Chapter 1

From National Income Accounting to
Integrated Environmental and Economic Accounting

1.1 Objectives of Maximizing Income versus Welfare versus Sustainability

The present system of calculating gross domestic product (GDP) came out of a 1928 League of Nations meeting, at the helm of an era where mass production and mass pollution were about to change the face of earth. The United Nation's System of National Accounts (SNA) came into being with the 1947 report on the "Measurement of National Income and the Construction of Social Accounts". Economic accounts of most countries are calculated in a standard format using the same framework (SNA), which has been developed, supported and disseminated by the United Nations Statistical Division (UNSD). Modernization has come largely in the form of additions to the system rather than essential modifications of the original system.

National accounts based on SNA do not include the full economic value of environmental assets or their contribution as important environmental inputs, by implicitly valuing them at zero prices. While man-made capital stocks and natural capital stocks are used in production, adjustments for the depreciation of only man-made capital are made in the GDP figures and the measure of depletion of natural resource stocks is omitted[1]. At the same time, all receipts from sale of natural resources are treated as current *income*[2], which is available for consumption, ignoring the fact that revenue derived from liquidating a country's natural assets is *neither recurrent nor sustainable*. Absence of market prices for most environmental amenities (since they are seldom bought and sold in the market) combined with the characteristics such as diffused property rights, incomplete information, public good nature etc. result in assignment of no value (or zero value) to such environmental amenities and no entries are made for them in either the *'flow accounts'* or the *'Wealth accounts'*. Natural resource stocks are

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[1] Part of the measure of depletion or degradation costs gets accounted for in the national accounts in the form of say higher prices of these scarce natural resources, for example increase in land rents, mineral royalties etc.

[2] Where *'income'* is defined that part of the total revenue which is available for consumption expenditure.

part of *national wealth* and thus ignoring their depletion is tantamount to treatment of reductions in *national wealth* as increases in *national income.* Equivalently it implies that the future generations are subsidising the current generation's (unsustainable) consumption expenditure. Similarly, environmental assets *in situ* may be degraded due to economic activity without any adjustment made in the accounts for such degradation costs. Thus, "………*A country could exhaust its mineral resources, cut down its forests, erode its soils, pollute its aquifers, and hunt its wildlife to extinction; but measured income would rise steadily as these assets disappeared.*" (Repetto, 1988).

Proponents of sustainable development recommend a system of natural resource accounting (NRA) to prepare a set of aggregate national data that links the environment to the economy, highlighting the interaction between the two with the objective of integration of macro-economic and environmental policy to ensure better long-term management of natural resources. Much of the NRA literature contributed by economic theorists, applied economists, ecological economists and by the national accountants proceeds with weak conceptual foundation. Concepts, assumptions and terminologies vary throughout the literature yielding tensions and inconsistencies in the framework for the practical recommendations regarding adjustments in conventional accounts. Particularly, there exist serious fundamental differences between economic approaches and those employed by national accountants in defining and measuring aggregates such as capital, income, consumption and so on, though all are masked by similar terminology.

The concept of income as presented by the national accountants is based on an accounting identity, which is an *atemporal* measure of current production. In formal notation, income as per national accounts (Y_{NA}) is denoted as:

$Y_{NA}^t = C^t + \Delta K^t$, defined as the sum of current consumption, C^t and the market value of the change in capital stock, ΔK^t. While GDP adds production of new capital to

consumption, net domestic product (NDP) adds only net capital accumulation to consumption.

However, environmental economists aim at measuring sustainable income in a broadly capital-theoretic framework by measuring total depreciation of produced capital as well as natural capital and deducting· them from total income to arrive at a figure for sustainable income. For them, income in the economic sense typically reflects a dynamic stock-flow relationship and is treated as return to wealth (including natural capital wealth). They adopt Hick's (1946) definition of income (called the Hicksian Income Y_H), wherein "..........a man's income (is defined) as the maximum value which he can consume during a week and still expect to be as well off at the end of the week as he was in the beginning." (Hicks 1946).

Formally Hicksian income can be denoted as $Y_H = \max C^t$ subject to $\Delta C^t \geq 0$ for all t.

