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# SUSTAINABLE DEVELOPMENT

K.S. KAVI KUMAR

DISSEMINATION PAPER - 14

**Centre of Excellence in Environmental Economics**
(Sponsored by Ministry of Environment and Forests, Government of India)
MADRAS SCHOOL OF ECONOMICS

# SUSTAINABLE DEVELOPMENT

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# Sustainable Development

## 1.0 Introduction

The growing population and its never satiating demands for higher and higher consumption poses concerns regarding the sustainability of the impressive economic growth registered by many countries including India. Since the increasing demands of the population must be met by the greater exploitation of available resources, they tend to exert additional pressure on the aggregate resource base of the economy.

The natural question which has come to occupy the minds of contemporary policy makers and social thinkers is whether the *impressive* growth rates of the economy can *last* and if so, how. The ecological footprint[1] analysis finds that World's present demand on the biosphere is already 25 percent more than the bio-capacity - the biosphere's ability to meet the demand. In case of India, it is estimated that the total national footprint has doubled since 1961. It is also shown that the balance between India's demand on and supply of natural capital has worsened, leaving the country as an ecological debtor. It suggests that the rate of depletion of the country's ecological assets and productive base is more than the rate of its accumulation. These analyses indicate that the current global level of consumption is unsustainable.

In order to take the right measures which will ensure a development path that is sustainable - continuing growth of the economy in the face of rising local and global resource constraints - one has to examine the true implications of the term 'sustainability' and the conditions under which it can be achieved. The aim of this dissemination paper is to present the concept of Sustainable Devel-

[1] 'The Ecological Footprint measures human demand on the biosphere in terms of the land and sea area required to provide the resources we use and to absorb the waste we generate.' (India's Ecological Footprint, p. 29)

opment (henceforth SD) from the economic perspective. Although different disciplines of knowledge have defined the concept of sustainability in several ways, the discussion here largely adheres to the meaning and interpretation of sustainability adopted by economists. The vast literature on SD is summarized here with focus on the following issues:

- Multiple interpretations of SD from different disciplines
- Measuring SD in economic and accounting terms
- SD in practice and policy issues

**2.0 Sustainable Development: Rationale, Meaning and Interpretation**

The term 'sustainable' is relatively easy to interpret: it means 'enduring' and 'lasting' and 'to keep in being'. So, SD is 'development that *lasts*' (World Development Report, 1992). Development could be narrowly defined in traditional terms as real GNP per capita, or real consumption per capita. Alternatively, it could be broadened to include other indicators of development such as education, health and some measure of the 'quality of life' including human freedom. On similar lines, SD has been defined over a wide spectrum, starting with the narrow definition of 'increasing GNP per capita over time' to a wider conception of 'ecosystem sustainability'.

A much less contentious definition of development would be a process which raises the average level of well-being in the community being referred to. The merits of this definition lie in terms of adhering to an interpretation which is to be found through observation of the common usage of the term, and for being consistent with the World Commission on Environment and Development's (popularly known as the 'Brundtland Commission') definition of SD. The Commission defines SD as "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1987).

It is critical to distinguish between the concept (meaning) of SD and the conditions under which the concept can be operationalized. That is, defining SD is

not the same as searching for necessary and sufficient conditions for achieving it. While the definition of SD can have a wide range of interpretations, the conditions (necessary and sufficient) under which sustainability can be achieved are fairly similar, if not the same, regardless of how development is defined. It is found that much of the literature on SD confuses definitions with conditions for achieving SD.

For example, many would cite political freedom as a necessary characteristic of a 'developed' society, but it could equally well be treated as one of the conditions that have to be secured for development to take place. The idea that a developed society is necessarily a politically free one is not, in any event, obvious: one can imagine an autocratic society with high levels of well-being. However, since development is a value word it is always open to others to say that 'being free' is part of what they mean by 'being developed'.

### *2.1 Rationale for Sustainable Development*

SD has come to settle as a desirable goal for the society due to the emphasis and endorsements of the term in several international conferences focusing on the nexus between environment and economic development. More commonly, SD appears as a natural fall out of the question: 'are the economic activities undertaken by the present generation sustainable?'

