for SEEA and comprise an intermediate step to link SNA with SEEA.

b. Under the second step, to prepare Integrated Environmental and Economic Accounts (environmental accounts) from the first step SNA for SEEA.

The Present SNA System

For a clear idea, it is necessary to know the present SNA system in its original form.

Gross Domestic product (GDP) and net domestic product (NDP) are derived as follows:
GDP is first calculated. It is equal to the total value of all goods produced and services rendered in a country in an accounting period, say one year.

In an equation form, it is expressed as follows;

\[
GDP = \text{Intermediate consumption} + \text{Consumption of Fixed capital} + \text{Final Consumption} + \text{Net Capital formation} + (\text{Exports} - \text{Imports})
\]

After deducting intermediate consumption + Consumption of Fixed Capital (depreciation) from GDP, one gets NDP i.e., GDP - Intermediate consumption - Depreciation of fixed capital = NDP.

Therefore,

\[
NDP = \text{Final Consumption} + \text{Net Capital Formation} + (\text{Exports} - \text{Imports})
\]

This NDP derived under SNA is used to measure the National Income and will be used for comparison with environmentally adjusted indicators.

The total value of goods and services produced for calculating GDP include both produced and non-produced assets. GDP in produced assets refers to additions to produced assets such as roads, machinery, commodities, orchards, plantations, livestock for breeding; in the case of non-produced assets, these include economic assets over
which ownership rights are enforced and provide economic benefits to their owners and their produce is generally valued in the market either directly or indirectly, e.g. land, improvement of land, cost of transferring land and non-produced assets between owners, metallic and non-metallic minerals, forests, fisheries and reforestation.¹

Consumption of fixed capital, including environment protection expenditure incurred by industry, refers to reduction in the value of the produced assets only.

The preparation of SNA in their original form is necessary to assist comparison with the results disclosed by SNA with environmentally adjusted economic aggregate and indicators arrived at as per SEEA, i.e. to compare NCF with EDP. (NCF is net capital formation under SNA: EDP is net capital accumulation under SEEA).

**Another Set of Identities under SNA**

Besides the above identity, another set of identities which explains the difference between opening and closing stock of assets by flows during the accounting period for produced and non-produced assets is also prepared.

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¹ As these assets do not add to the value of economic asset they are considered as an increase in non-produced economic assets.
These are prepared to find out what (and where) changes, i.e. additions and reductions, have taken place in them. They have nothing to do with the calculation of GDP and NDP. Under these, the closing balance is deduced in the following manner:

\[ \text{Opening stock} + \text{GDP} - \text{Consumption of fixed capital} + \text{Other changes in volume of assets} + \text{holding gains/losses on assets} = \text{Closing stock}. \]

**PREPARATION OF INTEGRATED ENVIRONMENTAL ACCOUNTS FROM SNA**

There are two steps: (i) Preparation of SNA for SEEA, (ii) Preparation of SEEA.

**Preparation of SNA for SEEA:** To assist in the preparation of SNA for SEEA, it has been suggested by UNSO to incorporate and show information relating to natural resources and environment, duly classified under specific heads.

Some of this information relating to environmental products already exists in SNA under another set of identities, which though, is not taken into account while calculating NDP. These are made for getting information to prepare environmental accounts (satellite accounts).

The separate identification of environmental protection expenses provides a comprehensive picture of the
efforts that have been undertaken by the different sectors and institutions of the economy to protect the environment.

The environmental activities on which expenditure is incurred may include the following:
1. Protection of ambient air and climate (prevention of air pollution, treatment of exhaust gases, etc).
2. Protection of ambient water, excluding ground water (prevention of water pollution, industrial pre-treatment plants, sewage, treatment of cooling water etc.)
3. Prevention, collection, transport, treatment and disposal of wastes (collection, transport, treatment of waste as well as prevention of waste generation).
4. Recycling of waste and other residuals.
5. Protection of soil and ground water (decontamination of soil, cleaning of ground water etc.)
6. Noise abatement (traffic, industrial process noise, etc)
7. Protection of nature and landscape (protection of species, habitats; erosion, fire and avalanche protection etc).
8. Other environmental protection measures (education, training, administration)
9. Research and development in environmental protection.
10. Expenditure on eradication of malaria and other epidemic diseases.
12. Prevention of environmental damage caused due to smoke produced by cremating dead bodies in some countries (Electric crematoriums have been set up at some places to avoid pollution caused by smoke produced by cremating dead bodies).

12. Expenditure incurred to mitigate the ill-effects on health on account of reduction in the qualities (nutritive value) of the commodities produced by using artificial fertilisers.

If needed, an account of each such activity may be opened to find out, total expenditure incurred separately under each head.

Preparation of Asset Balances under SNA for SEEA

The asset balances for produced or non-produced economic assets with separate identification of environmental elements under SNA for SEEA will be prepared as follows:

(1) Produced Assets. They include all goods and services produced.

Preparation of asset balances
Opening Stock of produced assets
+ Gross domestic product other than produced assets for environmental protection
+ produced assets for environmental protection
- Consumption of fixed capital\(^1\) produced assets other than those for environmental protection
- Consumption of fixed capital, produced assets for environmental protection
+ other accumulation of produced economic assets
- Other changes in volume of produced assets other than degradation.

\((+/-)\) Holding gains or losses on produced assets
= Closing stock of produced assets

(ii) Non-produced Economic Assets: They include, in principle all non-produced tangible natural assets\(^2\) except air, i.e. they include both economic as well as other environmental assets which are tangible non-produced assets, and non-produced natural assets like land (land with ecosystems and soil), land underlying buildings and structures, and under cultivation (agricultural land) recreational land and other land, and associated surface water, subsoiled assets (coal, 

\(^1\) besides intermediate and final consumption, it includes depreciation of man-made capital (fixed capital) also

\(^2\) Only economic ones.
oil and natural gas reserves, fossils etc), metallic and non-metalllic mineral reserves, non-cultivated biological resources (wild biota), and water resources including water.

There is no separate identification of non-produced environmental assets under SNA for SEEA.

Preparation of asset balances

Opening stock of non-produced economic assets
+ Gross domestic product
- Depletion of non-produced economic assets
- Degradation of non-produced economic assets reflected in market value of assets
+ other accumulation of non-produced economic assets

(+/-) Other changes in volume of non-produced economic assets other than depletion, degradation and other accumulation.

(+/-) Holding gains/losses on non-produced economic assets

= Closing stock.

All types of consumption of produced assets for environmental protection (intermediate, final and depreciation), depletion of non-produced assets, degradation of non-produced assets reflected in market value of assets and other accumulation both in produced and non-produced assets have been shown to meet the requirement of SNA for SEEA; they are not included to arrive GDP or NDP under SNA.
Preparation of Integrated Environmental and Economic Affairs Accounts (Satellite Accounts)

Either with the help of details given in SNA for SEEA, or directly from SNA and information otherwise available, integrated environmental and economic accounts known as satellite accounts will be prepared as follows:

The whole process is termed as the System of Integrated Environmental and Economic Accounts (SEEA) i.e. environmental accounting.

SEEA

The objects of SEEA are: segregation and elaboration of all environmental-related laws and stocks of assets; assessment of deterioration of environment in terms of costs, age of physical resource accounting with monetary accounting, and lastly, measurement indicators of environmentally adjusted domestic income and product (EDP).

It is also stressed to follow the principles and rules established by SNA as far as possible.

Environmental Accounting

Under SEEA all assets have been divided into three categories:
1. Produced assets
2. Non-produced economic assets
3. Other non-produced environmental assets.
Besides all items required to be mentioned in SNA for SEEA, the following are further required to be disclosed separately under SEEA:

1. Depletion of other non-produced environmental assets
2. Degradation of produced assets not reflected in market value.
3. Degradation of non-produced economic assets not reflected in market value
4. Degradation of other non-produced assets, and
5. Other accumulation of produced and non-produced assets with additional separate disclosures of accumulation in other non-produced environmental assets have been shifted to a section prior to consumption of fixed capital after degradation on non-produced assets reflected in market value of assets under SNA for SEEA.

With the help of information available under SNA for SEEA, and taking points 1 to 5 into consideration, asset accounts or balances are prepared in the following manner for (i) produced, (ii) non-produced economic assets and (iii) other non-produced environmental assets.
<table>
<thead>
<tr>
<th>Classwise No.</th>
<th>Produced Assets (p.ec) Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>p.ec.1</td>
<td>Opening stock of produced assets</td>
</tr>
<tr>
<td>p.ec.2</td>
<td>+ Gross capital formation, other than produced assets for environmental protection.</td>
</tr>
<tr>
<td>p.ec.3</td>
<td>+ Gross capital formation, produced assets for environmental protection.</td>
</tr>
<tr>
<td>p.ec.4</td>
<td>+ Other accumulation of produced economic assets.</td>
</tr>
<tr>
<td>p.ec.5</td>
<td>= Gross capital accumulation</td>
</tr>
<tr>
<td>p.ec.6</td>
<td>- Consumption of fixed capital,(^1) other than produced assets for environmental protection.</td>
</tr>
<tr>
<td>p.ec.7</td>
<td>- Consumption of fixed capital,(^2) produced assets for environmental protection</td>
</tr>
<tr>
<td>p.ec.8</td>
<td>- Degradation of produced assets not reflected in market values</td>
</tr>
<tr>
<td>p.ec.9</td>
<td>- Net Capital accumulation (EDP)</td>
</tr>
</tbody>
</table>

