

technological (inter-sectoral transactions) valuation needed for such incorporation. What generally, has been achieved is using indicator based "welfare approach", in which case, key indicators like degree of deforestation, air pollution, land degradation, water pollution etc. are assessed in separate tables for an economy and the overall decline in the environmental quality is deducted from gains in GDP growth. For example, if GDP growth is 6% in a given economy and FISD indicates a decline of -2%, then it is assumed that the Net GDP growth taking account of decline in environment is 4%.

What it achieves is not a precise estimate of the GDP growth, but an indication to the Government to undertake remedial action in improving the FISD in order to achieve better GDP, i.e., without compromising the overall welfare of people being affected due to decline in environmental quality in the process of national economic growth.

Chapter 5

SYSTEM OF ENVIRONMENTAL AND ECONOMIC ACCOUNTING (SEEA)

O.P. Singh

INTRODUCTION

Natural resources refer to naturally occurring assets that have the potential to be used for economic production or consumption. Consumption includes the consumption of environmental services, which refers to the qualitative functions of natural non-produced assets such as land, water and air (including the related ecosystem) and their biota. Economic growth and human well-being is dependent on the goods and services provided by the environment; such as the provision of raw material and energy, absorption of waste, and other amenities.

Natural resources can be renewable or non-renewable physical inputs that can be withdrawn from the natural environment. The moment natural resources are harvested or extracted for sale or economic use, they have entered the economic sphere. The economic sphere consists of all the physical flows and stocks that involve economic transactions and ownership as defined in the System of National Accounts (SNA). The alternative is the environmental sphere, which covers all other physical items not included in the economic

sphere. **Products** consist of material flows within the economic sphere. They are products resulting from production, and include both goods and services. Physical flows of goods are the most important, but there may also be services related to the delivery of goods. **Residuals** include all physical outputs discharged from the economic sphere back into the natural environment. Residuals can be reabsorbed into the economic sphere by recycling or waste (water) collection and incineration activities. As a result, these residual inputs are converted into products, or outputted as less harmful residual flows. Pesticides, fertilizer, and compost are examples of products whose use and function are brought into the environment on purpose, and so are related to flows from the economy into the environment.

FLOWS BETWEEN THE ECONOMIC AND ENVIRONMENTAL SPHERES

The economic sphere consists of all the physical flows and stocks that involve economic transactions and ownership as defined in the SNA. The environmental sphere consists of all the other items that do not belong to the economic sphere. For example, produced assets such as cultivated fish stocks are part of the economic sphere, while tangible non-produced assets such as fossil fuels are considered outside the economic sphere. Examples of flows between the economic and environmental sphere include fossil fuels that are extracted and used in economic production and pollution or waste resulting from economic activity. Further distinctions about flows can be made, including: flows between the economic and environmental spheres, flows of products within the economy, and the flows between the national economy and rest of the world.

ENVIRONMENTAL ACCOUNTING

The most common way to measure a nation's economic growth is its output in the form of Gross National Product (GNP)

which is prepared using the System of National Accounts. The GNP is calculated in two ways: (1) By way of money flow from households to businesses in the form of goods and services purchased; and (2) By adding all the costs of production in the form of wages, rent, interest, taxes, and profits. In both the cases, a subtraction is made for capital depreciation, the wear and tear on machines, vehicles, and buildings used in production. Often, this measure of development is criticized because it does not attempt to distinguish between economic activities that are beneficial or harmful for the people and environment, in long term. Further, GDP provides a robust, internationally comparable measure of economic performance of a country, however it ignores many environmental aspects that are essentially required for sustainable development. As a result, current practice of economic accounting is quite unsuitable as a tool for measuring environmental sustainability. For example, depletion of natural resources and discharge of effluent and other emissions into the environment occurring in the process of economic activity are not taken into consideration while accounting the GDP.

As a result, environmental accounting is being developed to overcome the weaknesses of traditional accounting system by incorporating information about stocks and flows of natural capital into the framework provided by national accounts. Apart from addressing conceptual concerns with GDP, environmental accounting has a number of other functions. It seeks to measure depletion of natural resources that can threaten living standards, the food chain, ecological stability, and economic productivity; assess the extent of environmental protection expenditure; and measure health and welfare costs associated with the degradation of the environment.