According to Perman *et al.* (1999), the rationale for SD arises from the 'desirability of cautious behaviour' with an objective to 'minimize ecological disruptions'. Such desirable behaviour, the authors argue, has moral, ecological, and economic grounds. From a moral stand point, they argue that actions of present generation must not jeopardize equal opportunities for future generation as enjoyed by the present. Moreoever, believing that ecological diversity is an important objective in its own right, any activity that threatens such diversity is undesirable. Lastly, from the angle of economics sustainable economic behaviour is more efficient than non-sustainable behaviour. Similarly, Daly (2005) contends that the main rationale for advocating sustainability is to restrain eco-

nomic growth from getting transformed into 'uneconomic growth'. In another study of the ESCAP region, Parikh and Parikh (1997) argue that degradation of natural resources or loss in the quality of the environment, imposes burden on the present and future generations. In a way, degradation can be viewed as the present generation borrowing from the future generations. However, it may be *just* to borrow from the future generations if we leave them richer.

Another rationale arises from what is observed in practice - high level of resource extraction, depletion of natural resources, loss in biodiversity, etc., which could signify that the present levels of consumption are unsustainable. The literature supports these observations from several standpoints. First, from the perspective of the materials balance principle (the first law of thermodynamics) current rates of material and energy use already exceed solar powered recycling potential. Second, from ecological considerations, activities become unsustainable if (i) the food chains, upon which human life depends, gets disrupted; (ii) ecological developments induce paths of decline and, after a threshold, result in irreversible damages and catastrophes; or (iii) human activities tend to simplify ecosystems and reduce biological diversity.

### *2.2 Meaning of Sustainable Development*

Several authors have treated the concept of SD in different ways. Therefore, no single definition is fully comprehensive to capture all the characteristics of the term. The wide range of definitions also reflects the inherent similarities and contradictions of the several interpretations of SD. Box 1 summarizes the popularly accepted definitions belonging to various disciplines.

**Box 1: Some definitions of sustainable development***

*"Sustainability is defined as...non-declining utility of a representative member of society for millennia into the future"*

- Pezzey (1992)

*"Sustainable activity is...that level of economic activity which leaves the environmental quality level intact, with the policy objective corresponding to this notion being the maximization of net benefits of economic development, subject to maintaining the services quality of natural resources over time."*

- Barbier and Markandya (1990)

*"Sustainable development is development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs"*

- World Commission on Environment and Development (WCED, 1987)

*"The alternative approach [to sustainable development] is to focus on natural capital assets and suggest that they should not decline through time."*

- Pearce *et al.* (1989)

*"Sustainable economy...is one that can be maintained indefinitely into the future in the face of biophysical limits."*

- Daly (2005)

** Adapted from Perman et al., 1999.*

### *2.3 Interpretations of Sustainable Development*

Five broad interpretations of SD can be inferred from its various definitions (Perman *et al.*, 1999). The interpretations are ways to operationalize the definitions of SD, or to bring them into practice. These are discussed below.

First, a sustainable state is one in which utility is non-declining over time. Economists adhere to this conventional way of interpreting the term. Robert M. Solow justifies this interpretaion using the Rawlsian ethics, and defines a soci-

ety as sustainable if it satisfies the criteria of 'intergenerational equity' – that is if per capita utility for all future generations remains constant.[2]

Deriving the necessary and sufficient conditions of the constancy of undiscounted utility of per capita consumption over time is a difficult task. Hence, economists interpret sustainability as 'constant' consumption over time, as proposed by John Hartwick. More recent literature combines the notion of constant utility and constant consumption - known as the Solow-Hartwick criterion - to interpret SD.

However, the Solow-Hartwick criterion ignores the concept of minimum threshold levels of consumption, that is, it does not require any conditions of how large the non-declining level of consumption should initially be. By implication, an economy can be sustainable if living consumption standards are abysmally low, provided they do not get any worse – a rather perverse interpretation (Perman *et al.*, 1999). Its limitations motivate other interpretations.