Bradford (1990) distinguishes between these two concepts of income and interprets Y_{NA} as a backward looking measure: 'how much value have we added?' and Y_H a forward looking measure: 'how much can we consume?'. Y_{NA} represents the return on the actual existing capital (where capital may include produced, natural, human and 'social' capital). Y_H represents return on wealth, where wealth is defined as value of total existing capital stock (broadly including man-made capital, human capital and natural capital). For sustainability, what is important is that the return measured by Y_H is non-declining. Thus the capital stock relevant to Y_H is the capital necessary for sustainable future consumption.

Current measures of national income provide a reasonable measure from the point of view of macro-economic stabilization (as changes in them reflect changes in total demand for produced goods and services). They are however inadequate indicators of social welfare and environmental sustainability. Of course, GDP or NDP are not meant

to be welfare measures. Even the indicators based on these un-adjusted national income aggregates remain seriously flawed with respect to the two complex and multi-dimensional conceptual standards, i.e. *welfare* and *sustainability*. While these two are related, they are distinct concepts. Welfare involves material questions of income and consumption along with the more complex societal questions of distribution, and of well-being that results from personal contentment, relative social status and social tranquility. *Welfare* is conceptually represented by a utility function that incorporates all relevant arguments that contribute to *wellbeing* (including environment-related amenities). One can conceptualise *sustainability* as a dynamic characterization of the level of well-being. A standard approach (Pezzey, 1989) is to define a *sustainable* path as one over which social *welfare* (utility) is non-declining. Economic definitions focus on sustainable development as non-declining per capita human *wellbeing* over generations (Dasgupta and Mäler 1995, Bromley 1995). *Sustainability* covers an amalgam of economic, environmental and social objectives. It is important to note that these two objectives may not be compatible. A certain growth path may reduce overall *welfare* and yet be *sustainable*, while another growth path that may maximize *welfare* may not be *sustainable*. It depends on the characterization of well-being and sustainability. When considering natural capital consumption allowance, the *welfare objective* will stress 'efficient' rate of exploitation of a reserve, while *sustainability objective* will stress adherence to a reinvestment rule also called the Hartwick rule (due to Hartwick, 1977). It is thus crucial to gain conceptual clarity on the definitions and their interpretations, and only then specify the objectives of the accounting exercise upfront. A focus on either welfare or sustainability will have different implications for the adjustments to be made for resource depletion or environmental change in our national income aggregates.

Since no account of economic development is complete without the inclusion of the environmental resource base, there is the need to adopt the system integrating environmental accounts with the national accounts and to compute environmentally adjusted measures of income and wealth (Environmental Accounting or Green

Accounting), which would better identify true income, better capture environmental services, account for depreciation of both man-made and natural capital, exclude the relevant categories of defensive environmental expenditure from income measures and estimate the environmental damage as a result of economic activities.

1.2 Limitations of the Conventional National Accounts

The national accounts provide measures of success or failure of the major macroeconomic objective, i.e., economic growth. Income accounting measures like GDP or NDP and their constituents by expenditure or factor income categories provides essential data for the economic analysis of macroeconomic performance or for future development planning. They are important as not only measures of changes in the level of economic activities, but also as values of the tools for economic stabilization, resource mobilization and short- and medium-run demand side management policies. While the conceptual basis of the rules of aggregation of values to obtain the estimates of macroeconomic variables of the national accounts has been the neoclassical market theory, the key indicators on which the SNA focuses are based mostly on the short run Keynesian macro models and not on any long run growth theory or models. As a result, it is not surprising that the scope and coverage of national accounts is considered to be inadequate for obtaining the information on the determinants of the process of growth and sustainability of development.

It may be noted here that the national accounts of many countries like India have only flow accounts of production, income and expenditure, and no accounts of economic assets which should include non-produced economic assets like land, subsoil minerals, fossil fuel resources, etc. As a result, the national accounts cannot generate adequate statistics on the tools of long run growth affecting sustainability. Nor do such accounts have their basis on any long run theory of growth and sustainability. The Hicksian definition of income describes income to be the maximum sustainable long-term constant consumption over time (Hicks 1946). The conventional SNA definition of income allows for adjustment of the gross value added for the depreciation of man made

capital but not for the depreciation of the natural capital and therefore does not represent true Hicksian income. The measures of income and investment of such accounts, as they are estimated are thus imperfect indicators of the level of human well-being whose sustainability is a major macroeconomic goal in the long run.

