BLOCK 6
SUSTAINABLE DEVELOPMENT

INTRODUCTION TO BLOCK 6

Block 6 is on Sustainable Development. It has two units (Units 13 and 14). **Unit 13** is on Concept of Sustainability. The units first explains the relationship between economic growth and sustainable development. It then describes the different perspectives on sustainable development viz. the economic perspective, the ecological perspective, the social perspective and a synthetic perspective. The two approaches to measuring sustainable development viz. weak sustainability and strong sustainability are then explained. Different 'sustainability rules' (e.g. Hartwick's rule, Daly's principles) are also discussed.

Unit 14 is on Growth and Environment. It first explains the concept of EKC (environmental Kuznet's curve) which describes the relationship between income and environment. This is followed by the different explanations to EKC in terms of: (i) income elasticity of demand, (ii) scale-technique-composition effects, (iii) technological progress, (iv) R & D, (v) innovation and adoption and (vi) organisational change. The environmental impact on international trade (in terms of FDI, globalisation, etc.) is also discussed.

UNIT 13 SUSTAINABLE DEVELOPMENT*

Structure

13.0 OBJECTIVES

After reading this unit, you will be able to:

- define the concept of sustainable development;
- outline the recognition accorded to environment as an important factor of production by historical economic theorists;

* Dr. Anindita Roy Saha, I. P. College, DU, Delhi.

- discuss the implication of economic growth on the quality of environmental degradation;
- outline the perspective of sustainable development in terms of its economic, ecological, social and synthetic perspectives;
- explain the 'concept of sustainability' distinguished for its 'weak' and 'strong' components;
- discuss the 'rules of sustainability' in terms of its various rules and principles; and
- describe the different 'measures of sustainability' in terms of its two practical approaches viz. 'green accounting' and 'genuine savings'.

13.1 INTRODUCTION

The unit deals with the concept of sustainable development. The two concepts of economic growth and development provides us a background for understanding the broader concept of sustainability addressed in this unit. Besides the economic perspective to sustainability, there are other perspectives like ecological and social, which also need to be synthesised in order to understand the multi-dimensional concept of 'sustainable development'. Further, the concept of sustainability is global in nature but carry implications at national level. Sustainable development, therefore, needs to be understood in terms of the treatment of the nation's 'natural capital stock' (of which environment is an integral component) which forms the base for investment and hence economic growth. Depending on the two main types of capital viz. man-made capital and natural capital, the focus would be on maintaining the capital stock, both in the aggregate as well as at the two individual levels.

Against this background, the unit discusses the sustainability rules and its linkage to the role of government in policy formulation. Depending on the policy focus, the policies would cover areas such as: optimal rate of extraction and usage of renewable and non-renewable resources, control and treatment of pollutants, etc. Methods of measuring sustainability, adjustments required in the estimation of national income accounts (to include non-market factors like environmental variables), approach to construction of economic performance indicators like green accounting, genuine savings, etc. are discussed in the unit. A comprehensive idea of sustainable development along with discussions on its perspectives, rules, approaches and measures are thus the aspects covered from an analytical perspective in this unit.

13.2 ECONOMIC GROWTH AND SUSTAINABLE DEVELOPMENT

Nations worldwide have long been concerned with economic growth to evaluate a country's economic standard. The rate of growth, in absolute terms as well as in comparison with the other nations, is the most commonly used indicator of economic performance. An increase in the real Gross National Product (GNP) or National Income is taken as an indicator of economic

growth. GNP is a measure of the standard of living because it measures the size of the economic cake to be divided across the people.

13.2.1 Economic Growth and Development

Economic growth is defined as a long run increase in potential output. The potential output rises due to two factors viz. (i) increase in the amount or quantity of resources used; and (ii) increase in the productivity of these resources. The latter (i.e. productivity) signifies a more efficient use of resources yielding higher output for every unit of input used. GNP can increase if there is an increase in the resource base comprising land, labour, capital, energy and raw materials. Technological progress adds to the efficiency of extraction and optimal utilisation of the resources. Capital accumulation through investment can occur even with constant consumption adding to the country's capital stock. Economic activity increases if productivity increases in people through better standards of education and health. The stock of human capital would thus increase along with an improvement in quality and productivity. While these sources add to the process of growth of an economy, these are not formally considered in measurements of economic growth. This necessitates the broadening of the concept beyond economic growth expressed in terms of GNP. In other words, GNP has been considered an inadequate measure of well-being because it does **not**:

- reflect the distribution of income and resources;
- reflect the changes in social factors such as health and education;
- include the effect of the economic growth process on the environment and vice versa;
- include natural resource stocks in the measurement of GDP/GNP.

Economic development, on the other hand, is a broader concept that encompasses a wide range of indicators requiring them to improve over time. These are:

- increase in GNP per capita;
- reduction in income inequality;
- improvement in education and health indicators.

Economic development may therefore be termed as a superset of economic growth. While GNP remains important for a country's living standard, development describes its overall 'quality of living'. A rising GNP per capita does not necessarily mean that every member is enjoying a better standard of living. It is important to consider both monetary and non-monetary indicators if a comprehensive picture is to be drawn about the quality of life.

While economic growth rests on the principle of 'efficiency' in the production system, it ignores the question of 'equity' or justice. More efficient economic systems produce better output, employment and income. However, it ignores the social variables and quality of life along with the

issue of efficiency in distribution. Development, on the other hand, focuses on efficiency as well as equity.

The basic idea of development was extended to define the Human Development Indicator (HDI). It is a composite indicator of income, health and education making it a better (or more inclusive) measure of the overall performance of an economy. While GNP remains important in the evaluation of economic performance, it is not the only variable in the computation of HDI. As a result, countries have attained HDI rankings quite different from their income rankings.

Even though HDI is an improvement over GNP, neither GNP nor HDI accounts for environmental degradation. However, economy and environment have such important bearing on each other that growth in one can be at the cost of the other. For instance, if there is high ambient pollution, peoples' well-being will decrease while the economy's cost of cleaning up would increase. As a result, GNP would increase due to the activities in the cleaning-up industry, but at the cost of the health of the population. Given this striking reality, it is interesting to examine how such an important component (viz. environment) has been accorded significance by the ancient economic thinkers and what are the turning points in the course of historical growth processes, which have led to 'environment' being accorded the kind of significance that it has come to occupy today. We do this in Sub-section 13.2.2 below.

13.2.2 Environment in the History of Economic Thought

Adam Smith (1723-90), generally recognised as the first economist, did not comment on the inter-relationship between economic growth and environment degradation which is accepted as a major concern today. Thomas Malthus (1766-1834) was the first one to draw attention to the fact that population grows exponentially while food output grows in an arithmetic progression. He thus referred to the pressure on land – an important natural resource – and held that excess food demand over supply may cause imbalance in the economic system. Although this framework was too simplistic, as it ignored the possibility of technological progress, it still offered a reference to the pressures on an environmental resource, if the growing population is not controlled. David Ricardo (1772-1823) used the idea of diminishing marginal returns i.e. with rising population and food demand to say that agriculture will expand to inferior quality of land, raising the cost of production and therefore the food prices. This would in turn have implications on the distributional systems. These views, known as Malthusian and Ricardian scarcity, may be considered as the first traces of concern about limited natural resources posing potential threats to the process of economic growth. John Stuart Mill (1806-73) felt economic growth is a race between diminishing returns and technological progress in which capital accumulation would lead to higher standards of living. Mill thus considered natural resources to be productive to this growth process. Stanley Jevons (1835-82), in his book 'The Coal Question' (1865), discussed the issue of limited reserves of non-renewable resources that are extracted more and more

with economic growth. His is thus one of the earliest prognosis to the concerns of exploitative uses of natural resources. Harold Hotelling developed the rule for optimal extraction of exhaustible resources (1931) while A C Pigou made the important contribution by showing pollution as an externality that can be solved by proper taxation (1920). Indeed, the concerns to declining environmental resources has received attention from early 19th century.

Recent development in environmental and resource economics began with the Limits to Growth theory of the Club of Rome (Meadows et al) in the 1960s. According to this theory, resource constraints may bring in a slow-down and eventually the collapse of the economic growth process. Subsequent economists have developed rigorous theories of environmental, ecological and natural resource economics.