NATURAL RESOURCE ACCOUNTING

Natural resource accounts are the first stage of environmental accounts. Natural resource accounts consist of stock and flow accounts in physical and monetary units. Natural resource

accounts provide information that can improve resource management, and will help determine whether natural resources are being utilized efficiently on a national basis, and across sectors. Natural resource accounts can be used to assess the physical and monetary extent of environmental depletion and degradation. The accounts will help researchers analyze the effects of environmental policy on the economy, and economic policy on the environment.

Natural resource accounts serve the basic functions of an accounting system. They provide the information needed by policy makers, businesses, and individuals to track important trends and to determine the economic importance of changes to environmental resources. Natural resource accounts (tracing the quantity and quality of resources), in combination with economic models, can be used to analyse various environmental/economic issues, including: Measuring physical scarcity of natural resources; improving resource management; establishing a balance sheet for resource sectors; measuring total wealth by examining policies for sustainable development; valuing environmental degradation and depletion of natural resources; measuring the incidence of environmental regulations and taxes; measuring the efficiency of natural resource use by economic sector; dealing with aspects of international trade and the environment; analysing structural changes in the economy; linking pollution components to standard macro-economic models; measuring the economic effect of pollution abatement and environmental protection; and measuring the sectoral costs associated with government regulation and policy. Furthermore, accounting of stocks and flow of natural resources is important as it provides essential information for efficient resource management; analysis of economic and environmental policies; evolving indicators of sustainable development; and framing strategies and policies for sustainable development.

Physical accounts of natural resources

The physical accounts measure the physical stocks and flows of natural resources in units such as tonnes and cubic metres.

These quantities are then valued (using a variety of methods and assumptions), resulting in monetary figures which form the environmental accounts. The physical and monetary accounts complement each other. It is preferable to value natural resources using market values, but where these are not available, other techniques may be used. There are also a number of assets that may only be measured in physical terms including soil resources, part of the water resources, agricultural land and associated surface water and ecosystems. Often the changes, for example degradation and depletion of soil resources, can be measured, but the opening and closing stock cannot. This may be due to the sheer vastness of the natural resource. The physical accounts are a good way of viewing what is actually happening in the environment.

Monetary accounts of natural resources

Monetary accounts have the advantage that they have a common denominator (rupees or dollars). This allows different resources to be compared using the same units. Valuation is calculated in a way that is consistent with the System of National Accounts. The monetary estimates can be linked to the current national accounts. As mentioned previously, the coverage of the monetary accounts is limited. Not all natural resources are able to have monetary values applied, and for those that can be valued, there may be issues regarding the appropriate valuation method. Monetary accounts should generally be used in conjunction with the physical accounts.

SYSTEM OF ENVIRONMENTAL AND ECONOMIC ACCOUNTS (SEEA)

System of Environmental and Economic Accounts was developed by the United Nations Statistical Division (UNSTAT). It was designed as a satellite system to use in conjunction with conventional national accounts, and aims to "reflect the use that is made of natural resources and the damage that is caused to the environment" by economic and social

development. It is consistent with the SNA and, amongst other things, allows for the measurement of natural resource accounts.

There are two principle differences between the SEEA and the SNA. The first difference involves the coverage of assets, and the second involves the treatment of assets. The coverage of the assets under the two systems differs significantly. Under the SNA, the asset boundary is used to define the types of goods that can be classified as 'economic assets'. To be defined as an economic asset, it must be of "economic value and be under the ownership or control of an economic agent". As such, natural assets are only included if they provide economic benefits to the owner and have effective ownership or property rights associated with them. This is usually as a result of being controlled by an institutional unit, often via explicit ownership, and having a market price available. Included within the SNA boundary are environmental assets such as proven subsoil assets, land and water over which ownership rights are enforced, farmed fish stocks and managed forests. Natural fish stocks over which ownership rights are enforced are also included.

Outside the SNA asset boundary are assets such as probable or possible subsoil assets, and land, water, naturally occurring forests, and natural fish stocks over which ownership rights are not enforced. Probable and possible subsoil assets are excluded as they are not of 'definite' economic value. There is no guarantee that they will provide economic benefit to the owner. As with natural fish stocks, naturally occurring forests are excluded only if ownership rights are not enforced. Examples of natural fish stocks that will be excluded from SNA are those in protected areas such as marine parks, and proven subsoil reserves in national parks. Environmental assets such as air are also excluded from SNA, despite the fact that economic activities could not exist without them. They are excluded because no ownership rights are associated with them, and they do not produce economic benefits 'directly'. Similarly, the SNA excludes environmental assets that produce non-economic benefits. Services provided by ecosystems such

as the cleansing of fouled air and water are excluded from the SNA for this reason (but are included in the scope of the SEEA). Not only does the SNA exclude assets that are not producing direct economic benefit, or non-economic benefits, the SNA also excludes items that are not of economic benefit to current individuals, such as unproven sub-soil assets.