Given the method of estimating aggregate income and asset accumulation as arising mostly from economic activities involving market transactions, the consequences of environment-economy interaction which have significant bearing on the sustainability of economic processes are not reflected in the national accounts. A change in the national asset and national income accounting system is required to ensure that environmental consequences of development activities or the effects of environmental policies on the macro economy are adequately reflected in the data of the accounts such that the latter can provide statistics on the indicators and tools of sustainable development. A different yardstick of measurement of economic change or progress as would be given by the change in the accounting system would change the policy priority as well.

The omission of explicit entries for natural resources in national accounts, along with common property rights implies that the accounts do not (cannot) identify under- or over-exploitation of natural capital stock. To broadly list the *missing elements in SNA accounts*:

1. *Environmental defensive expenditure*: Such expenditure involves expenses on goods and services to mitigate environmental damage. Since the idea is to restore the environmental quality, such expenses are also referred to as 'restoration costs'. Restoration may or may not be complete. A sugar plant investing in an air pollution control device or a consumer purchasing a catalytic converter for his car bears a defensive expenditure to avoid further air pollution. Such expenditure is treated as intermediate or final consumption expenditure in current national accounts and therefore they add to national income despite the fact that no one is better off! In fact such defensive expenditure mostly represents a rough measure of environmental degradation and to that extent they should be deducted form

national income figures. However, the dis-aggregation of such expenditure to highlight the cost incurred to prevent or mitigate environmental degradation is extremely difficult given the current definitions of income and expenditure and the status of data-reporting by different sectors in an economy for construction of national accounts.

2. *Environmental damage (costs):* While the output generated form economic activities adds to total output, no account is taken of the environmental damage done in the process, in the form of polluted water and air, related health problems, degraded soils, pollution from mining activities etc. National accounts need to be adjusted for such degradation of natural resources.

3. *Non-marketed goods and services:* The environment provides many goods and services which are not marketed but which are nevertheless of value; e.g. medicinal plants, fuel-wood, watershed protection by forests or water filtration by submerged vegetation. While some attempts have been made at estimating them, most of them are incomplete because of the difficulties involved in assessing their true economic value in the absence of markets for such goods and services.

4. *Consumption of Natural Capital:* SNA excludes any account of the depletion of natural capital as they are utilized in the economic production and consumption activities. Stocks of renewable natural resources are depleted if the rate of harvesting/extraction exceeds the rate of their natural regeneration/growth. An economy, which is rapidly deforesting will thus record growing income even as it destroys an important productive asset, the forest. Stocks of non-renewable resources are depleted each time they are used up in the production process. These depletions represent a decline in productive capacity in future but none of it gets reflected in the aggregate accounts. Thus it is strongly proposed to include the depletion of natural resources in the same way as the depreciation of other productive assets in national accounts.

While the last two omissions are clear, it is useful to elaborate on the first two omissions mentioned above, i.e., the treatment of defensive expenditure and environmental costs, for more clarity on problems entailed in their exposition and estimation. The concern over defensive expenditure and environmental costs arises from the fact that there are no negative entries for these in national accounts. Any economic activity which results in a market exchange makes a positive contribution to GDP and economic growth. Thus, as an example, production and transport of the oil is counted as part of GDP. And in case there is spilling of that oil resulting in an ecological disaster, that too adds to economic growth as the expenses on clean-up, insurance and legal disputes are also counted as productive activities (because they create marketed services). The general problem here is that environmental damaging activities as well as restoration costs, all add to the GDP figure.

Restoration costs that completely compensate for the environmental damage/degradation caused must be deducted from GDP figures to obtain the NDP figure. If restoration costs do not restore the environmental damage completely, then the NDP figure needs further adjustment for the value of environmental damage not compensated for by defensive expenses. It is very often the situation that the natural environmental resource base and its capacity have been depleted or degraded over a long time due to neglect. It is often not only a question of replenishing the environmental resource stock as depreciated in a given year or period to maintain the level on a year to year basis, as at the beginning of the period, but to restore the capacity to a benchmark level which corresponds to the environmental capacity in the base year period and is considered normative for the sustainability of the functions of ecosystems. See chapter 1 of SEEA in UNSD 2000 for details. For example, the Kyoto protocol targets to control the Green House Gas emission flow to a level marginally lower than that of 1990 levels for the protocol signatory nations. The sustainable capacity requirement would warrant investments to restore the capacity to the benchmark level. A benchmark is necessary and how one decides the benchmark is the important question that needs to be answered. See Sengupta and Saksena (2008a) for the decomposition of the historical loss of

environmental capacity as have occurred over time to get the norms for environmental adjustment of wealth and income to take care of the environmental capacity variation.