In the second interpretation, a sustainable state is one in which resources are managed so as to maintain production opportunities for the future. Sustainability may be defined in terms of *maintaining production or consumption potential* over time. Productive capacity at any point in time depends mainly on the stock of productive (capital) assets available for use. The word 'capital' is used in a very broad sense to include natural capital (e.g., forests, & fisheries), physical capital (e.g., plant, equipment), human capital (e.g., skills, know-how), and intellectual capital (e.g., disembodied skills, stock of knowledge). Human-made capital is the sum of physical, human, and intellectual capital. Thus, the productive potential of the entire ecosystem can be represented using a simple production function:

[2] Rawlsian ethics suggests a distribution or allocation that confers equal utility on each generation of people over time.

$$Q = f(L, K_N, K_H)$$

where $Q$ is the productive potential of the ecosystem, $L$ is labour or human-effort, $K_N$ is stock of natural capital, and $K_H$ is human-made capital. Therefore, the productive potential of the economy will be maintained if the *composite capital stock is non-declining* over time.

This interpretation of SD leads to a re-interpretation of 'sustainability' as notions of weak sustainability and strong sustainability discussed in Box 2 below.

**Box 2. Weak Vs. Strong Sustainability**

An operational definition of sustainable development requires maintaining the productive potential of the economy consisting of composite (aggregate) capital stock, viz., natural capital, and human-made (includes physical, human, and intellectual) capital. However, two contradictory views, viz. Weak sustainability and Strong sustainability have emerged in the literature pertaining to the conditions under which sustainability can be achieved.

The paradigm of weak and strong sustainability arises from the debate over 'substitutability' of different components of capital assets. If resources can be substituted for one another, this implies that more of one type can be used in place of less of another type.

If substitutability of capital is assumed, then SD can be achieved by ensuring a constant stock of composite capital in the infinite future. This is known as the Weak Sustainability criterion. For example, one can maintain the productive potential of the economy by substituting more of human-made capital for less of natural capital. Weak sustainability requires that capital depreciation on any form of capital must be at least offset by capital appreciation on other forms of capital. There must be 'reinvestment of rents' and the proceeds of capital depreciation must not be consumed.

Formally, if $K$ is the composite capital base and is defined as the sum-total of

man-made capital ($K_M$), natural capital ($K_N$), human-capital ($K_H$), and social capital ($K_S$), then

$$K = K_M + K_N + K_H + K_S$$

Sustainability would require, $\frac{\Delta K}{\Delta t} \geq 0$, (where, $\Delta$ stands for change; *t* stands for time) implying any change in the aggregate capital stock over time should be positive (or non-declining). Hence, in case of weak sustainability various forms of capital are assumed to be substitutable over the margin.

On the contrary, if substitutability is not assumed, it is necessary to maintain each component of the capital base in order to achieve SD. This has come to be known as Strong Sustainability criterion. Therefore, if natural capital cannot be substituted with human-made capital, one needs to maintain the level of natural capital while ensuring the weak criterion of non-declining stock of aggregate capital over time.

Formally, the strong sustainability criterion can be written as, $\frac{\Delta K}{\Delta t} \geq 0$ and $\frac{\Delta K_N}{\Delta t} \geq 0$. The conditions suggest that while maintaining the aggregate capital stock is necessary for achieving SD, the sufficiency condition for the same is a non-declining natural capital stock. Therefore, replacement or substitution of the depleted natural capital by any other form of capital is not allowed at the margin.

A third interpretation defines sustainable state as one in which the *natural capital stock is non-declining through time*. Maintaining natural capital is a necessary condition for sustaining the economy's productive potential if natural capital is essential for production and is not substitutable by other components of capital. This interpretation is also limited by the yet unresolved debate on weak versus strong sustainability.

The fourth is a biological interpretation of SD based on renewable resource stocks, e.g., forest. In this sense, a sustainable state is one in which the resources are managed so as to maintain a *sustainable yield* of resource services. A sustainable yield is a steady state in which some stock (e.g., forest) is held at a constant level and delivers a constant flow of resource services (e.g., timber) over time. However, whether it talks about maintaining resource stock or flow of resource services constant, and whether different elements or their weighted aggregates is not clear.

The fifth interpretation arises from the ecologists' interpretation of ecosystem and defines sustainable state as one which satisfies *minimum conditions of ecosystem stability and resilience* through time. Common and Perrings define a system to be ecologically sustainable if it is 'resilient'.[3] The problem with this interpretation is that one cannot know, *ex ante*, if the system would be resilient in the presence of future shocks, but can only be determined *ex post*.