\(^1\) Besides intermediate and final consumption

\(^2\) It also includes degradation (depreciation) of produced assets reflected in market value.
<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>p.ec.10</td>
<td>Other changes in volume of produced assets other than degradation</td>
</tr>
<tr>
<td>p.ec.11</td>
<td>(+/-) Holding gains/losses on produced assets</td>
</tr>
<tr>
<td>p.ec.12</td>
<td>= Closing stock of produced assets</td>
</tr>
<tr>
<td>np.ec</td>
<td>Non-produced Economic Assets (np.ec)</td>
</tr>
<tr>
<td>np.ec.1</td>
<td>Opening stock of non-produced economic assets</td>
</tr>
<tr>
<td>np.ec.2</td>
<td>+ Gross capital formation</td>
</tr>
<tr>
<td>np.ec.3</td>
<td>+ Other accumulation of non-produced economic assets</td>
</tr>
<tr>
<td>np.ec.4</td>
<td>= Gross capital accumulation</td>
</tr>
<tr>
<td>np.ec.5</td>
<td>- Depletion of non-produced economic asset</td>
</tr>
<tr>
<td>np.ec.6</td>
<td>- Degradation of non-produced economic assets not reflected in market value</td>
</tr>
<tr>
<td>np.ec.7</td>
<td>- Degradation of non-produced economic assets not reflected in market value</td>
</tr>
<tr>
<td>np.ec.8</td>
<td>= Net capital accumulation (EDP)</td>
</tr>
<tr>
<td>np.ec.9</td>
<td>- Other changes in volumes of non-produced economic assets, other than depletion, degradation and other accumulation</td>
</tr>
<tr>
<td>np.ec.10</td>
<td>(+/-) Holding gains/losses in non-produced assets</td>
</tr>
<tr>
<td>np.ec.11</td>
<td>= Closing stock of non-produced economic assets</td>
</tr>
</tbody>
</table>
### Other Non-produced Environmental Assets (np.env)

<table>
<thead>
<tr>
<th>Classwise No.</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>np.env.1</td>
<td>Opening stock of other non-produced env. assets</td>
</tr>
<tr>
<td>np.env.2</td>
<td>+ Gross capital formation</td>
</tr>
<tr>
<td>np.env.3</td>
<td>+ Other accumulation of other non-produced env. assets</td>
</tr>
<tr>
<td>np.env.4</td>
<td>= Gross capital accumulation</td>
</tr>
<tr>
<td>np.env.5</td>
<td>- Depletion of other non-produced env. assets</td>
</tr>
<tr>
<td>np.env.6</td>
<td>- Degradation of other non-produced env. assets</td>
</tr>
<tr>
<td>np.env.7</td>
<td>= Net capital accumulation (EDP)</td>
</tr>
<tr>
<td>np.env.8</td>
<td>- Other changes in volume of other non-produced env. assets, other than depletion degradation and other accumulation</td>
</tr>
<tr>
<td>np.env.9</td>
<td>= Closing stock of other non-produced env. assets.</td>
</tr>
</tbody>
</table>

Air is a non-produced environmental asset but nowadays with the use of air for wind mills it has also become a non-produced economic asset. As such, it is noth a non-produced economic asset as well as a non-produced environmental asset. Similar is the case with the rivers and lakes.
Amplification of the Terms
Used in SNA for SEEA and SEEA

The serialNos. given here correspond with the classwise numbers given in SEEA for produced assets, non-produced economic assets and other non-produced environmental assets.

(i) Produced assets: These include, buildings, roads, machinery, stok of commodities, natural assets such as live stock for breeding, orchards, plantations, timber tracts, agricultural crops standing on land or stored after harvesting, works of art, historical monuments, assets required for environmental protection such as treatment plants for gases, wastes, refuse, sewerage, cooling towers, fencing to protect wildlife and natural landscape, electric crematorium and so on.

p.ec.1 is the opening stock of produced assets. It includes the opening stock of the above-mentioned produced assets.

p.ec.2 - stands for gross domestic product (GDP) other than produced assets for environmental protection. It includes additions of all assets mentioned above, not related to environmental protection.
p.ec.3 - GDP of produced assets for environmental protection (a discriminatory decision). It includes addition of all assets mentioned above relating to environmental protection.

p.ec.4 - stands for other accumulation of produced assets. These include additions to the work of art, historical monuments and the like.

p.ec.5 - Gross capital accumulation. It is new term introduced in SEEA. It is a gross capital formation under integrated environmental and economic accounts (SEEA). The total of the preceding four items is called gross capital accumulation.

p.ec.6 - Consumption of fixed capital other than produced assets for environmental protection. It includes degradation (depreciation) of fixed assets other than produced assets for environmental protection reflected in terms of market value.

p.ec.7 - Consumption of fixed capital of produced assets for environmental protection. It includes degradation (depreciation) and depletion (intermediate and final consumption) of produced assets for environmental protection reflected in terms of market value.
p.ec.8 - Degradation of produced assets not reflected in market value. It includes degradation and depletion of produced assets used by households.

p.ec.9 - Net capital accumulation. Deduct the total of 6, 7 and 8 from gross capital accumulation. The result will be termed as net capital accumulation. It is a net capital formation under SEEA and termed as EDP from produced assets.

p.ec.10 - Other changes in volume of produced assets other than degradation. These include assets which are affected by non-economic decisions like seizure of assets by the government (political decisions) and disasters (natural/man-made).

p.ec.11 - Holding gains/losses on produced assets. They occur on account of revaluation of existing produced assets or price changes.

p.ec.12 - Closing stock of produced assets.

Note: Depreciation and final consumption are two different consumptions of produced economic assets. Deducting depreciation from GDP, gives NDP, Deduction of final consumption from NDP, gives NCF called as investment (I).

(ii) Non-produced Economic Assets: They include assets over which ownership rights are enforced and which provide economic benefits to their owners, for example, land
land underlying buildings and structures, land under cultivation, recreational land, associated surface water, subsoil assets (coal, oil and natural gas reserves, fossils, etc) metallic and non-metallic mineral reserves, improvements of land, cost of transferring land and other non-produced assets between owners, reforestation, forests, oceans, rivers and lakes used for economic purposes, and so on.

np.ec.1 - Opening stock of non-produced economic assets. It includes opening stock of non-produced economic assets mentioned above.

np.ec.2 - Gross capital formation. It includes additions of non-produced assets that are used/made available for production activities eg. improvements of land, cost of transferring land and other non-produced economic assets between owners, additions to proven mineral reserves, reforestation, and so on. It also includes hardwood from rain forests (heavy wood such as oak, teak), natural growth of non-cultivated natural resources (natural biotal) land cleared to grow rain forests.

np.ec.3 - Other accumulation of non-produced economic assets. These include new finds of subsoil resource transfer of land and natural assets for economic use, eg. virgin forest used for lumbering, land cleared for agriculture and human settlements, and so on.
np.ec.4 - Gross capital accumulation is the sum of all preceding items. It is a gross capital formation under SEEA.

np.ec.5 - Depletion\(^1\) of non-produced economic assets. It includes depletion of all natural resources, minerals, forests, etc.

np.ec.6 - Degradation of non-produced economic assets reflected in market value of assets. It includes quality changes due to degradation of land, and in non-produced natural assets due to economic use, or discharge of residuals and oil spills, contaminating urban and agricultural land, and so on.

np.ec.7 - Degradation of non-produced economic assets not reflected in market values. It includes pollution of air, water and land.

np.ec.8 - Net capital accumulation. From gross capital accumulation, deduct the total of 5, 6 and 7 to arrive at net capital formation under SEEA which is termed as EDP from non-produced economic assets.

np.ec.9 - Other changes in volume of non-produced economic assets other than depletion, degradation and other accumulation. These include changes brought out by non-

\(^1\) Depletion and degradation of non-produced assets is also termed as consumption of non-produced economic assets.
economic decisions such as seizure by the government and disasters, both natural and manmade.

np.ec.10 - Holding gains/losses on non-produced economic assets occur due to re-evaluation or price changes.

np.ec.11 - Closing stock of non-produced economic assets.

(iii) Other Non-produced Environmental Assets (np.env). They include air, ocean, rivers, lakes, wild species, wild biota, forests, land in wilderness, infertile soil, mountains, and so on, which are not used for economic purposes.

np.env.1 - Opening stock of other non-produced env. assets.

np.env.2 - Gross capital formation. It includes additions to wild species, increase it virign lands, natural growth of non-cultivated products (mushrooms), biological resources (growth of natural biota), reforestation in virgin lands which had been depleted or degraded. It also includes trees, birds (vultures) and snakes which eat insects: owls, hawks, cats, etc.

np.env.3 - Other accumulation of other non-produced env. assets which include additions to wildlife, wild forests, canals, rivers, lakes, air (rivers and air are to be included if they have not been included in non-
produced economic assets). Forests converted into recreation places also fall under this category.

np.env.4 - Gross capital accumulation, the total of the above three is termed at gross capital accumulation. It is gross capital formation under SEEA.

np.env.5 - Depletion of other non-produced env. assets including depletion of wild species, forests, land in wilderness, lakes and rivers. Consumption of other non-producer environmental assets also fall under this category.

np.env.6 - Degradation of other non-produced env. assets. It includes contamination of wildlife, rivers, lakes, forest, soil erosion and pollution of air, and so on.

np.env.7 - Net capital accumulation. Deduct the total of 5 and 6 from gross capital accumulation. The resultant will be termed as net capital accumulation. It is net capital formation under SEEA and termed as EDP from other non-produced environmental assets.

np.env.8 - Other changes in volume of other non-produced env. assets other than depletion, degradation and other accumulation. It includes seizure of assets by the government and other bodies, disasters (natural/man-made), earthquakes, eruption of volcanoes.
np.env.9 - Closing stock of other non-produced env. assets.

Note: The effect on environment due to the activities of the neighbouring countries, and vice versa, should also be taken into account while calculating degradation of all types of assets—produced, non-produced economic assets and other non-produced environmental assets according to the cost caused or cost borne by residents of the countries affected or rest of the world.