13.2.3 Implications of Growth on Environment

The relationship between environmental quality and economic growth has been a major focus of research in recent years. While environmental degradation is an inevitable outcome of production and consumption processes, higher income and higher population exerts higher environmental impact. This fact, as we saw above, had received due recognition right from 1830s. But with economic growth having received primary attention in the post-war period of reconstruction, issues of exploitative usage of resources and land clearance has caused concern on two counts viz. depletion of exhaustible resources and degradation of the environment and ecology.

The Environmental Kuznets Curve Hypothesis gives an answer to this problem by forecasting an improvement in environmental quality with rise in income, technological advancement and structural change resulting in improvement of the degraded environmental quality. Although empirical evidence of this hypothesis is varied, and therefore cannot be relied on entirely, it has nonetheless served as a guide on how to manage the environmental impacts of economic growth.

Economic growth is both a cause and cure of environmental problems. While growth causes environmental degradation through negative side-effects, it also gives opportunities to develop techniques to combat and reduce it. As in most economic problems, the optimal has to be efficiently chosen by reconciling between economic growth on the one hand and environmental quality on the other.

13.2.4 Sustainable Development: A Global Objective

Sustainable Development is a well-known concept today. The best-known definition is given by the Brundtland Commission Report [titled 'Our Common Future' (1987)] where it refers to the development that meets the needs of the present generation without compromising the ability of the future generations to meet their own needs. Sustainable development, in this sense, is based on the principle of intergenerational equity. It calls for fairness in resource use and distribution both within and across generations.

While 'efficiency' underlines economic growth, 'equity' underlines economic development. Ideally, both should converge with an inter-temporal balance.

Over the last few decades, there is a clear consensus that environmental quality has to be maintained by reduction of anthropogenic contamination to a level acceptable to society. Sustainable development is thus an issue of the management of the earth's resources in a way that their long term quality and abundance is ensured for future generations. What this goal makes clear is that economic policy and environmental objectives needs to be reconciled as it will be unwise to pursue economic growth without environmental concerns, just as it will be irrational to pursue environmental goals ignoring the economic consequences of the future.

Sustainable development is therefore intended to be a global objective. Because of its all-pervasive nature and meaning, collaborative efforts from all stake holders is required. Fundamental to this is negotiations on a global scale. It is an inter-temporal and inter-spatial process where environmental policy objectives are laid, debates and discussions held, and legislative procedures followed bringing the nations to come together to protect their common future.

Check Your Progress 1 [answer within the space given in about 50-100 words]

1) What is economic growth? What are the two factors that contributes to this growth?

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2) Why is a broadening of the concept of economic growth considered necessary to understand the true nature of human well-being?

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3) What are the three factors whose improvement over time signifies 'economic development'?

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4) What basically distinguishes 'development' from 'growth'? Which of the two is more encompassing? Why?

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5) How is HDI a better measure over GNP? Yet, what is a common limiting feature of both these measures?

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6) How can rising GNP be a misleading indicator of the welfare of people? Give illustration.

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7) To which historical economic thinker the credit of having associated 'environment' as a scarce resource can be attributed? Who are some of the other early thinkers whose contribution is recognisable in this regard?

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8) In what respect does the Environmental Kuznets Hypothesis provides an answer to the concern of rising incomes with degrading environmental quality?

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9) How is 'sustainable development' defined? What does it basically connote?

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10) How is 'sustainable development' a global objective? State the processes by which it can be achieved?

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13.3 PERSPECTIVES ON SUSTAINABLE DEVELOPMENT

There has been recognition in literature of three perspectives in defining sustainable development viz. economic, environmental and social.

- An economically sustainable system must be able to produce goods and services on a continuing basis to maintain manageable levels of government and external debt, reducing sectoral imbalance that may otherwise damage agricultural and industrial production.
- An environmentally sustainable system must maintain a stable resource base, control the exploitation of natural resources, maintain bio-diversity and atmospheric stability and other ecological functions that are ordinarily not considered as economic resources.

- Social sustainability aims at distributional equity and provision of social services including health and education. These objectives make sustainability a multi-dimensional concept and a challenge to optimise and balance. Different approaches may be taken and different methods may be adopted to measure different dimensions of sustainability.

Let us now elaborate on each of these perspectives.

13.3.1 The Economic Perspective

Under this, sustainability is defined in terms of the maximisation of welfare over time. The welfare here refers to human welfare and not of the non-human world. Moreover, this welfare considers the maximisation of utility derived only from consumption. Though over-simplified, this approach includes many important components of human welfare, such as food, clothing, housing, transport, health, education, etc. From a formal economic point of view, sustainability means efficient resource allocation which requires the use of time discounting as a method of comparing economic values of consumption at different time periods. The choice of the rate of discount therefore becomes crucial. Low discount rates (or some sustainability rule regarding resource use and environmental impacts) are necessary for establishing inter-generational equity.

The economic perspective of sustainable development (SD) can therefore be operationalised in terms of conservation of natural capital. This leads to the following policy objectives: (a) limit consumption of renewable resources to the sustainable yield level and (b) reinvest the proceeds from the exploitation of non-renewable resources into investment in renewable resources. This can help maintain a sustainable stock of natural capital, in the presence of a stable level of human population.

The above sustainability rule for natural capital is different from the standard neo-classical approach in which there is no reason to conserve natural capital. The well-known Hartwick Rule states that consumption may remain constant or increase with decline in non-renewable resources if the proceeds from these resources are re-invested in reproducible capital. Therefore, maintenance of any stock of natural capital is not necessary. In the Solow-Hartwick approach, man-made and natural capital are substitutable. The opposite view assumes complementarity in general and substitutability in the margins. Thus, given that natural capital has irreplaceable importance, the approach of neo-classical economic efficiency does not suffice for sustainability.

While some issues may be dealt with the neo-classical ideas of market efficiency, there are others like ‘natural capital’ requiring the use of the ‘safe minimum’ approach to protect natural resources and their environmental functions. Such a concept can be applied to intergenerational fairness following which society can chalk out actions that are acceptable in terms of environmental sustainability. This brings-in issues related to moral imperatives, public decision making and formation of social values. Viewed

from this standpoint, sustainability goes beyond the neo-classical economic framework calling for a broader interdisciplinary perspective.

13.3.2 The Ecological Perspective

Unlike the economic perspective, under the ecological perspective, physical scientists and ecologists use the idea of 'limits'. Natural systems are subject to laws of thermodynamics (and population ecology) whereas living organisms are subject to limits of time, space and energy. Therefore, according to the ecological perspective, sustainability must involve limits on population and consumption levels. Humans have to accept the boundaries of a finite time up to which only natural capital lasts. It is also accepted that ecological processes comprise huge variability encompassing genetic diversity much needed to preserve the ecosystem resilience. The importance of this can be understood from the fact that many critical problems faced by humanity are caused by the declining character (or nature) of ecological resilience. Examples of degrading ecological resilience can be cited in terms of consequences of climate change (e.g. extreme floods, forest fires), resurgence of diseases due to antibiotic resistance, spread of AIDS, etc.

An integration of economic and ecological perspectives is therefore required in order to have a holistic view of sustainability. The ecological-economic approach requires sustainability of 'systems' over 'individuals'. Besides these two, a third component viz. the social perspective is also important as it is instrumental in designing social actions linking the economic and ecological approaches.

13.3.3 The Social Perspective

The human development approach emphasises the issues of basic needs and equity. Though it does not explicitly include the environmental measures, the idea of intergenerational equity in life style is embedded in some of its later reports (i.e. Human Development Reports). Since environmental sustainability is intertwined with poverty and inequity, in addition to democracy and decentralisation (which are the two pillars for achieving the inclusive developmental goals), the principles of sustainable and equitable development also need to be built-into the development discourse. Such a perspective would amount to incorporating the essential social dimension to the developmental process.

13.3.4 A Synthesis of Perspectives

A combination of economic, ecological and social perspectives provides a new vision of development. This may be summarised as follows:

- Sustainable development has the potential to remedy social inequities and environmental damage over space and time while maintaining sound economic base.
- It is important to conserve natural capital for sustainable economic production and intergenerational equity. Market mechanisms are not sufficient for this purpose.

- From the ecological point of view, both population and total resource demand should be subject to 'limits of growth'. The integrity of ecosystems and diversity of species must be maintained.
- Social equity, fulfilment of basic needs and participatory democracy are all essential elements of development. All these are interrelated with environmental sustainability.

The above principles therefore suggest new guidelines for development, namely, sustainable development.