**3.0 Measuring Sustainability**

Measuring sustainability is one of the most daunting tasks given the wide range of definitions and interpretations of the concept. Moreover, the underlying conditions to achieve sustainability also vary greatly in the literature. Nevertheless, the body of literature pertaining to measurement of SD converge in certain areas. Here the discussion is restricted to measurement of SD following economic and accounting approaches. Although both the approaches provide some guidelines towards valuing the environment and thus measuring sustainability, none of the approach is complete in any sense. Therefore, one needs to keep the inherent differences and their limitations in mind before they are applied in practice.

[3] An ecosystem is resilient if it retains the organizational structure and functionality following a disturbance.

### *3.1 Measuring sustainability in economic terms*

In economic parlance, SD requires maintenance of intergenerational well-being, that is, to ensure that total well-being of the future generations of individuals do not decline over time. In other words, SD ensures that the future generations of individuals are at least at the same level of welfare as enjoyed by today's generation. Hence, intergenerational equity in welfare of the future generations lies at the heart of sustainable development. However, a non-declining well-being across generations is sufficient to ensure that sustainability is achieved, but it is not a necessary condition (Stavins *et al.*, 2003). To determine the necessary condition it is important to understand the relation between the actions of the present generation and its far reaching, potential consequences felt over multiple generations.

Take for instance, two cities situated along a river bank, one 'upstream' and the other 'downstream'. Then, the actions of the people living upstream (say, polluting the water) will have severe impact on the health of the people living at the downstream city. On similar lines, one could argue that the actions of the present generation of people living upstream in time will have adverse impacts on the future generations who live downstream. Therefore, the actions of the present generation will determine the very existence and the conditions of existence of the future generations. Hence, the welfare of the present generation cannot be treated in isolation to the future generations' welfare.

To include the notion of interdependence between generations, the neo-classical economists define the total well-being (aggregate welfare) of the current generation as the discounted present value of the well-being of the future generations.[4] According to this view, if the total welfare calculated for each generation does not decline, then development is considered to be sustainable.

[4] Discounted present value refers to the total value of a future stream of asset income from today's standpoint.

However, as the total well-being at any time, say *t*, depends on the level of consumption at *t*, it is necessary to choose the feasible consumption path over time such that total welfare in the corresponding time period is Pareto efficient.[5] It is important to note that choosing a consumption path consistent with a Pareto efficient level of welfare is different from getting an optimum consumption path (the consumption path which yields maximum welfare over time). This is because an optimum consumption path depends on the social rate of time preference (which weighs relative importance of consumption of different generations of individuals over time), and may as well result in Pareto inefficient level of welfare. Thus, 'dynamic efficiency' is a necessary condition for achieving SD. In simple words, the term dynamic efficiency advocates the notion of 'non-wastefulness' in consumption over time. Therefore, in this broader view of sustainability, an economy is sustainable if and only if it is dynamically efficient and the resulting stream of total welfare levels is non-declining over time (Stavins *et al.*, 2003).

A study by Arrow *et al.* (2010) follows a similar approach to define sustainability as the non-declining intergenerational well-being over time. That is, sustainability depends on the capacity to provide well-being to the future generations of individuals. The indicator of this capacity is called comprehensive wealth (the social worth of entire range of capital assets constituting the productive base of an economy), including both marketed and non-marketed assets. Sustainability criterion is satisfied if this comprehensive wealth measure is increasing on a per-capita basis.

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[5] Total welfare is said to be Pareto efficient if one individual's well-being cannot be increased without decreasing the well-being of another individual. Similarly, welfare is Pareto efficient over time (Dynamic Pareto efficiency) if one individual's well-being in any given generation cannot be increased without decreasing the well-being of another individual of the same or other generations.