In an account form, they can be put as follows:

**Produced Assets**

**Items**

(A) Opening Stock of produced assets

Add:

i. gross capital formation of all other produced assets except produced assets for environmental protection

ii. Gross capital formation for produced assets for environmental protection

(iii) Other accumulation of produced economic assets

Gross Capital accumulation

Less:

(i) Consumption of fixed capital of other produced assets for environmental protection
(ii) Consumption of fixed capital of produced assets for environmental protection

(iii) Degradation of produced assets not reflected in market value of assets

(B) Net Capital accumulation from produced assets (GDP)

(i) Less other changes in volume of produced assets other than degradation

(ii) Add/less holding gains/losses on produced assets

(C) Closing stock of produced assets

Non-Produced Economic Assets

(A) Opening stock of non-produced economic assets

ADD:

(i) Gross Capital formation of all other non-produced economic assets

(ii) All other increases in non-produced economic assets

Gross capital accumulation

LESS:

(i) Depletion (consumption) of non-produced economic assets

(ii) Degradation of non-produced economic assets reflected in market value of assets

(iii) Degradation of non-produced economic assets not reflected in market value of assets
(B) Net Capital Accumulation from non-produced economic assets (EDP)  

(i) Less other changes in volume of non-produced economic assets other than depletion, degradation and other accumulation  

(ii) Add/Less holding gains or losses on non-produced economic assets  

(C) Closing stock of non-produced economic assets  

Other Non-produced Environmental Assets  

(A) Opening stock of other non-produced env. assets  

ADD:  

(i) Gross capital formation in all other non-produced env. assets  

(ii) Other accumulation of other non-produced env. assets  

(iii) Gross capital accumulation  

LESS:  

(i) Depletion of other non-produced env. assets  

(ii) Degradation of other non-produced env. assets  

(B) Net Capital Accumulation from other non-produced env. assets (EDP)  

(i) Less other changes in volume of other non-produced assets other than depletion, degradation and other accumulation  

(C) Closing stock of other non-produced environmental assets
VALUATION OF NATURAL ASSETS

Different methods are being applied for the valuation of different types of natural resources and environment depending on the type of information available. The method applied should be mentioned either in footnotes or as parenthesis.

The usual methods being used are:

1. Market Value Approach,
2. Present Value Approach,
3. Net Price Approach
4. Maintenance Cost Approach, and
5. Compensation Cost Approach

Market Value Approach

The market value approach covers those--natural assets which have an economic value in the SNA sense and whose charges have been included in SNA, such as land (cultivated or non-cultivated, recreational), non-produced economic assets whose degradation caused by pollution, discharge of residuals, contamination, and water resources or wild biota, wild animals and uncultivated plants if priced, etc. These are valued at market price or market price of their substitutes or of similar assets. The natural assets which are not connected with actual or
potential market transactions such as air, land, water and wild species are not included.

Market value of the assets has to be estimated at the beginning and the end of the year. If it is not available the market value of the similar assets or its substitutes has to be estimated. The difference, i.e. the change in the value of the natural assets, is regarded as the depletion or degradation of the natural assets. This can only be determined exactly in cases which are based on the market price changes.

Flow of services of marketed, but not produced fixed assets can be valued on the basis of rents/lease of those assets or similar assets.

**Present Value Approach**

The present value of natural resources is the sum of the expected net revenue flows, discounted at nominal or real interest rates for the life of the assets. The net revenue flow is the total unit value of the resource less the cost of extraction development and exploration.

To calculate, it needs the following steps:

a. Find out the total unit value of the resource less the cost of extraction development and exploration;

b. Assess the total quantity which can be extracted every year.
c. Find out the total value of the resource in monetary term to be expected every year (by multiplying (a) and (b:) above).
d. Estimate the period for which the resource will last;
e. The expected annual net flow (calculated under (c) above) should be discounted at nominal or real interest rate over the estimated life period of the resource;
f. It will give the present value of annual flows for the number of years;
g. The total sum is the value of the resource.

Sometimes, the right of extraction is marketed in the form of rent/lease. The yearly value of the right in the form of rent or lease is taken as the value of the annual flow. The value at the end will also be determined likewise. In fact, the value at the end is equal to the value calculated like-wise at the beginning of the next year (value at the end of a year is equal to the value at the beginning of the following year).

The difference between the value at the beginning and the end of the year will be the depletion of the natural resource.

However, it is difficult to estimate future returns and cost of natural resource exploitation by
economic sector such as agriculture, forestry, mining, construction, etc. Those estimates would require information on the availability of future stocks (reserves) prices and interest rates that are usually, if at all, available only at the microeconomic rather than at sectoral level.

Net Price Approach

The net price method, which is the most simplified method, overcomes the drawbacks of the present value method. It requires two steps:

(i) Preparation of assets accounts and
(ii) Determination and application of net price.

Preparation of Assets Accounts Assets accounts showing the following should be prepared:

1. Opening stock
2. Depletion
3. Degradation of land
4. Discharge and treatment of residuals
5. Other volume changes (discoveries) and
6. Closing stock

It is done to represent and made available and important data base, either for the direct management of particular natural assets or as data input into physical model of environment-economy interaction (i.e. input-output analysis)
Determination and Application of Net Price: Determination of the net price of the resource consists of the following steps:

1. Determine the market price of one unit of different categories of resources.
2. Find out the total factor (production) cost including cost of capital at normal rate of return, of producing one unit of those resource items.
3. Calculate the net price as the difference between 1 and 2 above. It will give the value of one unit of the resource used.
4. Value items 1, 2 and 5 of the asset account (step 1 above) by multiplying them with the net price of (ii)(3). The valuation of items 3 and 4 is usually carried out by direct observation of (changes in) market values; ignoring the quality changes in natural resources.
5. Determine the value of the closing stocks by applying the net price at the end of the accounting period to the remaining resource stock (item 6).
6. Estimation of revaluation items (nominal holding gains/losses) as the remaining difference between (i) Opening stock minus depletion plus volume changes (new discoveries and (ii) closing stock (neglecting measurement and other errors) in monetary terms.
The Royalty paid is very negligible and is not equal to the value of the resource extracted. Royalty is paid to the owner because of his right on the natural resource as owner.

It is used for all types of natural assets, especially, minerals, gases, etc., which are exhaustible. It is also used for land (cultivated or non-cultivated), other arable-soils assets, wild life and water, if it can be exploited economically.

**Maintenance Cost Approach**

In order to obtain a more comprehensive picture of the changes in the environment, a maintenance cost valuation is introduced in the SEEA as an alternative to market valuation.

The term Maintenance Cost for environmental assets is used in the same sense as is used, in colloquial language for human-made other type of capital assets.

In colloquial language maintenance cost means the cost incurred to maintain the asset in a proper and sound condition through repairs to bring it nearly at the same level with its new shape, eg. maintenance cost of a scooter or car. Similarly, in case of an environmental asset, the cost incurred to bring it in its original form (to a large
extent) is called Maintenance cost. In actual practice, this is all hypothetical because it is not certain whether actual expenditure would be incurred to maintain it; it would only be an estimation.

As such, the cost so estimated or incurred to keep the environmental assets intact during the accounting period will be the degradation and depletion of that environmental resource. If no cost is incurred, there is no depletion. For example, water in the wells; to refill it, one has not to incur any cost; it is filled naturally.

The other method to estimate the maintenance cost is to find out the replacement cost of that asset. It is also hypothetical in nature because in a few cases, replacement is not at all possible and secondly, in other cases, it is not certain whether any actual expenditure would be incurred to replace it; it will be an estimation only. As such, the future cost for replacing an impaired environmental resource by an equivalent asset, assuming that the replacement expenses incurred would bring the impaired environmental asset to its original form, would be known as replacement cost of that resource. This replacement costs/expenses should be considered as the value of deterioration or depletion in the environmental resource.
The maintenance cost concept implies that if the use of the environmental resource has no impact on the nature, or no cost is incurred to replace it, there would be no degradation and depletion of that resource i.e. there would be no maintenance cost. If, for example, water is used, which is replaced in sufficient quantities by the nature, water extraction has no maintenance cost. This holds good for fishing and logging if natural growth offsets (balance) their use, extraction or cutting. The disposal of residuals in natural area has no maintenance cost if the nature can safely absorb those residuals. But in case of a river whose water is poured into canal, thereby water in the river decreases, there is a degradation and depletion of the river. It may be equivalent to the cost of pouring the water in the river plus the cost of the water to fill the river.

This method is applicable for non-produced natural assets used for consumption/production like exhaustible resources—minerals, water, coal, gas etc. and soil, forests, logging natural plants and trees.

If fertility of the land is maintained by the use of fertilisers and other means and/or increased by their use, there is no degradation of the soil.
Compensation Cost Approach

This method is applied for valuing effects resulting from environmental deterioration like logging and forest clearing for cultivation or habitation, colonization or urbanisation, etc. The impact is estimated for which the compensation is to be paid to the owners.

VALUATION OF WELFARE LOSSES FROM ENVIRONMENTAL DETERIORATION

There are three ways to value welfare losses from environmental deterioration.
1. Avoidance cost
2. Restoration cost and
3. Compensation cost

Avoidance Cost. It covers valuation of impact on human welfare caused by environmental deterioration. The value of loss or damage done to environment is calculated on the basis of the preventive measures which are to be taken to avoid the menace and how much it will cost. This avoidance cost may be considered as the cost of degradation done to the environment. Two types of costs are estimated to check this environment deterioration:
(i) If the activity which is responsible for this menace is closed and
(ii) If defensive measures to mitigate/lessen the effects are taken.
This decision is made after considering the costs and the pros and cons of each of the alternatives. The example of PNG is worth citing in this respect.