13.4 APPROACHES TO SUSTAINABLE DEVELOPMENT

The meaning of the term sustainability has been the subject of debate and discussion among environmental economists and other professionals ever since the inception of the concept. This is one of the very few issues that separates traditional economic view of the natural world from the views of modern scientists. The debate mainly centres around the substitutability of the environmental resources in order to keep the net 'natural resource stock' maintained by making appropriate compensatory additions to used-up resources. In other words, a balance is required to be established between natural capital and manufactured capital. This is the debate between weak and strong sustainability discussed in this section.

13.4.1 Weak Sustainability

Development is termed 'weakly sustainable' if the nation's portfolio of natural capital is maintained at a constant level (i.e. non-diminishing over generations) so as to maintain a non-decreasing level of output. The approach assumes substitutability among the different components of capital. This is the dominant interpretation of sustainability among economists who mainly consider only three types of capital viz. man-made/manufactured capital (K), human capital (H) and natural capital (N). Weak sustainability approach requires that the total capital stock (K+H+N) should be non-declining over time. The assumption of substitutability implies that all forms of capital can be aggregated in the same units. This is known as the 'Hartwick-Solow Sustainability'. Alternately, the 'Hicksian Sustainability' requires that the principle of non-decreasing consumption should equally apply to the consumption of environmental goods and services. The 'weak sustainability' approach implicitly assumes that if savings are invested in manufactured or human capital, they serve as perfect substitutes to natural capital.

Following this principle, countries with resource depletion and ecological damage may still look sustainable. However, substitutability of K and N may be one-way i.e. once transformed to K, it may be impossible to get back N. This, therefore, is a major limitation of this sustainability argument making it weak.

13.4.2 Strong Sustainability

The other interpretation of sustainability views sustainability (in terms of the non-diminishing characteristic) to be achieved by conserving the stock of all four components of production viz. human capital, natural resources capital, environmental quality and technological capability. According to this approach, minimum amounts of different types of capital should be independently maintained in real physical form. The underlying argument is that natural resources are essential inputs in economic production, consumption and welfare and hence cannot be substituted by manufactured and/or human capital. In other words, environmental components are unique. The environmental processes are irreversible and therefore not substitutable.

Very strong sustainability is a concept developed further by the Deep Ecology movement and by those who believe in the right to life for all species. This implies that every component or subsystem of the natural environment, every species and every physical stock must be preserved. However, this seems difficult for a number of reasons. These are: (i) the present industrial economy depends highly on primary resources; (ii) species and ecosystems are subject to continuous processes of natural change of which humans are also a part i.e. they are also subject to processes of natural change and while human activity accelerates some of these processes, it inhibits others; and (iii) the existing laws and traditions bestow some rights to some resources (e.g. property rights) but not for many others (e.g. uncovered areas and weakly enforced environmental standards).

A compromised version of strong sustainability is that a minimum amount of certain environmental assets should be maintained because these assets are partly complementary and partly substitutable to economic assets. They can be regenerated only by nature over a very long period of time.

Check Your Progress 2 [answer within the space given in about 50-100 words]

1) What is the central feature that distinguishes between the economic and environmental perspectives of sustainable development?

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2) In what way does the perspective of 'social sustainability' make it a multi-dimensional concept?

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3) What are the two policy objectives in terms of which the economic perspective of sustainable development can be operationalised?

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4) How does Hartwick-rule propose to maintain consumption levels in the face of declining non-renewable resources?

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5) What characterises the approach of 'inter-disciplinary perspective of sustainability' making it to go beyond the neo-classical economic framework?

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6) What is the fundamental premise on which the 'ecological perspective of sustainable development' is based? Under this, what does 'ecosystem resilience' mean?

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7) Why is it important to incorporate the 'social perspective to sustainable development' into the development discourse?

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8) What is the basic assumption behind the Hartwick-Solow concept of sustainability' making it less rigorous (weak) as compared to the concept of 'Hicksian sustainability'?

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9) Is it rational to regard 'man-made capital' and 'natural capital' as substitutes of each other? If no, why?

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10) State the reasons as to why the concept of 'very strong sustainability' is regarded untenable.

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13.5 SUSTAINABILITY RULES

The markets that provide economic solutions to consumption of natural assets/capital do so under certain rules and guidelines laid down by the governments. There may be rules for protecting environment where government intervention is crucial for sustainability. Four types of intervention have been suggested in this regard.

13.5.1 Valuation of Environmental Goods and Services

Natural resources are often over-used because they are generally under-priced. Since sustainable alternatives and economically efficient solutions do not necessarily coincide, placing the correct prices for environmental goods and services, as accurately as possible, is essential for sustainable use of resources. For instance, taxes may be imposed in order to incentivise abatement of pollution or waste disposal. These may lead to more efficient

use of the environment. At the same time, economic efficiency may also increase.

13.5.2 Hartwick's Rule

This rule is close to the idea of weak sustainability. According to Hartwick's rule, consumption levels may be kept constant over time if the rent derived from the consumption of natural resources is duly re-invested in man-made capital. Such a conditional 'reinvestment' may result in non-declining consumption allowing the 'net capital stock' to remain constant.

This idea has two limitations: (i) it assumes that utility depends on consumption and environment is important only as an input for production; and (ii) this rule works only when the different forms of capital are substitutes to each other which is not so in reality.

13.5.3 Daly's Operational Principles

Herman Daly prescribes a set of principles to attain sustainable development. There are four components to the Daly's principles. These are:

- Renewable Resources: The rate of harvest of renewable resources (e.g. fishery) must be kept at less than or equal to the rate of its natural growth.
- Non-renewable Resources: A large part of the income from the extraction of non-renewable resources must be invested in renewable substitutes. This will help create substitutes with the productive capacity nearly the same as the non-renewable resources consumed by the time the latter is exhausted. However, it may be difficult to estimate the optimal time of exhaustion and extraction just as it is difficult to develop a renewable substitute of a non-renewable resource.
- Pollutants: Emissions should not exceed the assimilative capacity of the receiving environment. Although it seems a sensible rule, the problem lies in the fact that the assimilative capacity varies over time and space. The correct policy is difficult to design temporally and spatially.
- Controls: Daly advocated tight quality controls over and above price controls to check increasing threats to human welfare.

13.5.4 Rules for Natural Capital

This is similar to the idea of strong sustainability which requires a non-declining stock of natural capital. This means, any action that reduces the stock of natural capital must be offset by a physical project that generates an offsetting replacement. Cost-benefit analysis should be carried out to identify such replacement activities. However, this may be difficult in the sense that many environmental effects do not have physical substitutes. Moreover, development projects may degrade some natural resources which may not have an offset value at the current point of time. This questions the development projects that threaten unique assets.

One possible answer lies in the concept of the Safe Minimum Standard (SMS). SMS is a means to assess the proposed change that threatens environmental and ecological balance. It involves identification of the minimum viable size of the resource and the cost of its safeguarding. The problem here is to decide the level that society will accept as not too high to preserve the SMS at some opportunity cost. Identification of SMS is easier for wildlife than for other forms of natural capital. It requires the developer and the conservationist to work together in order to decide the sustainable rules whereby economic development will not be sacrificed for ecological sustainability and vice versa.

13.6 MEASURING SUSTAINABILITY

As agreed upon at the Rio Earth Summit in 1992, the nations of the world have come up with a set of proposals for indicators of sustainable development. These indicators have been developed from a multidisciplinary perspective. Two important economic perspectives in this respect are the following.

13.6.1 Green National Accounts

The conventional accounts omit many of the inputs which are provided by the environment to the economy. This is largely because these resources are unpriced by the market. Depletion of natural capital is typically ignored in the national income accounts whereas that of man-made capital it is accounted for. Calculating Green GDP (Gross Domestic Product) is an attempt towards this adjustment.

In order to remove the deficiency in the measurement of conventional GNP measure, one measure suggested is to impose a maximum limit on the consumption of such natural capital for which there is scope for reinvestment to regenerate. Such a measure is evidently applicable for renewable natural resources like fishery and forest. Thus, the approach to Green Accounting allows a series of deductions for depreciation of natural capital stocks (e.g. deforestation, ground water depletion). The other approach involves making adjustments for non-renewable resources. In analytical terms, the formula for green GDP can be expressed as follows:

$$\text{Green GDP} = \text{GDP} - (P_1 - MC_1)\, D_{nr} - (P_2 - MC_2)\, D_r - V\, D_s$$

where P_1: price of non-renewable resources;

P_2: price of renewable resources;

MC_1: marginal cost of non-renewable resources;

MC_2: marginal cost of renewable resources;

D_{nr}: change in the stock of non-renewable resources;

D_r: change in the stock of renewable resources;

V: marginal cost of abatement of pollution;

D_s: change in the pollution stock S.