The study by Arrow *et al.* (2010) is quite broad based as it takes a comprehensive view of sustainable development by considering the entire productive (capital) base of an economy. The capital base includes reproducible capital goods (e.g., roads, buildings.), natural capital (ecosystem, minerals), population (its size and demography), intellectual capital (e.g., public knowledge), and institutions (formal and informal) which help in resource allocation. The authors acknowledge that market for several of these assets may not exist, and estimate the shadow prices for a number of capital assets.[6] For example, consider clean air as an asset for which market does not exist. Nevertheless, since clean air is one of the most important ingredients of life, it carries some value with it. In this sense, the maximum price that one would be willing to pay for an extra unit of clean air (i.e., to avoid an extra unit of pollution) is the shadow price of pollution. These shadow prices are used to estimate the shadow value of the comprehensive wealth. Using this, it is shown that an economy's intergenerational well-being is dependent on its comprehensive wealth. In other words, intergenerational well-being would not decline over a specified period of time if and only if an economy's comprehensive wealth were not to decline over the same period. Thus, development is sustainable over time if it can be shown that the economy's comprehensive wealth does not decline over time.

To infer whether a country is on the path of sustainable development or not, Arrow *et al.* (2010) adopt the concept of comprehensive investment (net addition to the stock of comprehensive wealth, holding the shadow prices constant). This is equivalent to the notion of 'genuine savings' as introduced by Pearce and Atkinson. Genuine savings ($S_g$) refers to that level of savings, over and above the sum of all the capital deprecations in the economy. Intuitively, if $S_g > 0$ any nation must be adding to its capital base. If $S_g < 0$ then the nation is running down its capital stock. As it happens, one cannot tell too much from

[6] The maximum price that one is willing to pay for an extra unit of a resource for which market does not exist.

the value of $S_g$ at any point in time as the interest is in the entire consumption path, not just one point on it. However, if $S_g$ is persistently negative then it can be interpreted that things do not look good for sustainability. If $S_g$ is persistently positive, then there is a greater chance that the way the economy is configured is sustainable.

Recall that if (comprehensive) wealth declines, the present value of utility or well-being also declines, hence the development path is unsustainable because wealth is being 'eaten into'. Moreover, additions to wealth (i.e., comprehensive investment) can be formally identified with genuine savings since genuine savings are defined as 'true' Net National Product (NNP) that is not consumed. Hence, continued positive genuine savings is the criterion for determining whether wealth is increasing and hence whether the development path is sustainable. Thus, it follows that a country is on a sustainable path implies a persistent increase in intergenerational well-being, which in turn implies that the (shadow) value of its comprehensive investment (or, genuine savings) is persistently positive.

### *3.1.1 Population and sustainable development*

All the above conditions for sustainability ignore the growth of population over time. Since population in any given economy is not constant, it significantly affects the conditions under which sustainability can be achieved. For instance, if a country is adding to its capital base (i.e., if genuine savings $S_g > 0$) over time, then one may conclude that the country is following a sustainable path. However, such an inference is misleading as it neglects to consider whether the economy has been adding to its population over the same time period or not. Let $s$ be the growth rate of genuine savings over time and $n$ be the population growth rate over the same time horizon. Then, if population growth is higher than growth rate of genuine savings (i.e., $n > s$) then, the economy's capital base (wealth) per person is declining over time. The country has added more

population than it has been able to add to its capital base over the given time horizon. Hence, the country's development path is unsustainable.

One can re-express the sustainability conditions in per capita terms. If population is growing faster than total wealth, the country has a declining wealth per capita. Since well-being is determined at the individual level by per capita wealth, sustainability means that we must have sustained genuine savings per capita. This is formally equivalent to saying that increments in wealth per capita must be increasing. It follows that we can write

$$\frac{dk}{dt} = \frac{d(K/N)}{dt} = \left(\frac{K}{N}\right) \cdot \left\{ \frac{1}{K}\left(\frac{dK}{dt}\right) - n \right\} \geq 0, \ \textit{Where, } k = \left(\frac{K}{N}\right)$$

Here, $dk/dt$ is the growth of capital per head, $K$ is now all capital (not just man-made capital, ($K_M$)), $N$ is population, and $n$ is the rate of population growth. Note that $dK/dt$ is genuine savings, the net addition to wealth.

It is immediately obvious that, whatever the size of wealth per capita *(K/N)*, the last bracketed expression could easily become negative. It is obviously negative if the rate of population growth, *n*, exceeds the rate at which per capita genuine savings increases as a proportion of per capita wealth. Population growth can be seen to be a potential threat to sustainable development.