The SEEA therefore has a wider coverage than SNA and in principle includes all natural assets. It also allows for the measurement of non-use benefits of assets — those that may eventually be of benefit to those currently living, or currently not born. "The inclusion of option, bequest and existence benefits effectively broadens the scope of the SEEA asset boundary to include all land and natural resources. In addition, ecosystems are included in the SEEA asset boundary on the grounds that they provide a variety of services that bring indirect use benefits to humans". The SEEA includes those assets that contribute to production activities directly, and those that are simply affected by the environmental impacts of economic activities. The SEEA includes economic assets and noneconomic assets (also referred to as environmental assets) as the focus is on environmental impacts. The essential point of difference is that the SEEA is broader than the SNA and includes all natural assets that are included in the SNA.

STRUCTURE OF THE STOCK ACCOUNT

Integrated economic and environmental accounting requires the measurement of stocks of assets, which are presented in a stock account. The two main objectives of a stock account are: to measure the absolute level of natural resources at a point in time as an indication of wealth, and to show any change in stock levels of the asset over a certain period of time. The change in stock level is determined by calculating an opening and a closing balance. The harvesting/extraction component of stock change is further examined in the flow (or supply and use) accounts. A stock account can be compiled for any quantifiable asset. Initially, a physical stock account is produced as per the SEEA natural resource account framework. Once

the physical stock account is compiled, the individual components can be valued in monetary terms. The SEEA methodology distinguishes between two types of assets included in stock accounts: economic assets and environmental assets.

Economic assets

For a natural resource to be considered an 'economic asset', and therefore included in the SNA, ownership rights must exist over the natural resource and it must bring economic benefit to the owners. Under the SNA, natural assets can either be fixed assets or work-in-progress. They are classified as a fixed asset if the same asset repeatedly or continually produces products, such as apple trees, or are classified as work-in-progress if they produce only once, such as forests for wood harvesting. Fisheries can be an example of both a fixed asset and work-in-progress. Fish used for breeding are considered a fixed asset, while fish cultivated for sale are considered work-in-progress.

Environmental assets

In the SEEA environmental assets are "natural assets that function as a source of materials and energy as well as of environmental services of waste absorption, ecological functions, such as habitat or flood and climate control and other non-economic amenities such as health or aesthetic values. Therefore, uncultivated forests, wild animals, fish within the exclusive economic zone (EEZ), and all ecosystems are included in the SEEA asset boundary".

Under the SEEA not all elements are considered to be environmental assets. There are some elements which in themselves do not directly provide benefits, but the larger elements within which they belong, such as an ecosystem, does provide direct benefit. It is the ecosystem that is considered an environmental asset. The parts that make this up are not considered environmental assets in their own right. For example, "the countless species involved in decomposing organic

matter in forests do not themselves provide either use or non-use environmental benefits to humans [with the exception of those used for medicinal purposes or as a food source] and are not, therefore, considered environmental assets in the SEEA. The forest ecosystems of which they are an element clearly do benefit humans and therefore, qualify as environmental assets in the SEEA".

For each asset, the structure of the account works like a balance sheet. Changes between the opening and closing stock levels are a result of both economic activity and environmental processes. Stock accounts describe the state of assets at a given point in time. In the SEEA, the accounts are compiled both in physical, and whenever possible, in monetary terms. According to the nature of the assets, and the purpose of the accounts, the unit of measurement may simply be a count of individual items, or an additive measure that allows for additions and subtractions from the stocks, such as area, volume or mass. Another way of measuring natural assets in physical terms is through the aggregation of different assets. By using conversion factors, different physical units of measurements are expressed as 'equivalents'. Expressing tables in equivalents will usually make the tables more useful analytically. Measuring quality changes in an asset could be utilized in a stock account for those resources where the total stock is too vast to measure, or measurement is otherwise impractical or of no real benefit. Assets can be classified according to their inclusion in a given quality class. Stock accounts describe not only changes in quantity but also changes in quality that can be measured by changes in classification. An asset in a given quality class may change to another class, for example, land may change from 'agricultural land' to 'land underlying buildings'. In general, complex environmental assets, such as ecosystems and air, cannot be fully described by their monetary value or by any other additive measure. The quality of the asset may be used as an alternative description, an example being, how the quality of the air changes over time. Because of consistency and comparability in the units of measurement, changes between the opening and closing levels of stock can be accurately measured.