There could be many variants of the above equation. However, since one needs to aggregate over many types of renewable and non-renewable resources and pollutants, the adjustments will be correct if the price and cost figures come from 'competitive and dynamically optimal' use of resources. Though there is a debate over green GDP as a sustainability indicator, it does show the way to modify the traditional economic approach to incorporate the ecological and social perspectives with that of the economic perspective.

13.6.2 Genuine Savings

An alternative indicator of sustainable development is the concept of genuine savings. It compares reinvestment in an economy to make up for depreciation in both natural and manufactured capital. It is defined as:

$$GS = S - D_m - D_n$$

where GS: gross saving; S: Total saving; D_m: depreciation in man-made capital; D_n: depreciation in natural capital.

The calculation of natural capital depreciation is similar to that of the environmental adjustments in GDP in that it includes all the components valued in the same way. To make the calculations more complete, changes in the stock of human capital can also be included. The genuine savings approach is based on the weak sustainability principle because it assumes substitutability of the different types of capital. It also tests whether a country on an average is following the Hartwick rule or not. Genuine savings and green GDP are derived from the same underlying theory. However, as has been observed empirically, they need not send the same signals.

13.6.3 Other Sustainability Indicators

Indicators of sustainability have also been designed in disciplines other than Economics. These include the net primary production-consumption ratio and ecological footprints. There are also socio-political indicators such as the Index of Sustainable Economic Welfare.

All these indicators are designed to be calculated at the national level. There are more indicators of sustainability at the regional, industrial and individual firm levels.

Check Your Progress 3 [answer within the space given in about 50-100 words]

1) State Hartwick's rule. What are its two limitations?

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2) What are the four components of Daly's principles? In particular, what is the limitation of his proposal on 'pollutants'?

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3) Define the concept of Safe Minimum Standard. How can this be determined and operationalised in reality?

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4) State the equation for estimation of Green GDP specifying its different components.

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5) What is the concept of 'Genuine Savings'? How is it defined?

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13.7 LET US SUM UP

The unit discussed the implications of economic growth on sustainable development. Describing the relationship between economic growth and development, it dealt with the implications of growth on environment. Different perspectives on sustainable development like the economic, ecological and social perspectives have been discussed. A synthesis of all

perspectives is to develop a comprehensive indicator of sustainable development. Sustainable development has two dimensions viz. weak sustainability and strong sustainability. The difference in the two lies in the treatment of the different types of capital so as to maintain the overall level of nation's natural capital stock. Sustainability rules are important to design policies that the government can impose in order to promote economic growth without compromising on environmental sustainability.

13.8 KEY WORDS

Weak Sustainability : Refers to the maintenance of total capital stock in a non-declining manner. It assumes that manufactured and human capital are perfect substitutes of natural capital consumed in production process and that they can be aggregated in the same units.

Strong Sustainability : The concept argues for the conservation of natural resources and environmental quality, at least in its minimum amounts. The concept assumes that environmental processes are irreversible and hence manufactured and human capital are not substitutes of natural capital.

Net Primary Production-Consumption Ratio : This ratio measures the human society's draw on nature. It indicates the rate of human appropriation/consumption of the net primary resources from various natural eco-systems like forests, oceans, land, etc.

Ecological Footprint : This is a measure of human impact on earth's ecosystem. It reveals the dependence of the human economy on natural capital.

Index of Sustainable Economic Welfare (ISEW) : Developed by Daly and Cobb (1989), this is an indicator intended to replace the GDP. It tries to include variables related to social and environmental issues over and above the ones included in the conventional income accounting.

13.9 SOME USEFUL BOOKS AND REFERENCES

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13.10 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Economic growth is defined as a long run increase in potential output.

2) As conventionally measured, GDP does not incorporate the contribution of many factors which add to the process of growth.

3) Increase in GDP per capita, reduction in income inequality and improvement in education and health indicators.

4) Development incorporates 'equity' while growth considers only 'efficiency'. Development is thus more encompassing as it considers growth with equity.

5) By being a composite indicator of income, health and education.

6) GDP can increase due to expenditure incurred in cleaning up services caused as a result of rising pollution affecting the health of people. Thus, growth in GDP could be at the cost of the population.

7) Malthus and Ricardo, Stanley Jevons, Harold Hotteling, etc.

8) By forecasting an improvement in environmental quality with rise in income.

9) It incorporates the principle of inter-generational equity.

10) Because of its all-pervasive nature and meaning, it requires negotiations on a global scale.

Check Your Progress 2

1) The former emphasises continuous production with concern for sectoral balance while the latter emphasises on a stable 'resource base'.

2) By aiming at distributional equity and provision of social services including health and education.

3) By limiting the consumption of renewable resources and by reinvesting the proceeds from the exploitation of non-renewable resources into investment in renewable resources.

4) By reinvesting the proceeds from the consumption of non-renewable resources in production of reproducible capital.

5) By bringing-in issues relating to moral imperatives, public decision making and formation of social values.

6) The premise that sustainability must involve limits on population and consumption levels.

7) To make the two pillars of achieving inclusive developmental goals complete.

8) The former (Hartwick-Solow concept) assumes that all forms of capital can be aggregated in the same units. But the latter (i.e. the Hicksian) requires that the principle of non-decreasing consumption should equally apply to the consumption of environmental goods and services.

9) No. Because, natural resources are essential inputs in economic production, consumption and welfare and hence cannot be substituted by manufactured and/or human capital.

10) Because species and ecosystems are subject to continuous processes of natural change.

Check Your Progress 3

1) That consumption levels may be kept constant over time if the rent derived from the consumption of natural resources is duly re-invested in man-made capital.

2) The assimilative capacity varies over time and space.

3) It is a means to assess the proposed change that threatens environmental and ecological balance.

4) Green GDP = GDP – $(P_1 – MC_1) D_{nr} – (P_2 – MC_2)D_r – V Ds$.

5) It compares reinvestment in an economy to make up for depreciation in both natural and manufactured capital.

UNIT 14 GROWTH AND ENVIRONMENT*

Structure

14.0 OBJECTIVES

After reading this unit, you will be able to:

- discuss the relationship between 'income and environment' in terms of the EKC (Environmental Kuznets Curve) hypothesis;
- outline the issue behind the growth-environment controversy;
- establish the relevance of the EKC hypothesis for the three major environmental quality indicators;

* Prof. Soumyananda Dinda, University of Burdwan, West Bengal.

- explain the factors contributing to the differing trends in the EKC;
- distinguish between the 'displacement, pollution haven and factor endowment' hypotheses in the context of international trade;
- describe the factors which links trade with changing environmental standards in high and low income countries; and
- analyse the factors which needs to be efficiently tackled in order to have a 'market mechanism' capable of preventing environmental degradation.

14.1 INTRODUCTION

The nature of relationship between economic growth and environmental quality has become the focus of increased attention in the literature of development and environmental economics. The issue is one of whether environmental degradation associated with economic growth increases monotonically, or increases in the beginning but declines in the later stages, etc. More generally, the interest is to know whether the trend in the decline of environmental quality once it begins is continuous or whether there could be further upward turns in it. Thus, while economic growth through industrialisation brings higher incomes and well-being, it also acts as a *magnifier* of environmental degradation. The linkage between environmental quality and economic growth has evoked much interest particularly since the 1990s with the publication of World Development Report, 1994. The report presented cross-sectional evidence across countries on the relationship between different indicators of environmental quality and per capita national income. Two major explanations offered by this report are:

i) use of environment as a major *source of input and a pool for waste assimilation* increases at the initial stage of economic growth, but as a country grows and becomes richer, structural changes take place resulting in greater environmental protection; and

ii) viewed as a consumption good, as an economy grows, the *status of environmental quality changes from a luxury to a necessary good*.

Thus, with rising per capita income levels, phenomena like: (i) structural economic change and transition, (ii) technological improvements, (iii) rise in public spending on environmental research and development (R & D), etc. are considered to be important in determining the nature of relationship between economic growth and environmental quality. The study of such a relationship therefore relates to the issue of the 'impact of economic growth on environment'.