Having such broadbased treatment, Arrow *et al.* (2010) are able to empirically test whether some country is on the sustainable development path. They consider five countries which differ vastly in terms of the characteristics of their capital base, viz., United States, China, Brazil, India, and Venezuela. The study finds comprehensive investment as positive in all countries with maximum contributions from human capital. The increment in human capital is a major factor that outweighs the negative influence caused by the depletion of natural capital. China receives the least contribution to its comprehensive investment

from human capital. Similarly, Venezuela appears to be the most resource depleting country, with very large reductions in natural capital. In per capita terms, the study finds India to be a sustainable economy.

### *3.2 Measuring sustainability in accounting terms*

As discussed earlier, the analysis of sustainable development requires a comprehensive measure of wealth which includes different forms of capital, *viz.*, man-made, human, natural, and social capital. Hence, natural resource accounting needs to be much more comprehensive than the conventional national income accounting if one were to encourage the formulation of policies for sustainable development (Parikh and Parikh, 1997, p.4). It is also argued that accounting for the environmental resource use does not normally take place in the process of economic activities because the costs of environmental degradation and resource depletion are not borne by the economic actors who cause them. Although the effects of environmental resource depletion may be outside the profit and loss account of a firm, they are not outside the accounts of society, or nation as a whole.

However, the traditional measures of wealth like Gross Domestic Product (GDP) and Net Domestic Product (NDP) fail to measure accurately the contribution of the environment and the impact of economic activities on environment. This accounting method neglects not only the value of services arising out of rich natural resources, but also factors like high population growth and their pressure on natural resources. The valuation of services from agriculture, fishing, forestry, mineral extraction, and other primary activities on which many developing countries depend are not taken into account. Hence, such omission of the degradation and depletion of the country's natural capital leads to over estimation of national income figures, and also creates an illusion that economy is growing when, in fact, its natural wealth is declining (Haripriya, 2004, p.13). With the above considerations in mind, the traditional accounting systems have been duly considered inadequate. From this viewpoint, it is im-

portant to consider the role of the environment in our economy and the impact of our economic activities on the environment. Hence, a true national income accounting system must consider the role of environment and the impact of economic activities on the environment (e.g., reflect the depletion of natural capital base). Hence, the value of such impact (*i.e.*, value of depletion of natural resources) need to be subtracted from the conventional notion of income to arrive at a true figure of net income. Such accounting measure which is a true indicator of sustainable development is called Green Accounting.

Green Accounting estimates the prices for all national assets, including natural and human capital assets, and includes those estimates in the 'financial statement' of the nation. The methodology captures the 'externalities' (spillovers resulting from economic activities) coming from material and unaccounted changes in several capital, viz., natural, human, and social capital by estimating their stock or net asset values, and brings them within a common framework of value accounting for the nation. In practice, Green Accounting involves an array of quantitative estimations, which involves modeling and valuing the non-marketed services of environmental assets such as forests, calculating the value of education as a generator of future incomes, valuing future liabilities in the form of pollution abatement costs and healthcare costs, etc. One of the important indicators of Green National Accounting system is the Environment Adjusted Domestic Product or Eco-Domestic Product, also popularly known as the 'Green GDP'.

The handbook on a *System of Integrated Environmental and Economic Accounts* published by the United Nations (1993) defines eco-domestic product as follows:

*eco-domestic product (EDP) = gross domestic product (GDP) – depreciation of produced assets – depletion of natural resources – degradation and pollution damage*

Although it is suggested that in order to have a true picture of the rate of economic progress, one must have a more encompassing measure of national income. Thus, eco-domestic product is an intrinsically important measure of inclusive income. However, from the viewpoint of sustainability, eco-domestic product does not directly measure whether this true income can be sustained. This leads to the notion of genuine savings, which can be conceived as the net change in wealth over an accounting period as new assets are invested, old assets depreciate, and natural resources are augmented or depleted. Since wealth represents the potential to generate income and induce well-being, changes in wealth (i.e., genuine savings) are intimately linked to the question of sustainability. The operational or accounting definition of genuine savings is as follows:

*genuine savings = net savings - depletion of natural resources - pollution damages*

where, net savings = gross savings - depreciation of produced assets.