Then there are the environmental damage costs arising from economic activities that are not accounted for in national aggregates at all. For instance, if swamps are drained and wetlands are lost, there is no accounting for the loss of the wetlands' natural 'protection' of fish, birds and purified water. Values for more abstract phenomena like loss of biodiversity or habitat are even further from national accounting. The bottom line of the accounts seems to be that- whatever happens, the GDP spirals upward always by adding everything, making no distinction between costs and benefits, well-being or decline.

In response to this one directional accounting, proponents of sustainable growth have raised concern over identification and proper accounting for both defensive expenditure and environmental costs. These are different but related concepts. Defensive expenditures have been defined as "....outlays with which the attempt is made to eliminate, mitigate, neutralise or anticipate and avoid damages and deterioration that the economic process .... has caused to living, working and environmental conditions." (Leipert 1989). Classic examples of such defensive expenditure are police and security (which "defend" against crime), spending on pollution control/mitigation (e.g. sewerage treatment or water filters), and the additional health and transport costs associated with industrialization, urbanization and the concomitant pollution and congestion, in order to maintain certain minimum level of well-being. These expenses are welfare enhancing in that the consumers and/or the public are made better off by that expenditure. But because they only prevent (or mitigate) social and environmental costs, they do not represent an overall increase in welfare.

By contrast, environmental costs like loss of wetlands, arable land, habitat, or air and water quality are outright losses of welfare. If the loss is on account of conversion or change in use, for example if a wetland is converted into land for agricultural purposes, all expenses incurred for the conversion get reflected in higher asset-value (upward

revaluation of asset prices). However, no downward correction is made for the loss of national wealth as the wetlands are lost.

Thus, defensive expenditure and environmental costs are conceptually different. In relation to defensive expenditure, the criticism is about *the way* defensive expenditure is recorded (as positives). With environmental costs, the problem is that they are *not included* (at least not all of it) in the national accounts. However, in practice the concepts overlap, particularly since the imputed value of environmental costs is often based on projected or actual defensive expenditure necessary to ameliorate the cost (the so-called maintenance cost approach).

A more solid argument is that, if such defensive expenses are deducted from national accounts, then some measure should be (or should have been) added for the original welfare created by the natural asset/amenity or environmental service concerned. Thus, if a deduction is made for loss of leisure, or the cost of reducing beach pollution, then an addition should be made for the utilities 'produced' by leisure time or cleaner beaches. Such estimates probably produce insurmountable data problems, and even if estimates could be produced, their magnitude would overwhelm the accounts. UNSD 2003 manual elaborates how some of such environmental cost estimates can be obtained/measured and incorporated in the integrated environmental-economic accounts.

Most economic literature on natural resource accounting argues that, since natural resources display both the flow and stock dimensions of reproducible man-made capital, not only should their depreciation/ depletion be accounted for in the net domestic product (Hartwick, 1990), but also their mineral reserves should be a part of national wealth (Hartwick, 1995). Typically the *difference in the treatment of produced capital and natural capital* in traditional economic accounts can be broadly traced under 4 categories:

1. There is no entry for additions to stock of natural resources parallel to the entry for additions to stock of man-made or produced capital structures and equipment.

2. There is no explicit entry for the contribution of natural resources to current production, as measured by the GDP, parallel to the entries that capture the value added by produced capital. However it must be kept in mind that some of their contribution does get reflected in national accounts in terms of rents, royalties, change in land prices etc.

3. .There is no entry for the using up of the stocks of natural resources parallel to the entry for the depreciation of produced capital used to arrive at NDP.