14.2 INCOME-ENVIRONMENT RELATIONSHIP: THE EKC

The linkage between environmental quality and income has evoked considerable discussion since the pioneering work of Grossman and Krueger (1991). Several other studies have documented an inverted U-shaped relationship between environmental degradation and income. The common

point of all these studies is the assertion that environmental degradation initially increases, but after reaching a maximum level, as the economy continues to grow, it declines. This systematic inverted-U relationship has been called as the *Environmental Kuznets Curve* (*EKC*). The logic of *EKC* hypothesis is that environmental degradation rapidly rises in the early stage of economic growth primarily because the society attaches a higher priority to growth of material output and income over the demand for clean air and water. The awareness of environmental problem being low at this stage, environment-friendly production technologies are either not used or not available. Typically, income growth at this stage takes place through expansion of agriculture and other intensive resource extracting activities causing an enormous pressure on environment and increase in pollution. Beyond a threshold level of development a high and rising income level induces people to value environmental quality. This awareness induces qualitative changes in the economy in favour of: (i) less resource intensive production; (ii) stricter enforcement of environmental regulations and standards; etc. In sum, as Arrow (1995) puts it: the story of *EKC* hypothesis is a narration of the process of evolution of a clean agrarian economy to a polluting industrial economy and ultimately to a clean service economy.

14.2.1 Growth - Environment Controversy

Before 1970, it was believed that, as an economy grew, the consumption of raw materials, energy and natural resources would grow almost at the same rate (i.e. at the steady state rate). In the early 1970s, the Club of Rome's *Limits to Growth* view expressed concern on the continued availability of natural resources. Briefly, the environmental economists of the Club of Rome argued that the finiteness of environmental resources would prevent economic growth and therefore urged for a steady state (i.e. *zero rate of growth*) growth to avoid the drastic ecological consequences in future.

By 1990s, it was realised that economic growth degrades environmental quality. Beckerman (1994), in contrast, suggested that the economic growth by itself could be a panacea for environmental degradation. Supporting this view, Panayotou (1993) also claimed that economic growth could be a precondition for environmental improvement, particularly in developing countries. The essential argument was that if a country in its course of development is able to reach a high enough income stage, it will be willing and able to afford an income generation strategy leading to improved environment. This is in direct conflict with the pessimistic view of the Club of Rome viz. global economic development will be unsustainable unless a zero growth rate (or a steady state strategy of development) is pursued. A bridge between these two opposite views about the future of the world ecology was the idea of a *development path* which provided a stage-based link between environment and economic growth. This notion of development path suggested that in the early stage(s) of economic growth a poor society will prefer and strive for a fast growth of output and income at the cost of extensive environmental degradation, whereas, once a threshold level of development is crossed, the same society will attach a much greater value to

the environmental quality and hence take measures to ensure improvement of the environment.

Empirical data on various pollutants started becoming available from the early 1990s. Major agencies publishing such data are: (i) Global Environmental Monitoring System (GEMS); (ii) the Oak Ridge National Laboratory (ORNL); (iii) World Resources Institute (WRI); (iv) International Energy Agency (IEA); (v) United Nations Environment Programme (UNEP); (vi) Compendium of the OECD; (vii) FAO's Production Yearbook; (viii) WHO's Health database; etc. Such data availability induced several researchers to empirically test the validity of the income–environment relationship. The first empirical study to appear was a paper by Grossman and Krueger (1991), published by the National Bureau of Economic Research (NBER). Being the first, it became a landmark in a series of studies which appeared later. The next two empirical *EKC* studies which appeared independently are: (i) a discussion paper for the International Labour Organisation (Panayotou in 1993), and (ii) the World Development Report (1994). Thus, it was the Grossman and Krueger's study (published in 1993) that first pointed out an inverted-U relationship between pollutants and income-per-capita. However, since this bear a close resemblance to Kuznets' inverted-U relationship between income inequality and economic development, Kuznets's name was later attached to the inverted-U relationship between pollution and economic development. In light of this, from 1990s onwards, the Kuznets Curve took on a new existence becoming a vehicle for describing the relationship between pollution and income. In fact, Kuznets had published that the relationship between per capita income and income inequality would be an inverted U-shaped one in 1955. As per Kuznets, as the per capita income increased, income inequality would also increase at first but then start declining beyond a turning point. The distribution of income would thus be more unequal in early stages of growth but later, as economic growth continues, it would move towards greater equality. Thus, the relationship between income per capita and income inequality can be represented by a bell-shaped curve. This observed empirical phenomenon is what is popularly known as the Kuznets curve.

14.2.2 Environmental Quality Indicators

In the absence of a single environmental indicator, literature distinguishes three main categories of environmental quality indicators viz. (i) air quality indicator; (ii) water quality indicator; and (iii) other environmental quality indicator. We shall now note briefly how the environmental curve for each one of these indicators behaves itself compared to the postulation by Kuznets.

The measures of urban and local air quality indicators generally show an inverted-U relationship with income. Significant *EKC*s have been observed mainly for local air pollutants like SO_{14}, SPM, NO_x and CO (all of which are energy related). Selden and Song (1994) focussed on urban air concentrations and observed a peak at lower income levels rather than in terms of total per capita emissions. In contrast, for the global environmental indicators like CO_2 emission, it was observed that municipal waste and energy consumption

either increased monotonically with income or else has high turning points with large variation. Generally, the literature does not find much evidence in support of *EKC* for air pollutants but recent studies observe that CO_2 emission increases monotonically with rising income. Several studies have reported finding evidence of N-shaped curve for some indicators i.e. they visualised a inverted U-curve initially but beyond a certain income level the relationship (between environmental pressure and income) again turned positive, making it a N-shaped curve. In other words, there can be a secondary turning point at which the levels of ambient air pollution could increase. Thus, the *EKC* may be a short run phenomenon for local air pollutants and may not hold in the long run.

For water quality indicators also, the empirical evidence on the validity or otherwise of the *EKC* hypothesis is mixed. Three main categories of indicators are generally used as measures of water quality viz. (i) concentration of pathogens in water, (ii) amount of heavy metals and toxic chemicals in water and (iii) measure of deterioration of the oxygen content in water.

Studies focused on 'other environmental indicators' mostly do not support the *EKC* hypothesis. These studies observe that environmental problems having ***direct*** impact on the population (e.g. access to sanitation and safe drinking water) tend to improve steadily with economic growth. On the other hand, environmental problems having ***indirect*** impact on people (e.g. municipal solid wastes, CO_{14} emission) do not show a tendency to decline. The evidences on the *EKC* relationship in case of deforestation are also highly conflicting.

Check Your Progress 1 [answer within the space given in about 50-100 words]

1) The present concern about the relationship between rising economic growth and environmental degradation can be traced to which particular event? What are the two major explanations offered in this regard?

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2) Give examples of likely determinants which needs to be focused upon for describing the phenomenon of the 'impact of economic growth on environment'.

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3) State the underlying logic behind the EKC hypothesis? Does the EKC provide for a second turn in its declining trend in the improving environmental quality?

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4) What is meant by the 'steady state rate of growth' or strategy?

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5) What is the compromising idea of a 'development path' propounded to bridge the difference in perspectives of two different schools of thought?

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6) How did the name of Kuznets come to be associated with the environmental curve i.e. the EKC?

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7) Does the available evidence supports the EKC for air and water quality levels unambiguously?

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14.3 EXPLANATIONS TO EKC

As the income of an economy grows over time, initially emission level rises, reaches a peak and then starts declining after a threshold level of income has been crossed. It thus describes a development trajectory for a single economy growing through different stages over time. Individual countries, in their process of development, generate income and emission which, *ceteris paribus,* follow the *EKC*. Empirically, this development trajectory has been observed in cross-country cross-sectional data, which represents countries belonging to different (low, middle and high) income groups corresponding to their respective emission levels. Assuming all countries follow one and the same *EKC*, at any point of time, it is observed that poor countries are mostly at the rising part of *EKC*, developing countries are at the part of the *EKC* where it is approaching the peak (or about to cross it) and the rich countries are in the falling part of the *EKC*. Thus, several factors could be responsible for shaping the *EKC*. The various explanations for these differing trends are offered as follows.

14.3.1 Income Elasticity of Demand

The most common explanation of the inverted U-shape is in terms of income elasticity of demand for environmental quality. As income grows, people achieve a higher standard of living. They start caring more about the quality of environment they live in and demand its improvement. Thus, the income elasticity of environmental quality demand is invoked in the literature as the main reason for the reduction of pollution (emission) levels with rising income. This implies that people attach increasing value to environmental amenities when a country achieves a sufficiently high income level. This would be reflected through *defensive* expenditures, donations to environmental organisations and/or use of less environmentally damaging products and technologies. OECD data on public R&D expenditure for environmental protection confirms this.