Table 1: SEEA Asset Classification

EA.1 Natural Resources
EA.1.1 Mineral and energy resources
EA.1.2 Soil resources (cubic metres, tonnes)
EA.1.3 Water resources (cubic metres)
EA.1.4 Biological resources
EA.1.41 Timber resources
EA.1.42 Crop and plant resources, other than timber
EA.1.43 Aquatic resources
EA.1.44 Animal resources, other than aquatic
EA.2 Land and surface water (hectares)
EA.2.1 Land underlying buildings and structures
EA.2.2 Agricultural land and associated surface water
EA.2.3 Wooded land and associated surface water
EA.2.4 Major water bodies
EA.2.5 Other land
EA.3 Ecosystems
EA.3.1 Terrestrial ecosystems
EA.3.2 Aquatic ecosystems
EA.3.3 Atmospheric systems
EA.M Memorandum item — Intangible environmental assets
AN.112.1 Mineral exploration
AN.222.1 Transferable licenses and concessions for the exploitation of natural resources
AN.222.2 Tradable permits allowing the emission of residuals
AN.222.3 Other intangible non-produced environmental assets

FLOW OR SUPPLY AND USE ACCOUNTS

Understanding the physical flows between the environment and the economy helps to identify the consequences of economic activities on national or global natural resources and ecological systems. Similar information could be produced on a regional level if desired. It is the purpose of flow (or supply and use) accounts to record these flows. Flow accounts show the supply and use of resources, and the flow of resulting products and residuals. Natural resources are used as inputs to the production and consumption processes, while the

outputs include disposal of solid waste and other residuals from the economy back into the environment.

The purpose of flow accounts includes: revealing the economic flows generated by harvesting from the stock account; identifying potential threats to the environment as a result of residual flows (or waste); and providing information needed to construct environmental performance indicators that help analyse further the environmental impacts of particular economic and social activities. Flows can occur domestically or internationally. The economic activities of one country can affect its own environment, but they can also affect the environment of another country.

Physical flows are characterized according to the type of material and energy and according to their nature with respect to origin and destination. Three types of physical flows can be distinguished. They are: natural resources, which are the physical flows from the environment to the economy (eg timber from forests to sawmills); products, the physical flows within the economy (e.g., wood products from sawmills to furniture manufacturers, and furniture to consumers); and residuals, which are flows from the economy back to the environment (e.g., timber treatment chemicals).

FUNCTION OF FLOW ACCOUNTS

In their most complete form, the physical flow accounts give a description of how material and energy are used as inputs in the economy, how commodities are produced and used, and how residuals and wastes are the result of economic activities by industries and households. Individual flow accounts can help highlight the origin or destination of some specific natural resources, materials or residual flows within the economy, or between the economy and the environment.

For any particular production or consumption process and for a regional or national economy, there should be a balance between all inputs (ie national resources, products, and imports) and all outputs (exports and residuals), plus total material accumulation. Flow accounts are measured in physical

and monetary terms. A detailed physical flow analysis may lead to hundreds of different products or substances being created. To communicate the results more effectively, the flow accounts require aggregation. It is possible to present physical flow accounts at different levels of aggregation.

Purpose of flow accounts is also to provide information to enable the construction of environmental performance indicators. These help assist the analysis of the environmental impacts resulting from certain economic activities, such as domestic consumption and production, and international trade. Flow accounts are often used to show how 'resource efficient' the economy is, and how efficiency has changed for particular material and industrial sectors.

ACKNOWLEDGEMENT

The information in this chapter is compiled from various websites. The author is grateful to these websites including the websites of UNEP and UNSTAT.

Chapter 6

CONSERVATION OF NATURAL RESOURCES AND SUSTAINABLE DEVELOPMENT

B.K. Tiwari

INTRODUCTION

In social and regional context, development is often understood as a change for better, improvement, growth or progress. It is studied in two broad categories viz., social, which includes health, education, family welfare, literacy, child mortality and nutrition and economic, which includes per capita income, gross domestic product, employment, industrialization, infrastructure etc. During recent years ecological development has also emerged as an important organ of development which deals with the health of natural systems and state of natural resources like forest, water bodies, soils and levels of environmental pollution and its interactions with the socio-economic development.

The term development is understood differently by different people. For a farmer development means better availability of water, power, fertilizer and pesticides so that he can reap a good harvest from his fields. From the perspective of an industrialist a developed region should have good roads,