The discharge of the tailings of the mining sector was destroying the downstream aquatic life. Two types of avoidance costs were estimated for the environment impact. The conservatists option of closing the mines provided an upper-limit value of value added foregone to 432 million kina (K) per annum (1986-90). Another approach suggested was to construct tailing dams and/or detoxifying wastes and hauling wastes to safer dumping grounds. The cost of it was estimated between 35.7 million K and 101.2 million K per annum, if an earthquake solution is applied. Being considered the more realistic approach, the second approach was accepted and adopted. It is of the least-cost and the most efficient strategic one. It needs a considerable value judgement about environmental risks.

Cost of pollution control equipment to check or lessen the pollution is taken as the value of loss/damage to the environment by pollution.

**Restoration Cost.** The restoration cost may be considered as the cost of degradation done to the environment on account of this activity with which it can be
restored. Expenditure to remedy losses from flooding, earthquakes, volcano eruption and river bed migration due to soil erosion and ensuing sedimentation were based on the cost calculated to restore them in the same position. It was also applied for valuation of environmental impact in PNG.

**Compensation Cost.** It is the same as discussed under compensation cost approach in previous pages. It will be clear from PNG's example.

Customary land ownership, in combination with traditional compensation requests for Wrongful deeds have created a unique negotiation process in the field of natural resource exploitation in PNG. Almost all land and water, and related natural resources are owned by tribal groups or clans.

These local communities are dependent for their livelihood on the direct remuneration of their services or receipts of royalties. It is they who are to suffer the most by the loss and exploitation of environmental resources.

Compensation for losses of social, cultural and ecological values has been established through negotiation of landowners and the government with logging companies. (In principle, such compensation would be reflected in the cost accounts of these companies and consequently in conventional
valuing environmental effects resulting from logging and forest clearing for shifting cultivation.

The depletion and degradation of land, water or its quality, forests and wildlife are normally measured by this method.

**VALUATION TECHNIQUES**

Some writers like Mohan Munasinghe, Andrew Steer and Earnst Lutz have suggested the valuation techniques for some of the environmental changes, depletion and degradation.

**General**

In their opinion indirect estimates will be required for most of the changes. One has to estimate the impact on health, productivity, global warming, ozone layer, etc. and defensive or protective costs to save them, and a monetary value placed on such costs. The impact should be calculated by estimating the amount required to restore them in the same position or its equivalent and to ameliorate the damage or loss caused by that impact on health. For example, different pollutants would be multiplied by both their health impact and the affected population, areas affected by national accounts also). Those amounts (compensation) were, therefore, applied in valuing environmental effects resulting from logging and forest clearing for shifting cultivation.
different types of soil damage would be multiplied by estimated impact on such factors as future yields. The resultant would be considered as depletion or degradation of natural resource and environment.

In some cases, they are valued on the basis of what will be their value in future (wild/natural species which may be used in future for medical purposes, wilderland which may be used for habitation in future).

**Specific**

**Recreational Places:** The degradation of recreational places is equal to the cost which the visitors are willing to pay as surplus over the normal price to visit a recreational site.

**Environmental Assets not Marketed:** The value of the substitute goods may be taken as the depletion of the environmental assets which is not marketed.

**Mitigatable Damages:** Ex-post costs incurred for mitigating the impact caused by damage done to the environment, eg. pollution provide a minimum estimate of degradation of that environment. They are called defensive of protective costs.

**Restorable Impaired Environmental Resource:** Any environmental resource which has been impaired but can be restored by replacing it by another equivalent asset, should
be valued equal to the value of the replacement cost. This replacement cost should be taken as the depletion of that environmental resource.

**Rare Species, Rare Plants etc:** The value of rare species, rare plants etc. is determined by bargain and negotiation which can be fetched. Because, the holding of them gives such satisfaction (pride) to the holder. Additions and depletion of such assets are equally valued at the bargain/negotiation amount.

**Scarce Resources:** The price of scarce resources such as water is equal to the cost of providing marginal (Additional) unit of output. This cost is taken as the depletion cost. But the maintenance cost of water is nil if water is available in sufficient quantity.

**Watershed/Sun Protection of Wood Land:** They should be valued at maintenance cost and their depletion is equivalent to that cost.

**Environmental Condition Worsen by Economic Growth:** If environmental conditions have deteriorated on account of economic growth, affecting the health or income, the estimated cost of improving the health condition or income source should be taken as the cost of depletion or deterioration of the environment.
Depreciation of Fishery Assets: The annual change in the capitalised value of fishery assets based on sustainable rents should be taken as the depreciation of fishery assets.

Benefits or harms on Others: Being difficult to measure in physical and monetary terms, they should be assessed on the basis of Shadow Prices¹ (cost of new reafforestation scheme to replace forests inundated by hydro dam may be taken as the depletion of non-produced assets) or at economic opportunity cost. The economic opportunity cost of the development may be assessed and the same may be considered as depletion.

Open Access Resources: The use of open access resources such as lakes, public highways is difficult to value and tend to be over exploited since charges for their use are negligible. Their value can be assessed on the basis of shadow prices or economic opportunity cost, and a charge is imposed as cost of depletion.

¹ Shadow prices: They are closely related to replacement cost, involving cost of special project designed to offset environmental damage caused by another project (e.g. cost of new reafforestation scheme to replace forest area inundated by hydro-dam). Estimated amount of replacement cost would be considered the value of harm done to the environment.
Oilspills and Unsound Production and Waste Disposal: In case of degradation used by oil spills that contaminate urban and agricultural land and property, or environmentally unsound production (cultivation) and waste disposal resulting in land degradation (erosion and contamination), the environmentally measured value duly adjusted in degradation may be taken as the value of that asset, and the difference in value before deterioration and after deterioration may be taken as cost degradation.

Problem of aggregation

Another problem which may be faced is the absence of numeraire (common unit of account), aggregating the effects. For example, in view of many types of soil degradation, erosion salinisation or nutrients, and logging, the state of a nation's land resource in any aggregate sense can hardly be obtained.

Aggregation, of course, requires a numeraire. In this regard, important work is underway by U.N. Development Programme to derive relationships between various forms of environmental damage and health, economic productivity and human amenity which could provide a numeraire.

Increased efforts have been made in the past few years to help overcome this problem. Global Environmental
monitoring system managed by the U.N. Environmental Programme collected data on air and water pollution in some 150 countries. Either they can be used or based on them, data may be estimated to the acceptable levels, and it should be treated as depletion. It needs basic data collection, research on the relationship between such data and human welfare, and economic development.

**Important Hints**

1. Application of these methods overlap each other while valuing the natural assets, and changes therein.

2. Depletion of Natural assets is the difference between the value of the stock, as calculated by any method, at the beginning and the end of the period.

3. Valuing sub-soil depletion is the cost of substituting the sub-soiled assets by the other natural or man-made assets.

**APPLICATION OF METHODS**

<table>
<thead>
<tr>
<th>Methods</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Market Value Approach</td>
<td>Natural assets and non-produced economic assets which have a market value. If no market value then market value of similar asset or substitutes-natural or man made.</td>
</tr>
<tr>
<td>2. Present Value approach</td>
<td>Natural assets whose annual flow can be estimated or determined.</td>
</tr>
</tbody>
</table>
3. Net Price Approach For all types of assets like land minerals, gases, coal, all exhaustible resources, and wild biota and water, if those can be exploited economically.

4. Maintenance Cost Approach Where replacements are thought of or possible, such as non-produced natural assets used for consumption of production like exhaustible resources -- minerals, water forests, natural plants and trees etc. If no maintenance is required to restore the depletion or degradation of natural assets the depletion and degradation should be valued at zero.

5. Compensation Cost Approach Community as a whole is affected. Impact of environmental deterioration resulting from logging, forests clearing for cultivation, habitation (Colonisation or urbanisation) etc. and/or natural assets are acquired.

6. a. Avoidance cost In case of alternatives, where deterioration of environment is to be avoided.

       b. Defensive/Protective cost Where environmental damage is required to be mitigated or lessend.

7. Restoration cost Community as a whole is affected by the deterioration of the environment due to the dam-construction colonisation, urbanisation, losses from flood, migration due to soil erosion and ensuing sedimentation volcanic eruption, earthquakes, epidemic like plague, malaria or the like.

(5,6, & 7 are applied where human welfare is considered)
Direct

1. **Effect on Production**: Impacts valued by the effect on the quantity, quality or production cost of marketed outputs.

2. **Effect on Health**: Impacts valued as output lost due to sickness or death including earnings foregone and cost of health care or prevention incurred.

3. **Replacement cost**: Future cost of replacing an impaired environmental resource by an equivalent asset assuming that the value of the impairment done to the original resources was at least equal to the replacement costs. This cost will be taken as the value of deterioration of the environment.

4. **Shadow Prices**: They closely resemble the replacement cost, involving cost of special project designed to offset environmental damage caused by another project, for instance, cost of new reafforestation schemes to replace forest area inundated by a hydro-dam. The estimated amount of replacement would be considered as the value of the harm done to the environment.

5. **Defensive or Protective cost**: The ex-post cost of mitigating or lessening the impact (pollution) caused by environmental damage.
**Indirect**

If direct market valuation is impossible, indirect market data may be used to determine implicit values. Under it, the following are to be considered.

1. **Travel Cost**: Willingness of tourists to pay a surplus over the normal price to visit a recreational site. The income from tourism is mainly related to variables like visitor income and price including entry fees, travel costs and opportunity value of time.

2. **Wage Differences**: Wage premium needed to compensate for working in polluted or hazardous environment, after first accounting for other wage determinants like age and skill level.