Consumers with higher incomes would not merely be willing to spend more for *green products.* They can also create pressure for environmental protection regulations and institutional reforms such as promulgation of environmental legislation and creation of market-based incentives to reduce environmental degradation. Systematic efforts for reducing pollution in high-income countries has been observed with economic growth accompanying improvements in many social indicators, particularly income inequality. Such indicators include education and information accessibility that shift social preferences away from consumption of private goods toward public goods like environmental amenities.

14.3.2 Scale-Technology – Composition Effects

Economic growth is observed to affect the environmental quality through three different channels viz. scale, technology and composition effects. Since increasing output requires more inputs, and thus more natural resources are used up in production process, growth exhibits scale effect on the

environment. This generates more wastes and emissions as by-products and they in turn, degrade environmental quality. Economic growth, on the other hand, may have a positive impact on environment through a composition effect. As income grows, the structure of the economy tend to change in a way that the share of cleaner activities in GDP is gradually raised. For instance, environmental degradation tend to increase as the structure of the economy changes from rural to urban, or agricultural to industrial, and then it starts declining with another structural change taking place due to the gradual replacement of energy intensive industrial activity with knowledge based technology-intensive industrial activity. Technological progress thus plays a major role in this process of transformation by helping in the substitution of dirty and obsolete technologies by cleaner ones. This is called the *technological effect* of economic growth. The *EKC* suggests that the negative impact on the environment of the scale effect tends to prevail in the initial stages of growth, but eventually gets outweighed by the positive impact of composition and technological effects that help reduce emission levels.

14.3.3 Technological Progress

Generally, technological progress leads to greater efficiency in the use of energy and materials. Thus, a given amount of goods can be produced with successively reduced burdens on natural resources and environment. One aspect of this progress may be better and more efficient reuse and recycling of materials. Coupled with greater efficiency in use, reuse and recycling can yield large resource savings. There is a growing trend among industries to reconsider their production processes in order to take environmental consequences of production into account. This concerns not only traditional technological aspects of production but also new organisation of production and design. Technological changes associated with the production process also result in changes in the input-mix of materials and fuels. International trade facilitates diffusion of technology which otherwise prevents economic late-comers by requiring the same levels of materials and energy inputs (per unit of production) that the industrialised countries needed in the beginning. Thus, trade allows developing countries to *dive through* the *EKC*. Munasinghe (1999) suggests that developing countries may learn from the experiences of industrialised nations and restructure growth and development to *tunnel* through any potential *EKC* - thereby avoiding going through the same stages of growth that involve relatively high (and even irreversible) levels of environmental harm.

14.3.4 R&D

As income grows, people can adopt better and efficient technology that provide cleaner environment. This preferential behaviour of people is reflected through their income elasticity. The income elasticity of public research and development funding for environmental protection was found to be positive in the case of 19 OECD countries over the period 1980-1994. This indicates the key role of such public investments for environmental improvements in reducing environmental degradation. The effect of economic growth on pollution/emissions differs substantially among high-

income countries. Relative income levels and existing political framework (in which policy decisions are taken) determine the emergence of downward sloping segment of EKC. This depends on the adoption of new technology.

14.3.5 Innovation and Adoption

New technologies, unambiguously, improve productivity but create potential dangers to the society through risk from new hazardous wastes. Such negative externalities are unknown in the early phase of diffusion of technology, while in later stages, regulation is brought-in to address it. Once the technology is regulated, it stimulates the gradual phasing out of existing technology. Thus, a cyclical pattern emerges in which diffusion effect in the first phase gets regulated in the second phase and finally are phased out in the third phase giving rise to adoption of next generation of technologies with the cycle repeating itself successively. Thus, an inverted-U shape can be observed with reference to each technology. Through this pattern of innovation, income growth and pollution over-cycles, a sequence of Environmental Kuznets Curves emerge relating to each technology. This may produce an envelope of EKCs, which may again be of an inverted-U or N-shaped or inverted-L shaped curve. As we saw above, the Environmental Kuznets Curve hypothesis is confirmed with empirical evidence for many pollutants although the earlier EKC studies established that for some pollutants it follows an N-shaped relationship with income. Thus, for some pollutants, there can be different turning points. This implies that over a certain period, during which income grows, one pollutant may decline but another may rise due to adoption of new technology.

14.3.6 Organisational Change

Improved technology not only significantly increases productivity in the manufacture of old products but it also aids the development of new products. There is a growing trend among industries to reconsider their production processes thereby taking the environmental consequences of production into account. This concerns not only traditional technological aspects but also the organisation of production and the design of products. Technological changes associated with the production process would also result in changes in the input-mix of materials and fuels. In this, material substitution is an important element which may result in lower environmental impacts. Such economy-wide reforms often contribute comprehensively to the economic, social and environmental gains. The EKC approach seeks to relate the stages of economic development of a country to phases of environmental degradation. Developing countries could learn from the experiences of industrialised nations and restructure their growth and development strategies to avoid going through the same stages of growth that involve relatively high (and even irreversible) levels of environmental harm. However, it still may not be clear which environmental policies would be effective to reduce pollution. However, all studies which investigated EKCs have hinted at the importance of policy implications in this respect.

14.4 INTERNATIONAL TRADE

International trade is an important factor that helps to explain the relationship between environmental quality and economic growth. Environmental quality could decline through the *scale effect* as increasing trade volume (especially export) would expand the size of the economy thereby increasing the extent of pollution. Thus, *ceteris paribus,* trade might be a cause of environmental degradation. Trade may be good for environment as well through the *composition* and *technological effects*. As income rises through trade, environmental regulation is tightened. As a result, *pollution reducing innovation gets promoted*. It is hypothesised that *polluting industries concentrate in developing countries with low environmental standards*. The differences in the consumer preferences for a cleaner environment in rich and poor countries induce these two hypotheses.

It is observed that changes in the structure of production in developed economies are not accompanied by equivalent changes in the structure of consumption. This could be explained by the *EKC,* which actually record the shifting of dirty industries to less developed economies. As Rothman (1998) speculates, what appears to be an improvement in environmental quality may in reality be an indicator of increased ability of consumers in wealthy nations to distance themselves from the *environmental degradation* associated with their consumption. The mechanisms through which such distancing takes place include both moving sources of pollution away from the people and moving people away from pollution sources. Thus, in general, the phenomenon of *distancing* may be a possible source of *EKC* results. Hettige et al (1994) observe that toxic intensity grew rapidly in high-income countries during the 1960s but this pattern was sharply reversed during the 1970s and 1980s, after the advent of stricter environmental regulations in the OECD countries. Concurrently, toxic intensity in LDC manufacturing grew quickly. This is what is referred to in the literature as the displacement hypothesis. Analysis of the composition of international trade reveals that manufacturing goods exporting countries tend to make higher energy consumption. They find the poor and rich countries to be net importers and net exporters of pollution-intensive goods respectively. Therefore, the inverted U-shaped *EKC* curve might partly be the result of changes in international specialisation under which poor countries engage in *dirty* and energy intensive production while rich countries specialise in *clean* and service intensive production, without effectively any change in the overall consumption patterns.

A polluting activity in a high-income country normally faces higher regulatory costs than its counterpart in a developing country. Under these circumstances, the pollution intensive industries will have a tendency to migrate to countries with weaker environmental regulations. This is referred to as the *Pollution Haven Hypothesis (PHH)*. In other words, the *PHH* basically suggests that countries having stricter environmental standard will lose all their *dirty industries* to poor countries having poorer environmental standards. On the contrary, the *factor endowment hypothesis* (FEH) asserts that under free trade the differences in endowments (or technology)

determine trade between two countries. Under this view, capital-abundant countries tend to export capital-intensive goods, regardless of differences in environmental policy. According to the FEH, polluting industries will first concentrate in affluent countries, which also tend to be capital abundant. This is because polluting industries are typically also capital intensive and thus affluent countries have a comparative advantage in these industries. Thus, the differences in environmental policy and differences in factor endowments might jointly determine the comparative advantage in trade. With this, the FEH and PHH counteract and offset each other. Thus, the basic characteristics of a country and its dominating comparative advantage determines how trade liberalisation influences its sectoral composition and consequently environmental outcomes. Thus, the three basic factors which links trade with changing environmental standards in high and low income countries are the following.