4. Neither the stocks of natural resources, nor the stocks of reserves-inventories are included as part of the national balance sheets, thus underestimating national wealth in countries where they are prepared. Asset accounts and national balance sheets are not prepared in India.

Such omissions of natural resource inputs also create problems in productivity analysis. Estimation of production functions includes estimates of land, labour and capital but excludes measures of natural resource inputs (which are significant in some sectors). Traditional accounts ignore the overall contribution of natural resources resulting in less-than-optimal state budgeting decisions.

1.3 Need for Natural Resource Accounting in Developing Countries

El Serafy (1994) notes that in the industrialized countries, an appropriate structure of tax allowances and royalties is in place, which to some extent corrects the real value added for depletable natural resources. Although the correction factor may not be exact, it is better than the situation in developing countries where no such correction is made. Thus, there is the pressing need in developing countries not to device more theory or techniques but to apply the existing methodology to concrete problems. The objective should not be to obtain fine tuned numbers but to make a beginning to indicate the orders of magnitude of the environmental problems at hand and depict them in national accounts.

Dasgupta and Mäler (1995) discuss how the developing countries face greater pressure to overexploit their natural resources by highlighting the two-way causality between environmental degradation and poverty. They note that while environmental degradation is a cause of accentuated poverty among the poor and developing countries, poverty itself can be a cause of environmental degradation. Developing country governments with a perpetual fiscal crunch, find it difficult to attain the many development targets they set to achieve. The preparation of natural resource accounts and their regular publication can bring much needed accountability of public policy. These accounts will reveal the real income of the Nation, what it borrows form nature, what this generation borrows form the future as well as how much some members of the society gain at the cost of others.

"Natural Resource Accounting (NRA)" is a system of preparing a set of aggregate National data linking the environment to the economy, which will have a long run impact on both economic and environmental policy making" (The World Conservation Union). It undertakes exercises to adjust and / or supplement the SNA for environmental costs, contribution and benefits. It helps integration of macro-economic and environmental policy to ensure better long-term management of natural resources.

NRA is carried out at various levels by different countries depending on data availability and the objective under consideration. A country may construct only **Physical Natural Resource Accounts** that include information about natural characteristics of the environment and its use; the size of mineral reserves and forests, quality of air and water, depth of top soil etc. In contrast some countries undertake to construct the more difficult **Monetary Natural Resource Accounts** that place an economic value on characteristics or use of environmental assets so as to understand the role they play in the economy.

NRA involves construction of *Integrated Accounts* in some countries and only *Satellite Accounts* in others. While the *integrated accounts* change the calculation of GDP and

other key national aggregates to obtain estimates of environmentally adjusted aggregates, *satellite accounts* (of which physical accounts are one example) are only linked to the SNA as supplements. They do not change the calculation of key indicators or the central framework of the core accounts. They provide useful environmental data without threatening the consistency of the information in the conventional accounts. They do not attempt to correct the distortions inherent in the key indicators such as GNP or GDP.

UNEP, UNSD and World Bank worked on design of environmental accounts through the 1980s and launched a concerted international effort to build consensus on how the SNA may be modified to include the environment. This led in 1993 to the publication by UNSD of a draft, Handbook for Integrated Economic and Environmental accounting, describing a preliminary methodology to be tested and refined. The approach described in this document is referred to as *System of Integrated Economic and Environmental accounting* or **SEEA** (UNSD 1993, 2000, 2003[1]). The **SEEA** attempts to integrate many of the different methods proposed for environmental accounting into a single organized framework. It proposes a series of 'building blocks' for the construction of the accounts, beginning with physical accounts and the disaggregation of data already included in SNA, and working towards more complex information such as calculation of depletion and estimation of maintenance cost required for sustainable use of resources. The SEEA includes environmental depletion and degradation by measuring the change in value in asset accounts. SEEA leaves the core income and expenditure accounts of SNA largely unchanged. Although SEEA is entirely compatible with them, it provides satellite accounts which sit alongside the core accounts and can be integrated through balance sheets and other means. SEEA is elaborated in the following chapter.

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[1] UNSD 1993 and UNSD 2003 are more commonly referred to as SNA 1993 and SEEA 2003 respectively. Thus, UNSD 1993 and SNA 1993 are used synonymously as also UNSD 2003 and SEEA 2003.