3. **Property Value**: Willingness of property buyers to pay extra for real estate in cleaner neighbourhoods.

4. **Valued Proxy Goods**: Market value of a substitute for and environmental asset that itself is not marketed.

5. **Contingent Valuation**: Willingness to pay for an environmental assets or willingness to accept compensation for its loss determined by direct questions. The method will be most effective, if respondents are familiar with the quality of assets, eg. Ganges Water.
UTILITY AND NON UTILITY OF ENVIRONMENTAL ACCOUNTING

This has been divided into two parts with the intention of discussing the utility of environmental accounting in a lucid and crystal-clear way.

1. A study of Papua New Guinea (PNG) and Mexico where the system has been practically applied and
2. Merits and demerits of environmental accounting, under which, utility, uses and demerits have been discussed.

A Study of Papua New Guinea and Mexico

A study of Papua New Guinea and Mexico shows how the data can be compiled and presented under environmental accounting for making comparison with the conventional accounts.

In case of Papua New Guinea two tables are given:

1. Table 1, account for sub-soil assets and
2. Table 2, comparison of conventional and environmental accounting indicators.

Both the tables are separate and are not lined. In case of Mexico, two tables are given:

---

1 The study made in PNG and Mexico has been given prior to discussion on the merits and demerits of environmental accounting

2 Only relevant data have been given.
1. Table 1, Calculation of EDP1 and EDP2 and
2. Table 2, comparison of conventional and environmental accounting indicators.

The findings of table 1 has been incorporated in Table 2 showing how they can be incorporated for comparison purposes. As such, both the tables are linked.

As part of the preparation for the SNA review, the World Bank has collaborated with the UNSO and countries authority in (A) Papua New Guinea and (B) Mexico, to see the efficacy of the new methodology and handbook, and its advantages. The result provided not only the viability or the approach but also the sensitivity of the finding to the assumptions made and the solutions to the difficulties.

PAPUA NEW GUINEA

Papua New Guinea is a less developed country with limited statistics. Regarding its natural resources, the study of the Table 1 (given below) illustrates some of the initial difficulties and the possible solutions that might be adopted to encounter them in a less developed country.


<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening stock</td>
<td>1750.0</td>
<td>2648.7</td>
<td>3683.7</td>
<td>1584.4</td>
<td>-154.7</td>
</tr>
<tr>
<td>Depletion other volume</td>
<td>-126.8</td>
<td>-209.7</td>
<td>-106.3</td>
<td>-25.2</td>
<td>-180.7</td>
</tr>
<tr>
<td>Changes (New Discoveries)</td>
<td>9.0</td>
<td>122.8</td>
<td>175.6</td>
<td>-383.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Revaluation</td>
<td>1016.5</td>
<td>1121.9</td>
<td>-168.6</td>
<td>-1330.6</td>
<td>n.a.</td>
</tr>
<tr>
<td>Closing stock</td>
<td>2648.7</td>
<td>3683.7</td>
<td>1584.4</td>
<td>-154.7</td>
<td>n.a.</td>
</tr>
</tbody>
</table>


**Difficulties**

Table 1 presents an example of balances at the end of the year for sub-soil assets, i.e. for copper, gold and silver mines in the country for the year 1986, 1987 and 1988. Discoveries included under other volume changes are shown as additions to and increase in the value of mineral stocks.

Data included comprise reserves (t, kg), production (t, kg), unit values (kina) and estimated lifetimes of the reserves per mine and mineral. However, the net price of each mineral could not be calculated in the
absence of cost data per unit of mineral extracted. Hence, the net value of total annual mine production (including an estimate for a normal return to capital) had to be used as the amount of depletion.

Even those valued, detailed cost-structure information of the mines, were difficult to obtain. Hence, in some cases, figures have to be extrapolated for years for them.

In the next step, opening stocks in monetary terms were calculated by multiplying net revenue with lifetime estimates of the mines. Those estimates were based on assumptions about production patterns and further earnings by the mining companies themselves.

The Bougainville mine stopped working in 1989 and led to negative adjustment in the mineral extracted or extractable. In 1988 and 1989, a slump in mineral prices also resulted in negative net prices under the head revaluations. With the result, the net price in 1989 showed the pessimistic expectations about the profitability of the mine(s). The negative value of the closing stock disclosed in 1989 (-154.7) was not liked by the technical specialists working in that country. They stated that the negative value can not be considered an accurate representation of the
value of mineral reserves, because of the difficulties in producing correct quantitative estimate of the expected (future) returns from mines operating under volatile political conditions.

The downfall in mining sector to -154.7 also called for changing the technological and sectorial structure of the economy to shift to resource saving and low-waste production and consumption.

Table 2 making comparison of conventional and environmental accounting indication discloses the alarming results about the capital accumulation and productivity in the country.
## Table 2

### Comparison of Conventional and Environmental Accounting Indicators (1990)

<table>
<thead>
<tr>
<th></th>
<th>Conventional Accounts</th>
<th>Integrated (Green) Accounts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EDP1a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(after depletion of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>natural resources)</td>
</tr>
<tr>
<td>NDP</td>
<td>2760 Million K</td>
<td>2580 million K</td>
</tr>
<tr>
<td>EDP/NDP</td>
<td>--</td>
<td>92.99%</td>
</tr>
<tr>
<td>C</td>
<td>2754</td>
<td>2754</td>
</tr>
<tr>
<td>C/NDP</td>
<td>99.8%</td>
<td>106%</td>
</tr>
<tr>
<td>*CAP(net)</td>
<td>463 Million K</td>
<td>282 Million K</td>
</tr>
<tr>
<td>*CAP/NDP</td>
<td>17%</td>
<td>11%</td>
</tr>
</tbody>
</table>

(Capital formation of NDP, i.e. capital efficiency)

Note:  
a-Net price valuation of mineral resources depletion  
b-Potential damage restoration on avoidance cost valuation in the case of waste water discharge (from mining); compensation cost for environmental impacts of forest clearing and dam construction.

Results are preliminary/tentative. Human capital is excluded.

NDP - Net Domestic Product
EDP - Environmentally Adjusted Net Domestic Product
C - Final Consumption
*CAP - Capital Formation/Accumulation

Source: Bartelmus, Lutz and Schweinfest, 1992
Table 2 shows that the depletion of natural resources (as reflected in an EDP 1 calculation) lowered net capital formation, to nearly 60 per cent of value added, i.e. net capital formation disclosed under conventional accounts to find out NDP. If all environmental costs (reflected in EDP 2 calculation) are taken into account, the capital accumulation reduced to less than half.

Considerable fluctuations among the different economic sectors indicate a quite different picture of capital efficiency if natural capital is used and accounted for in different production processes.

In terms of percentage of NDP, the capital formation (*CAP/NDP) reduced from 17 per cent in case of EDP 1 to 11 per cent and in case of EDP 2 to 9 per cent.

MEXICO

Two tables are given about Mexico.
1. Table 3: Calculation for EDP 1 and EDP 2
2. Table 4: Comparison of conventional and environmental accounting indicators.
TABLE 3
CALCULATIONS FOR EDP 1 AND EDP 2
(Figures for 1993)

<table>
<thead>
<tr>
<th>In million pesos</th>
<th>Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net domestic product minus resources depletion</td>
<td>42060</td>
</tr>
<tr>
<td>Oil</td>
<td>1470</td>
</tr>
<tr>
<td>Timber</td>
<td>164</td>
</tr>
<tr>
<td>Land use change</td>
<td>764</td>
</tr>
</tbody>
</table>

Equals EDP 1 minus environmental degradation | 39662 | 94.3 |

| Soil erosion | 449 | 1.1 |
| Solid wastes | 197 | 0.5 |
| Groundwater use | 191 | 0.5 |
| Water pollution | 662 | 1.6 |
| Air pollution | 1657 | 3.9 |

Equals EDP 2 | 36506* | 86.7 |

Note: * Before household protection services

Source: Towards improved Accounting for the Environment, Chapter 6, Jan, vanTongeran et al
<table>
<thead>
<tr>
<th></th>
<th>Conventional accounts</th>
<th>Integrated (Green) Accounts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>EDP1a</td>
</tr>
<tr>
<td>NDP</td>
<td>42.1 Million P</td>
<td>39.7 Million P</td>
</tr>
<tr>
<td>EDP/NDP</td>
<td>--</td>
<td>94%</td>
</tr>
<tr>
<td>C/NDP</td>
<td>83%</td>
<td>88%</td>
</tr>
<tr>
<td>Final consumption</td>
<td>34.9</td>
<td>34.9</td>
</tr>
<tr>
<td>*CAP (net)</td>
<td>4.7 million P*</td>
<td>2.4 Million P</td>
</tr>
<tr>
<td>*CAP/NDP</td>
<td>11%</td>
<td>6%</td>
</tr>
<tr>
<td>(Capital formation of NDP)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: * After final cons.34.9 and (X-M), 2.4 from NDP

NDP - Net Domestic Product
EDP - Environmentally Adjusted Net Domestic Product
C - Final Consumption
*CAP - Capital Formation/Accumulation
CAP - Capital Stock

Results are preliminary/tentative (Human Capital is excluded)

Source: Ban Tongeren et al 1991
In table 3, two sets of environmentally adjusted net domestic product calculations have been made. The first one, EDP 1, shows the deduction of estimates of resources depletion in monetary value, such as oil, timber, land use change, from NDP. The second one, EDP 2 shows the further deduction of estimates in monetary value of environmental degradation (for example soil erosion, solid wastes, ground water use, water pollution and air pollution).

The figures of Table 3 have been incorporated in Table 4 to show, how the comparison can be made between conventional and environmental accounting indicators.