14.4.1 Foreign Direct Investment

Most of the developing countries rely on technology transfer through foreign direct investment from developed countries as a primary means of technology acquisition. Thus, developing countries can be said to provide a 'pollution haven' if they set environmental standards below their efficiency levels in order to attract foreign investment. However, increased global eco-consciousness, and linking of trade and investment with environmental issues, has the potential to disrupt these investments flows.

14.4.2 Globalisation

Globalisation could trigger the environmental 'race to bottom', in which competition increases for investment and jobs. In fact, 'the bottom' rises with economic growth as the poor economies improve their environmental quality with increase in investment, income and employment. Thus, globalisation is compatible with pollution reduction. Economic globalisation is thus a driving force for global economic growth notwithstanding the fact that opinion is divided about the benefits of this process. Open economies, however, raises the issue of potential conflicts between two powerful current trends viz. (i) the worldwide acceptance of market oriented economic reform process and (ii) environmental protection.

14.4.3 Race to Bottom

In a race to bottom scenario, relatively high environmental standards in developed economies impose high costs on polluters. So, polluting activities in high-income economies face higher regulatory costs than their counterparts in developing countries. This creates an incentive for at least some highly polluting industries to relocate and thereby result in international capital reallocations. Rising capital outflows force governments in high-income countries to begin relaxing environmental standards. As the race to bottom accelerates, the EKC flattens and rises toward higher existing level of pollution.

14.5 MARKET MECHANISM

The existence of a self-regulatory market mechanism for traded natural resources is expected to prevent environmental degradation. The argument underlying this assertion is that in the early stages of growth, there is a heavy exploitation of natural resources due to the relative importance of the agricultural sector. This tends to reduce the stock of natural capital of an economy. Efficient use of natural resources would increase only after: (i) a threshold stage of development is crossed, (ii) markets for environmental resources develop and (iii) prices begin to reflect the real value of natural resources. Consequently, the rising price of natural resources reduces their exploitation at later stages of growth. Further, higher prices of natural resources accelerates the shift toward less resource-intensive technologies. Hence, not only induced policy interventions, market signals also can explain the shape of the *EKC*. Therefore, *EKC* has become a standardised notion in technical discourses about environmental policy. Strong policies and institutions in the form of more secured property rights, better enforcement of contracts and effective environmental regulations can help flatten the *EKC*. Most of the empirical evidences suggest that environmental problems can be solved at higher levels of income only for some specific environmental quality indicators. The factors which contribute to this are the following.

14.5.1 Information Accessibility

Degree of competition in the market depends on information about the product quality and production process. Given the overall sources of pollution, emissions partially account for the environmental problem. Other than economic growth, several other factors like income distribution, education, information accessibility, etc. also goes to determine environmental quality. Since social policy decisions heavily depends on information accessibility (corresponding to the position of the economy and the environmental quality), information plays a vital role to curve down the pollution levels through regulations.

14.5.2 Regulation

With economic growth, economies advance along with the development of their social institutions essential to enforce environmental regulation. Developing countries are now moving from command-and-control policies to market-oriented forms of regulation. Information about polluters, damages, local environmental quality, abatement measures, etc. significantly improves the ability of regulators to enforce environmental standards. Environmental regulatory institutions are either weak or absent in less developed countries. In this situation, focusing on few sources, which are responsible for most of the pollution, helps. Targeting, monitoring and enforcement efforts on such dominant sources can significantly reduce emissions. When formal regulation is weak or absent, 'informal regulation' to induce pollution abatement can work. For instance, in a situation where community complaints was confronted by a paper mill in India, the company installed pollution abatement equipment and also compensated residents for repairing the

damage caused. Non-Governmental Organisations (NGOs) and social groups (including religious institutions, social organisations and politicians) can thus contribute in informal regulation. Such informal pressure has to be highly localised with a proactive vernacular media acting as an important agent. The resulting 'pollution equilibrium' reflects the relative bargaining power of the informal efforts of the community and the formal efforts of the government.

14.5.3 Property Rights

Most of the natural resource base could be treated as commons although with time, some commons gets redefined as private property. Private property is, however, the most incentive-enriched as individuals have greater incentive to manage, conserve and accumulate wealth (either to be traded or passed on to future generations). Economic progress is partly determined by the extent to which environmental assets are protected by private property rights. Countries with a high degree of private ownership and proper allocation of property rights have more efficient resource allocation which help to increase income and decrease environmental problems. Policies related to secured property rights under a rule of law with better enforcement and effective environmental regulations can help flatten the EKC. In other words, EKC could be a proxy for a property rights model that begins with a commons and ends with private property rights.

14.5.4 Structural Change

Along with economic development, societies advance with their social, legal, and fiscal infrastructures which are essential for enforcing environmental regulation. Institutional changes triggered by citizens' demand for cleaner environments are more likely to occur in democratic countries. Such changes could lead to structural changes both in the patterns of production as well as the socio-economic features. It is observed that the production structure shifts rapidly in industrialising and developing countries whereas it remains more or less stable in developed countries. In a developing economy, the sectoral composition also changes rapidly, changing thereby the industry's share in *GDP*. Such changing compositions of economic activity, in combination with trade, could have a major impact on environment. Sometimes, an external shock may also force the structure of the economy to change.

14.5.5 Socio-Political Regime

Restructuring the environment tends to become more and more expensive, and it may be less costly to prevent or abort it today than in the future. There is a general agreement that environmental policies are the key determinants of the future path of income-environment relationship. Public preferences are reflected through environmental quality related public policies that influence the relationship between income and pollution. In other words, demand-side characteristics are identified to influence the state's environmental policy, and also the mechanism through which such preferences are manifested. Provision of public good, especially with regard to air and water quality, falls in the state domain because it is beyond the capacity of individuals to influence the quality of such goods directly. The environmental policy is thus

a function of the preferences of society with the actual levels of environmental quality depending on the weights placed on various heterogeneous societal preferences generally characterised as 'the policy regime'. One major determinant of environmental policy is the socio-political regime of a country in which corruption and rent seeking behaviour greatly influences the income-environment relationship. A well-defined property rights structure, democratic voting systems and respect to human rights create synergies leading to increased levels and efficacy of environmental policy. Such policies are formulated at national level but implemented at local levels. In many such situations, command and control policies are ineffective because policy makers suffer from lack of proper information about local environmental damage. Local communities should therefore assume a role in protecting their environment. The demand for environmental protection should therefore come from local levels to national levels and thereby to global level. It is such demand led policies which are emerging and will actually shape the Future World.

Check Your Progress 2 [answer within the space given in about 50-100 words]

1) In what way 'income elasticity of demand' contributes to the following of EKC by a country?

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2) How does technology aids adoption of cleaner methods of production thereby reducing the ill-effects on environment?

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3) How does 'technological progress' assists developing countries in controlling their environmental degradation?

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4) Why do certain pollutants have different shaped trajectories than that of EKC?

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5) What is meant by 'displacement hypothesis' in the environmental literature?

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6) What are the three factors which contribute to altering the structural composition of industries, linking trade and changing environmental standards, in a country?

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7) Do you agree that globalisation is compatible with improving environmental standards? How?

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8) What do you understand by the term 'race to bottom'? Does this give a reason for the EKC to have a secondary turning point?

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9) How does 'informal regulation' help in abatement of pollution? In this context, what does the term 'pollution equilibrium' mean?

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10) In what way does the 'demand side characteristics' influence the environmental policy of governments?

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14.6 LET US SUM UP

Economic growth and Environmental quality have elicited conflicting reactions from researchers and policy makers with the stakes in *growth - environment* debate being high for both the developing and the developed countries. Among a multiplicity of possible outcomes, an inverted-U pattern can only be obtained under specific circumstances. This requires attention to an array of factors that forms the economic-environmental system. The growth-environment (or *EKC*-analysis) may have some limitations but empirical evidence for the existence of the *EKC* is substantial although not always conclusive. The subject of EKC analysis is thus open-ended with the growth-environment debate continuing to be widely discussed. Again this background, the unit exposes the learners to its various determinants and instruments.

14.7 KEY WORDS

Steady State Strategy of Development : A zero rate of growth, argued by the Club of Rome, to cope with the 'finiteness of environmental resources' which would eventually prevent economic growth.

Development Path : This is an idea which provided a stage-based link between environment and economic growth. It argued that once a certain stage of development is reached, countries would themselves attach a greater value to environmental quality.

Factor Endowment Hypothesis : This hypothesis asserted that under free trade, the differences in endowments (or technology) would determine trade between two countries.

14.8 SOME USEFUL BOOKS AND REFERENCES

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14.9 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Since the 1990s with the publication of World Development Report, 1992.