Therefore, using the accounting measure, one can infer a country as sustainable, if the genuine savings are non-declining over time. In other words, a country is sustainable if the growth in its genuine savings is persistently positive over time.

**Box 3. Measuring sustainability: Economic Vs. Accounting approach**

One must make a comparison of the two measures of sustainability in order to facilitate the right choice in policy making. Parikh *et al*. (1997) compare the two approaches in the environmental valuation context. According to them, while the accounting approach prefers to record only the actual financial transactions, the economic approach looks at environmental valuation from a broader perspective.

The true damages of environmental degradation are grossly under estimated in the pure accounting approach, whereas economic approach accounts for some,

if not all, of the environmental damages. In accounting for the health damages, for instance, the accounting approach would record only the actual expenditure on illness, and leads to a cost of illness method. The economic measure, on the other hand, goes beyond illness to account for the loss in human capital including disability adjusted life years (DALY), or statistical value of life (SVOL) or known loss of IQ in children, or the loss of work or output due to absenteeism.

The economic approach presents a broader measure of sustainability. As part of the discussions of the two approaches above, one finds that both economic and accounting measures of sustainability may arrive at the same condition (that genuine savings over time must be non-declining). However, both approaches will yield completely different estimates of genuine savings, because, while the economic approach follows a method of shadow valuation (resource rental for non-marketed goods) and takes into account the opportunity cost of any economic activity, the accounting approach primarily rely on the expenditure approach.

Further, economic measure is surrounded by severe uncertainties arising from the computation of shadow value which is a major limitation of this approach. The accounting approach on the contrary, even if limited in its scope, is a first step towards measuring environmental sustainability which can be applied in practice.

Finally, although the economic approach to measure sustainability is quite broad based and comprehensive, it nonetheless remains value ridden like the very meaning of SD. For instance, the normative requirement that the intergenerational welfare being Pareto efficient is contentious, because one can find consumption path satisfying the condition of non-declining intergenerational welfare that is not Pareto efficient.

## 4.0 Sustainable Development in Practice - India

One of the chief merits of Green accounting is that it overcomes the shortcomings of the traditional approach of the System of National Accounts (SNA) which does not include natural resources into national accounts of an economy. Moreover, having an environment adjusted domestic product, policies can be designed to enhance economic growth without extensive natural resource depletion, thereby achieving more sustainable income. Finally, the gap between GDP and the environmental adjusted GDP quantifies the extent of depletion and degradation and sends important signals to take necessary policy actions.

The field of environmental accounting of natural resources is in a growing stage. India has made a major breakthrough by initiating studies on Natural Resource Accounting (NRA) with the ultimate objective of building up Green GDP for the Country. The Central Statistical Office (CSO) has been working on a methodology to systematically incorporate natural resources into national accounts in different states for land, water, air, and sub-soil assets.

A recent initiative by the Green Indian States Trust (GIST) aims to set up top-down economic models for annual estimates of adjusted Gross State Domestic Product ("GSDP") for all Indian States, thus capturing true "value addition" not just at a National level but also at the States level. The study's top-down approach provides a consistent and impartial national framework to value the unaccounted aspects of national and state wealth and production by establishing the link between existing research which are not yet tied together in a manner to be useful for policy analysis.

Clearly, the efforts till date in India towards incorporating the natural resources in its national income are far less than what is required for an informed decision on sustainable development policy. This requires speeding up the research activities which facilitate better valuation techniques for the environmental resources. An increased participation of the government, both state and central, is necessary to invoke far more seriousness in the pursuit to understand wheth-

er sustainability can be achieved or not. Moreover, equal emphasis on economic approaches as with the accounting approach should be laid to come up with a strong base of environmental accounting in India. Constructing environmental indicators, which would suggest the depletion values of specific natural resources (e.g., GIST's state-wise estimation of the depletion values of several environmental resources), may also help in this direction.

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## DISSEMINATION PAPER SERIES

The Centre of Excellence in Environmental Economics was asked by the Ministry of Environment and Forests to explain the concepts of environmental economics to non-economists through a series of short dissemination papers. The authors welcome feedback on the papers from readers. The following fourteen dissemination papers have been posted on the Centre Website (http://coe.mse.ac.in).

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## Centre of Excellence in Environmental Economics

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