Comments on Table 4: The analysis of table 4 discloses that the depletion of natural resources (as reflected in EDP 1 calculation) lowered net capital formation to nearly half of its value. If all the environmental costs (reflected in an EDP 2 calculation) are taken into account, an actual disinvestment (dis-accumulation) (-0.8) can be observed. The capital formation of NDP (*CAP/NDP) reduced from 11 per cent in case of EDP 1 to 6 per cent and in case of EDP 2, (-2 per cent).

Reductions in capital productivity are reflected in the overall capital-output ratios EDP/NDP and *CAP/NDP.
The study of both the countries reveals that the environmental accounting can provide early warning signals about the trends and limits of sustainable growth.

UTILITY AND NON UTILITY OF ENVIRONMENTAL ACCOUNTING

Utility

The utility of Environmental Accounting are as follows:

1. Disclosure of True Maximum income: The data so arrived through the environmental accounting reveals the true maximum income (true net capital formation) which a country can actually consume without depleting the stock of the natural assets. It also reveals how much has been the net contribution of each of the determinants of the capital formation.

2. Disclosure of Unsound Production and Consumption: It discloses how the environment has been distorted the environmentally unsound production and consumption patterns, and how they should be corrected. The data arrived through environmental accounting also discloses where the resources are being missed in production and consumption or need a sparing use of assets like water, and how much has been the degradation in them. Besides, it suggests steps to be taken to protect/preserve/enhance them or compensate the
damages/loss if any, incurred in them to safe-guard the interest of the present and future generations. (The Cherrapunjee in Meghalaya, India is a concrete example of this).

3. Disclosure of Environmental costs: inter-firm and intra-firm comparison reveals whether environmental costs are adequate, excessive or less in comparison to other countries and previous years. The higher/excessive environmental costs would call for changing the technological and sectoral structure of the economy, and to shift to resource saving and low-waste production and consumption patterns. In other words, if the true net capital formation (EDP 1 and EDP 2) is declining, it means, natural resources are being used excessively without keeping any regard to the future.

The loss of environmental capital, if not recorded now, may take some time before it reflects itself in income and product measurement. It is, therefore, necessary that remedial steps are taken before such a situation arises.

4. Application of the Principle of Polluter-pays and User-pays: The environmental accounting is the most useful weapons in applying the principle of polluter-pays and user-pays for the depletion and degradation of natural resources. The aim in both cases is to make those
responsible for environmental problems, to account for environmental impacts. The government by using economic instruments (financial budgets and other measures), makes them responsible to pay for the pollution and depletion by levying effluent charges, user taxes, tradeable pollution permits, deposits refund system, pollution tax on vehicles, surrounding spoiling tax on restaurants, etc. The recent liberalisation policy on the use of natural resources announced by some countries is an example of exploitation of natural assets without regard to the present and future generations. The environmental accounting will deter them to adopt such policies and leave them to change the policy or use the proceeds to development.

5. Lead to Optimal Allocation of Resources: Government can also use the data through the changes in financial budgets and by taking other measures to achieve an optimal allocation of scarce resources in the economy. The example of Papua, New Guinea reveals that the net capital formation, after taking into account the EDP 1 reduced to 60 per cent (see table 4). Further analysis showed that in the mining sector, the environmental costs accounted as high as 3/4 of the value added, i.e. 3/4 of the value was of the cost of degradation and depletion of environmental resources.
Likewise, the results of the study done by the World Resources Institute which calculates deterioration for oil, timber, and top soil for Indonesia are illustrative of how adjusted national income figures might differ from traditional ones. They found the growth rate of the adjusted NDP for the period 1971-84 was only 4 per cent compared to GDP growth of 7.1 per cent.

Such disclosures call to change the technical and sector structure of the economy to mitigate or off-set the deterioration or reduce the cost, and to shift to resource saving and low-waste production and consumption patterns to have a sustainable development.

6. Details of the Economy's Dependence on Natural Resources: From the conventional accounts, one would not be able to know whether the economy is dependent on natural resources or is genuinely growing or merely living unsustainable on asset-sales beyond its true income. It is also not possible to know whether the balance of payment is actually in surplus or deficit on current account and whether it contains export of elements of environmental capital, and whether the exchange rate needs to be changed to safeguard against it.
7. Disclosure of Internationally Deteriorating Environment: The keeping of the accounts of natural response will enable the other countries who have been using the natural resources, not only of their own country but of others also, to know, how far they are responsible for deterioration of natural resources. It will have more universal value, it will enforce them to see how they compensate for this excessive and imprudent use of natural resources.

It will also divulge how far the multinationals are responsible for increase in pollution and that too, by how much, by transferring or establishing the pollution-prone industries if other countries or exporting and dumping their wastes.

8. Disclosure of Decrease in Environmental Area: Environmental accounting will disclose deterioration of soil and vegetation area due to desertification, reduction in environment and its services by constructing buildings in the open area or increase in population pressure. It may lead to take appropriate steps like establishment of green belt adoption of Contour Farming, use of low-cost moisture conservation techniques, stopping or demolishing constructions, and so on.
9. **Comparison with Conventional Accounts:** The comparison with conventional accounts will disclose how far the findings arrived under conventional accounts are substantial, the main causes for change in net capital formation under environmental accounting. It will also give an idea about the corrective steps that should be taken, and the changes that are needed in the policies and procedures to attain a substantial path.

10. **Planning the Resources:** The Mexico study discloses that before the depletion and degradation of environmental resources were taken into account, the gross domestic investment was more than 20 per cent of the GDP. But after they were taken into account, it is nearly (-2 per cent) of GDP. It bears one out, how environmental accounting provides a precise estimation of the economic value of damages to the environment and provides early warning signals to the policy-makers about the trends and offers an insight into the long term production capacity of nation. It provides a valuable information base to improve design of policies and procedures for sound management and investment decisions for integrated development, planning, policy making and implementation for achieving a sustainable development.
11. To Meet the Conditions of Financiers like IMF, World Bank and the UNO: National Institutions and multi-lateral bodies such as the IMF, the World Bank and the UNO among others are looking for the countries seeking their assistance to meet the environmental needs. They insist to keep regard to the environment of that area and compensate equally those who are affected by the loss of environment. Environmental accounting will help them to strengthen the case by providing more details.

Non-Utility

The only drawbacks is that the result arrived at through environmental accounting would show a lower level of measured income than GDP and NDP, and a lower growth rate which the planners and the Government might not like.

But the case is not always so. In some cases, like Jaisalmer (Rajasthan, India) where through Indra Canal, accumulation (additions) may increase, in turn, GDP and NDP may go up instead of going down.

It has been said that the depleting natural capital will reduce the productive capacity of the nation. But it is not always true, if its proceeds are used to some other purpose which ultimately result in better and higher type of development of a nation.
Similarly, there is no harm, in cases where countries which are economically poor but ecologically rich, allow liberal use and exploitation of environmental resources without keeping any regard to sustainable development, provided the proceeds are largely reinvested for development and betterment of the present and future generations, subsequently and gradually improving the environment or the exploitation and extraction are kept at the minimum.

The study made in PNG and Mexico clearly reveals that the environmental accounting can provide a good understanding of the physical, biological and social impact of environmental degradation and depletion, and provide an early warning to lead a better economic decision and utilisation or resources to plan sustainable development.

IMPLEMENTATION OF ENVIRONMENTAL ACCOUNTING

In view of the facilities and the data available in the country, and the educational standard, the statistical agency which is handling the national accounts should be entrusted with the task of collecting and compiling data about environmental and natural resources.

In the beginning, establishing a framework for environmental accounting, the agency would have to fill in gaps by very rough estimates, latter, they would be replaced
with more reliable data. A national programme of environmental accounting should be of long-term (say 10 to 20 years), as the statistics required take a long time to develop. The analysis of some environmental effects may even require long time series.

Universities and the research institutes can also play key roles in this task. Once the frame-work has been established, special studies have to be taken to improve the data and contents of the frame-work. In-depth studies of particular natural resources can also be taken, as done for the forest resources in Phillipines and for crude oil and natural gas in Cambodia, measuring not only asset stock but also changes therein and their economic and non-economic causes.

Industrial causing the depletion and degradation of the environment can take a study of one specific aspect of natural deterioration by them across all industries or some specific industries.

If the statistical agencies feel incapable to develop and maintain their own database and contribute data to the main office with the intention of incorporating into the integrated environmental accounting system, a decentralised approach should be taken. As a result, special agencies should be entrusted with the task.
While implementing the environmental accounting, the other problems which may arise can be:

a. Putting the data in the accounting form,
b. Measurement and valuation of physical data and its conversion into monetary terms, and
c. The linkage of environmental data with socio-economic indicators (GDP & NDP).

These difficulties have already been discussed in the previous pages.

Further, to overcome them, a flexible approach should be adopted in the beginning and flexible framework may be made out which can be modified according to national priority, environmental conditions, statistical capability and the experience gained. But the data collection both at micro and macro level should be accurate as far as possible. Local people should also be associated.

While valuing the environmental, the help of the experts and professionals will be necessary. Once the data have been collected, a suitable accounting method can be adopted. It is only by practice, and trial and error, a good environmental accounting will come in use.

1. After taking into account the changes in natural and environmental resources and services, the GDP and NDP will
show a lower growth rate which the planners and government might not like.

2. Uncertainty about the benefits may hinder to proceed with the idea.

3. It will need a large amount of labour and money.

4. Considering its costs and uncertainty about the benefits, whether it is worthwhile to go ahead with it.

5. Gathering and reliability of the data are the other question marks in its implementation.

Since this task is to be entrusted and handled by the statistical agency which is at present collecting data for GDP and NDP, it will not be difficult. Difficulties will be of various degrees and different types for various categories of natural and environmental resources and services. Flexibility in approach at the beginning will enable to overcome many difficulties. As regards the non-reliability of the estimates in the beginning, with the passage of time, and the availability of the experts opinion and necessary modifications, they will be considered reliable too, like GDP and NDP. Cost benefit study will also be necessary in this task. Costs are always higher in the beginning, but comparing with the social and economic benefits that will accrue by this study in the long run, and
the information revealed, will result in a better and more sustainable development.

Further, publishing of the data will bring awareness among the public about the present situation and the need for protective measures. It will result in drawing the attention of the authorities.

The days are not far off, when people will start asking to account for the pollution of ozone layer and ocean. Sooner the precautions are taken to safeguard them, better it would be.

Since environmental accounting is based and like with system of national accounts, in the beginning it will have same problems and difficulties with which SNA also suffered like variation in the valuations and the results arrived thereof. But gradually a common consensus on its concepts and methods will be reached.

Heads and activities on which data to be collected:

While implementing environmental accounting, the data may be collected about the following activities under such heads:
1. Agriculture
2. Animal farming and breeding
3. Forests
4. Fishing, hunting etc.
5. Oil
6. Other mining
7. Manufacturing
8. Electric, gas and water
9. Construction
10. Hotels and restaurant
11. Trade and business
12. Transport
13. Storage
14. Communication
15. Government services
16. Households protection services
17. Depreciation (consumption of fixed assets)
18. Other accumulations like finding new mines, Renovation of temples, Development of areas (Shekhawati Festival, Jaisalmer Festival in Rajasthan, India)
19. Logging
20. Forests land transferred to economic uses
21. Urbanisation, colonisation etc.
22. Transfer losses (land transferred to construction activities resulting in loss of land for forests, trees, agriculture)
23. Soil erosion
24. Solid waste
25. Ground water use
26. Water pollution
27. Air pollution by smoke, carbon gases of vehicles
28. For air pollution used:
   Sulphur dioxide
   Hydro carbons
   Carbon monoxide
   Nitrogen oxide
29. Floods
30. Wind storms
31. Loss of cultural heritage and vice-versa
32. Hydro power
33. Water (fresh and marine, lakes and rivers)
34. Dams
35. Refineries
36. Stone, clay and glass querries and their manufacturing units.
37. Wild biota
38. Crematoriums
39. Rivers
40. Lakes
41. Disasters
42. Wilderness area
43. Non-renewal resources
44. Noise pollution by vehicles, bhajans and loud speakers, excess use of typewriters causing deafness
45. Congestion of areas, roads, etc.
46. Soil salinity
47. Beaches
48. Picnic spots
49. Recreation places
50. Pollution of surrounding by dust flown by vehicles, animals, etc. cowdung, garbage, rubbish, bad drainage system, striking smell, and so on.
51. Hoardings on the road, checks wind and create conjunctions.
52. Religious fire sacrifices (Havans)

Note: The list is not an exhaustive one. Their effects on produced economic assets, non-produced economic assets and environmental non-produced assets should be perceived, estimated and valued, then asset-wise list showing increase/decrease may be prepared.
ENVIRONMENTAL ACCOUNTING FOR DEVELOPING COUNTRIES

Most of the developing countries are members of the Commission on Sustainable Development, New York, the world commission on issues of environmental concern. The last meeting of the commission was held on May 16, 1994.¹

Unless comprehensive record of the use of natural resources and environment and their services is maintained, reliable and sustainable development can not be planned and achieved. And the results disclosed by the national accounts would be misleading as well as it would be far from truth.

The keeping of accounts and records relating to environment and its services would be useful and beneficial to the developing countries especially on the following two counts.

(i) **Deter exploitation of natural resources:** The developed countries, using the natural resources not only of their own country but of others also, in the pretext of Free Trade, are further destroying the basis of sustainable development. Keeping of accounts relating to natural resources and its services would acquaint the developed countries, had far they are responsible for the deterioration in natural resources and its services.

¹ The Economic Times, May, 13, 1994
Check the depletion of Ozone Layer: Most of the carbon gases of the developed countries are, at present, sequestered and stored by the forests of the developing countries. Forests, especially trees, assist in increasing the well being of people by sequestering (To isolate) and storing the carbon gases and sulphur dioxide (CO$_2$ and SO$_2$) of the country. The emission of CO$_2$ and SO$_2$ through industrialisation and pollution results in reduction of well being of the people because of reduction in trees and forests on account of industrialisation.

It has been found that each tonne of carbon sequestered in a tree is worth between $5 to $25. The amount of carbon stored in a hectare of forest depends upon the type of forests. The various types of forests classified are:

1. Closed primary forest (tropical forests), capable of storing up to 280 tons of carbon per hectare (tc/hs).
2. Open forests about 115 tc/hs
3. Pasture land about 60 tc/hs
4. Agriculture land about 80 tc/hs

The keeping of records and accounts relating to number of trees and their value per hectare of forests counted in terms of carbon gases and sequestered by the trees, would give the total capacity available to sequester and absorb the carbon gases in a country/region.
Example

The capacity of one hectare of closed primary forest (tropical forest) to sequester is 280 tons of carbon, whose value would be 280 \times 5 and 28 = $1400 to 1700.

Suppose, a country decides to convert its tropical forests into agricultural land. Its effects on the sequestering of carbon dioxide would be as follows:

The capacity of tropical to store the CO$_2$ will be reduced by 280 tons of carbon per hectare. By conversion into agriculture and the capacity will be increased by 80 tc/hs. Net decrease by conversion would be 200 tc/hs to store carbon.

In monetary terms, the loss in capacity would be 200 \times 5 to 200 \times 25 = $1000 to 5000 per hectare.

Similarly, when a hectare of open forest land is converted into industrial land, the loss of capacity would be 115 tc/hs, in terms of money, $575 to 2875 per hectare.

To check, emission of carbon gases and sulphur-dioxide, preservation and increase forests are very necessary. But situation is different. Instead of preserving them, they are destroyed.\footnote{The Indian Express, October 11, 1997}
Since most of the forest land exist in developing countries, the developing countries are sequestering carbon gases of the developed countries. By keeping accounts and records, they can ask the developed countries to pay for them to check deterioration. The amount would vary from place to place and region to region. The regions nearer to developed countries would be paid more.

This viewpoint of the author was upheld in Jhonsberg convention (September 2002) where Americans were ready to accept proposals to defray compensation for loss of on account of their actions but do not accept any cut in them because they can neither change their life style nor the system of development.\textsuperscript{1}

It can be calculated by finding out:

i. how much amount would be required by the developed countries to check the production of carbon gases and adoption of other means to check the emissions of carbon gases.

ii. how much amount of CO\textsubscript{2} and SO\textsubscript{2} is being emitted by the developed country which is to be absorbed by the forests of the developing countries.

\textsuperscript{1} Rajasthan Patrika, September 2, 2002
Feasibility of Systems of Other Countries

Since many resources and environmental accounting methods are still in infancy, no method can be recommended in its entirety for the developing countries. The method suggested should be in line with the country's need, policy, educational standard, availability of data, and so on. Keeping in view these conditions, the developing countries should adopt the UNSO system since it is the best and comprehensive one.

THE UNSO SYSTEM

The procedure is as given below:

(i) Asset account of each items should be prepared showing:
1. Opening Stocks
2. Depletion
3. Degradation of land
4. Discharge (and treatment) of residuals
5. Other volume changes
6. Closing stocks

(ii) The data—actual or estimated—should be collected either from the asset account (above), or, otherwise, to arrive at the integrated environmentally adjusted indicators for produced assets, non-produced assets and other non-produced environmental assets.
Produced Assets

1. Gross capital formation in produced assets other than for environmental protection.
2. Gross Capital formation of produced assets for environmental protection.
3. Additions to the work of art, historical monuments and the like.
4. Degradation (Depreciation) and depletion of produced fixed assets other than environmental protection reflected in market value.
5. Degradation (Depreciation) and depletion (intermediate and final consumption) of produced assets for environmental protection reflected in market value.
6. Degradation and depletion of produced assets used by households.
7. Seizures of assets by the government and loss of produced assets by disasters.
8. Gain or losses on produced assets on account of revaluation or price changes.

Non-produced Economic Assets

2. New finds of sub soil resources, transfer of land and natural assets for economic uses, etc.
3. Depletion of all natural resources, such as minerals, forest, etc.

4. Quality changes by degradation of land and non-produced natural assets including urban and agriculture land due to economic uses, discharge of residuals or oil spills, contamination and so on.

5. Pollution of air, water and land.

6. Seizure of non-produced economic assets by the government or their loss by disasters.

7. Gain or losses in non-produced economic assets by revaluation or price changes.

Other Non-produced Environmental Assets

1. Gross capital formation in non-produced environmental assets, eg. additions to wild species, increase in virgin land, desertification natural growth of non-cultivated product, reforestation and natural biota such as trees, birds, snakes, owls, hawks, cats

2. Addition to forests, canals, rivers, lakes and forest converted into recreation places.

3. Depletion of wild species, forests, land in wilderness, lakes and rivers and consumption of non-produced environmental assets.
4. Contamination of wild-life, rivers, lakes, forests, soil erosion, and pollution of air, and so on.
5. Seizure of non-produced environmental assets by the government or their loss by disasters like earthquakes, eruption of volcanoes, floods.

Note: Effect of activities of neighbouring countries over the produced, non-produced economic assets and non-produced environmental assets of the country, and vice-versa, should be taken into account.

Calculation of EDP
1. Find out the EDP for produced assets, non-produced economic assets and other non-produced environmental assets by preparing accounts.
2. Make comparative table showing NCF and EDP.
3. Make analysis and prepare the report.

Alternative Method
Another method which can be easily adopted, consists of two steps:
1. Collection of data and
2. Accounting

Collection of Data: Data have to be collected at the following levels:
1. Village level
2. Tehsil level
3. District level
4. State level
5. National level

Accounting

1. An inventory should be made out of the produced assets, non-produced economic assets and non-produced environmental assets at the (a) beginning of the year, and (b) end of the year.

2. The comparison of (a) and (b) (above) will show the net gain/loss or growth/deterioration in natural and environmental resources and services.

3. The following adjustments are to be made further:
   a. Deduct the expenditure by the government and the household to protect and preserve the environment.
   b. Deduct the effect of environmental changes on health and other aspects of human life measured in monetary terms.
   c. Deduct the effect on environment by the activities of the neighbouring countries, measured in monetary terms, if not, taken into account in 1(b).

Note: In case the negative environmental effects are transferred abroad, there is no need to make any adjustments since there is no deterioration of natural resources and environment of the country.
The net result will provide an estimated change in the environment as a result of economic and other activities.

a. Add/subtract this data from NDP to arrive at EDP.
b. Make comparative statement showing NCF and NDP
c. Make analysis and report inferences.

Second Alternative Method

If it is not possible to adopt any of the two methods mentioned above, to start with the following method may be adopted. The data used may be estimated by observation gathered or inferred.

Gross Domestic Product (Eco.uses, i.e. intermediate consumption)

Add Accumulations and formation not included in GDP

i. Produced assets
ii. Non-produced economic assets
iii. Other non-produced environmental assets

Gross Capital Accumulation

Less Depreciation of produced assets

Net Domestic product (NDP)

Less Depletion:

i. Produced assets (final consumption)
ii. Non-produced economic assets
iii. Other non-produced environmental assets
Less Degradation:

i. Produced assets
ii. Non produced economic assets
iii. Other non-produced environmental assets

Less Other volume changes:

i. Produced assets
ii. Non-produced economic assets
iii. Other non-produced environmental assets

Add/less holding gains/losses

i. Produced assets
ii. Non-produced economic assets
iii. Other non-produced environmental assets

Less (Exports-Imports)

EDP

NCF = NDP - Final consumption - (Exports-Imports)

Make a comparative table showing NCF and EDP; and make analysis, and report inferences.

If the EDP is decreasing every year, it means that there is a great diminution/loss/depletion in the environmental and natural resources, and may ultimately effect the future development of the country. The comparison of NCF with EDP will indicate how far the data disclosed by NCF indicates the real capital formation and is reliable for sustained development of the country.
Example

The accountant of the country has collected the following data for three years:

<table>
<thead>
<tr>
<th>Category</th>
<th>1992</th>
<th>1993</th>
<th>1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDP as per national a/cs</td>
<td>30000</td>
<td>30000</td>
<td>30000</td>
</tr>
<tr>
<td>Final consumption</td>
<td>10000</td>
<td>10000</td>
<td>10000</td>
</tr>
<tr>
<td>Exports-imports</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>An inventory of produced assets, non-produced economic assets and non-produced environmental assets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. at the beginning of the year</td>
<td>20000</td>
<td>50000</td>
<td>80000</td>
</tr>
<tr>
<td>b. at the end of the year</td>
<td>50000</td>
<td>80000</td>
<td>110000</td>
</tr>
<tr>
<td>Expenditure by the Government and the household to protect and preserve the environment which are treated as final consumption in SNA</td>
<td>2000</td>
<td>3000</td>
<td>4000</td>
</tr>
<tr>
<td>Effect of environmental changes on health and other aspects of human life and other habitants measured in monetary terms</td>
<td>5000</td>
<td>6000</td>
<td>7000</td>
</tr>
<tr>
<td>Environmental damages on account of capital goods that are discarded, accounted in closing inventory</td>
<td>4000</td>
<td>5000</td>
<td>6000</td>
</tr>
<tr>
<td>Effect on environment of the neighbouring country by the activities of this country</td>
<td>10000</td>
<td>10000</td>
<td>10000</td>
</tr>
<tr>
<td>Effect on environment by the activities of the neighbouring country, measured in monetary terms, not included in closing inventory</td>
<td>6000</td>
<td>6000</td>
<td>6000</td>
</tr>
</tbody>
</table>
### SOLUTION

<table>
<thead>
<tr>
<th></th>
<th>1992</th>
<th>1993</th>
<th>1994</th>
</tr>
</thead>
<tbody>
<tr>
<td>NDP</td>
<td>30000</td>
<td>35000</td>
<td>40000</td>
</tr>
<tr>
<td>Less Final consumption and Imports</td>
<td>11000</td>
<td>11000</td>
<td>11000</td>
</tr>
<tr>
<td>NCF</td>
<td>19000</td>
<td>24000</td>
<td>29000</td>
</tr>
</tbody>
</table>

#### Calculation of EDP

**Inventory at the end**
- 1992: 50000
- 1993: 80000
- 1994: 110000

**Less Inventory at the beginning**
- 1992: 20000
- 1993: 50000
- 1994: 80000

**Contribution**
- 1992: 30000
- 1993: 30000
- 1994: 30000

**Less Expenditure by the Govt. and household**
- 1993: 3000
- 1994: 4000

**Effect of environment changes on health, etc.**
- 1992: 5000
- 1993: 6000
- 1994: 7000

**Effect on environment by the activities of neighbouring country**
- 1992: 6000
- 1993: 6000
- 1994: 6000

**EDP**
- 1992: 17000
- 1993: 15000
- 1994: 13000

**Note:** 7 and 8 not included. Effect of the 7th considered in closing inventory.

### Comparative Statement

<table>
<thead>
<tr>
<th></th>
<th>NCF(Rs.)</th>
<th>EDP (Rs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>19000</td>
<td>17000</td>
</tr>
<tr>
<td>1993</td>
<td>24000</td>
<td>15000</td>
</tr>
<tr>
<td>1994</td>
<td>29000</td>
<td>13000</td>
</tr>
</tbody>
</table>
### NCF as % of NDP vs EDP as % of NDP

<table>
<thead>
<tr>
<th>Year</th>
<th>NCF (x100)</th>
<th>EDP (x100)</th>
<th>NCF as %</th>
<th>EDP as %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992</td>
<td>19000</td>
<td>17000</td>
<td>63%</td>
<td>56%</td>
</tr>
<tr>
<td>1993</td>
<td>24000</td>
<td>15000</td>
<td>69%</td>
<td>43%</td>
</tr>
<tr>
<td>1994</td>
<td>29000</td>
<td>13000</td>
<td>73%</td>
<td>33%</td>
</tr>
</tbody>
</table>

**Inferences:** NCF as a percentage of NDP is increasing whereas EDP as a percentage of NDP is declining. The situation is alarming. The EDP is decreasing both in absolute figures as well as in percentage of NDP. Necessary measures are needed to reduce the depletion of environment and natural resources of build a fund from the NDP for the future development.

**Indian Context**

Being a developing country, India faces the common problems of the third world. Moreover, with the introduction of the Panchayat Raj Act by the 73rd Amendment of the Constitution which envisages the decentralisation of the
administration at the district and village levels by formation of district zilla parishads and village panchayats, the importance of such data and their services have further enhanced.

To raise the gross national product and net national product, local authorities can make use of the natural resources and environment. But the maintenance of environmental accounting will deter them to adopt policies on natural resources and environment such as policies on over-exploitation of minerals, deforestation, construction of annicut (small dam), discharge of refuse and wastes into the river, disordering of the eco-system and so on.

The maintenance of environmental accounting will induce them to use the natural resources and environments in limits and find means to increase the efficiency in their use or reduce their waste and deterioration.

Preparation of environmental accounts at regional level, district level and village level will disclose the disparity in growth rate between one village and the other villages and cities, and so on.

Few states taking advantage of the Liberalisation Policy have liberalised the rules for extraction of minerals and use of other natural resources without caring for the future.
It will be in fitness of the situation if a levy is imposed on extraction and uses to build a fund to be used, and compensate the loss which the future generation may suffer on account of liberalisation policy.

A study on price of pollution in India made by two World Bank Officials—Mr. Carter Brandon and Mr. Kirsten Hommann for the 1992 is worth citing here showing the impact of the major problems in terms of costs. They have calculated that the damage to environment cost India about $9.7 billion (Rs. 34000 crores) per year, (about 9.5 per cent of GDP).

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1 The cost of inaction: Valuing the Economy—Wide Cost of environmental degradation in India (World Bank).
## ENVIRONMENTAL COSTS IN INDIA OF A FEW MAJOR PROBLEMS

(Figures in US $ Mill.)

<table>
<thead>
<tr>
<th>Problems</th>
<th>Impact on health and/or production</th>
<th>Low estimate</th>
<th>High estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Air Pollution</td>
<td>Urban Health impacts</td>
<td>517</td>
<td>2102</td>
</tr>
<tr>
<td>Water Pollution</td>
<td>Urban and rural health impacts</td>
<td>517</td>
<td>2102</td>
</tr>
<tr>
<td>(health impacts)</td>
<td>especially diarrheal diseases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil degradation</td>
<td>Loss of agriculture output</td>
<td>1516</td>
<td>2362</td>
</tr>
<tr>
<td>Rangeland degradation</td>
<td>Loss of livestock carrying capacity</td>
<td>228</td>
<td>417</td>
</tr>
<tr>
<td>Deforestation</td>
<td>Loss of sustainable timber supply</td>
<td>183</td>
<td>244</td>
</tr>
<tr>
<td>Tourism</td>
<td>Decline in tourism revenue</td>
<td>142</td>
<td>283</td>
</tr>
</tbody>
</table>

Under the present conditions, readers themselves estimate—how much it would be in 1997.

However, developing countries, to begin with, can adopt any method in which, gradually, necessary alternations can be made as experience is gained and requirement increases.