2) Structural economic change and transition, technological improvements, etc.

3) Environmental degradation rises rapidly in the early stage of economic growth primarily because the society attaches a higher priority to growth of material output.

4) Growing almost at the same rate.

5) The compromise is provided by a stage-based link between environment and economic growth.

6) Kuznets's name was later attached to the inverted-U relationship between pollution and economic development since Krueger's study (1993) observed the same relationship as observed by Kuznets between inequality of income and growth of GDP.

7) No. The EKC may a short run phenomenon for local air pollutants and may not hold in the long-run.

Check Your Progress 2

1) By creating pressure for environmental protection regulations and institutional reforms.

2) By a gradual replacement of energy intensive industrial activity with knowledge based technology-intensive industrial activity.

3) By enabling the production of a given amount of goods with successively reduced burdens on natural resources and environment.

4) Because, as income grows, structural changes may result in one pollutant to decline but another to rise due to new technologies.

5) Displacement hypothesis suggests that people create/keep distance from pollution or polluted products.

6) Social, legal and fiscal infrastructures.

7) Yes. Globalisation could be a driving force for global economic growth notwithstanding the fact that opinion is divided about the benefits of this process.

8) Due to relatively high environmental standards in developed economies, polluting industries in high-income economies face higher regulatory costs providing an incentive for at least some highly polluting industries to relocate.

9) Through NGOs, social groups, etc. Pollution equilibrium refers to the result of bargaining power of the informal efforts of the community and the formal efforts of the government.

10) Environmental policy being a function of the preference of society, public preferences on environment influences the relationship between public policies and pollution.

GLOSSARY

Abiotic Natural Resources : Abiotic resources are non-living objects found in the biosphere (e.g. minerals, water, air and energy resources like petrol, diesel, etc.).

Act : An Act is a legally binding legislation or law. It is enacted by either the parliament or a state legislative assembly with their jurisdiction extended either to the whole nation or the particular state.

Ambient-differentiated Regulation : Refers to the compensation for damage inflicted.

Arrow's Impossibility Theorem : Arrow's result shows how aggregate preferences will be 'well-behaved' (i.e. complete, transitive and reflexive, and independent of irrelevant options), only under a dictatorship. In other words, the desired properties of a social welfare function cannot be achieved under a democracy. 'Aggregation' of individual preferences to construct social preferences is, thus, not a straightforward exercise.

Bill : The draft of a proposed law presented for debate in either a house of parliament or state assembly.

Biotic Natural Resources : Biotic natural resources are either gathered from the biosphere or may be grown by mankind (e.g. vegetables, birds, trees, plants, algae, worms, etc.).

Cap and Trade : The regulator sets a cap (a limit) on overall emissions and allows trading among polluters. This system is more centralised. Trading involves a price or value on a permit to pollute.

Cap-and-Trade System : A policy through which a limited number of permits to pollute are issued and can be bought and sold in the market. It combines a quantity based limit on emissions and a price based approach that places a cost on environmentally damaging decisions.

Capital Flight : Describes a phenomenon of outflows of resident capital due to distortion in domestic policies and political risk or instability.

Coasian Bargaining : Refers to a negotiation process that takes place privately between parties to eliminate an externality provided property rights are defined.

Command and Control (CAC) Approach	:	CAC prescribes regulations on what to do and in what measure? They involve the environmental regulator stipulating the action that an individual firm or polluting agent should take with regard to pollution control for environmental protections. A polluter may have limited flexibility in how it meets the regulatory requirements.
Congestible Goods	:	Goods that are excludable but non-rival up to a point.
Contingent Valuation Method	:	In contingent valuation method, the individual is posed a set of questions directly asking him to reveal his willingness to pay for the good.
Cost-Effectiveness	:	The cost-effectiveness of a policy is defined as achieving the target/goal by implementing a said policy at least cost.
CPCB	:	A statutory organisation, constituted under the Water (Prevention and Control of Pollution) Act, 1974. It is entrusted with the powers and functions to prevent and control air and water pollution.
Development Path	:	This is an idea which provided a stage-based link between environment and economic growth. It argued that once a certain stage of development is reached, countries would themselves attach a greater value to environmental quality.
Discrete Manufacturing Production Technology	:	A firm can produce one good/product for distinct purposes with differentiated technologies for a given time. For instance, M&M company produces Jeeps with discrete technology for civilian and defence.
Ecological Footprint	:	This is a measure of human impact on earth's ecosystem. It reveals the dependence of the human economy on natural capital.
Ecosystem	:	Ecosystem refers to coexistence and mutual interaction of living organisms and nonliving components in the natural environment as a system.
Efficiency	:	An allocation of resources is efficient if it is not possible to make anyone better off, without hurting at least one person in the economy.
Efficient Emissions	:	When the cost of abating one more unit of pollution by one polluter is equal to the cost of abating one more unit of pollution by another is equal across 'n' number of polluters, then an

efficient aggregate level of emission is achieved.

Emission Rate Trading : 'Emission trading' is expressed in terms of the rate that a pollutant constitutes in total output.

Emission-Differentiated Regulation : This ignores the differences among polluters and tries to control pollution in such a way as to achieve the ambient target.

Environmental Protection Act, 1986 : An Act passed in 1986 with the objective of providing for the protection and improvement of the environment. It empowers the central government to establish authorities charged with the mandate of preventing environmental pollution in all its forms and to tackle specific environmental problems that are peculiar to a region.

Equity : It is a normative concept, often understood as 'fairness'.

Existence Value : Value which arises from mere knowledge that the environmental resource exists.

Externalities : Externalities arise when the consumption or production of one agent affects (positively or negatively) the consumption and/or production of another agent with no compensation mechanism existing.

Factor Endowment Hypothesis : This hypothesis asserted that under free trade, the differences in endowments (or technology) would determine trade between two countries.

Global Common : The term describes international or global resource domains in which common-property resources are found. They include the earth's shared natural resources, such as the high oceans, the atmosphere and outer space and the Antarctic in particular.

Hedonic Pricing Method : Under the hedonic pricing method, keeping other things constant, we measure the price of housing for different levels of air pollution and see how the housing price changes due to change in air pollution.

Index of Sustainable Economic Welfare (ISEW) : Developed by Daly and Cobb (1989), this is an indicator intended to replace the GDP. It tries to include variables related to social and environmental issues over and above the ones included in the conventional income accounting.

Kaldor-Hicks Compensation Test : This criterion postulates that a change is welfare-improving as long as the winners

(those who gain from the change) could, in principle, fully compensate the losers, and still be better off.

Liability : It means if you harm someone, you must compensate that person for damage.

Liability laws : Liability laws make polluters liable for the damages they cause. The party claiming damage can approach the court which can assess the value of the damages and stipulate suitable compensation in accordance with the law.

Market Based Instruments : Indirect instruments which provide rewards for polluters to do what is perceived to be in public interest.

Market Failure : Refers to the inability of the market to achieve allocative efficiency, due to the violation of certain 'ideal' conditions.

Marketable Environmental Assets : Marketable environmental assets are those natural assets which can be traded in the market (e.g. timber, medicinal plants, minerals and natural gases, etc.).

MoEF : The nodal ministry 'for planning, promotion, co-ordination and supervising the implementation' of India's environmental and forestry policies and programmes.

Natural Assets : Natural assets are provided to us by the nature. These include air, soil, water, forests, biodiversity, minerals, etc.

Net Primary Production-Consumption Ratio : This ratio measures the human society's draw on nature. It indicates the rate of human appropriation/consumption of the net primary resources from various natural eco-systems like forests, oceans, land, etc.

Non-Excludability : Refers to a situation where no agent is denied access to a good or service.

Non-Marketable Environmental Assets : Non-marketable environmental assets are non tradable natural assets. They cannot be sold and bought in the market because they are common property resources (e.g. river, wildlife, air, groundwater and glaciers, etc.).

Non-Produced Assets : Non produced assets are supplied to us by nature free of cost. They include all natural assets.

Non-Rivalry in Consumption : Refers to a situation where the consumption by one agent does not reduce the units of consumption available to another agent.

Non-Use Value : Value which arise even when the good is not actually used (e.g. existence value).

Normative Economics : The branch of economics that can be used to explain 'what should be'. It entails making value judgements.

Offset Trading : Offset trading targets the new firms to pay existing firms to reduce their emission below standard so as to offset the added emissions of the new firms.

Open-Access Resources : Goods that are non-excludable but rival.

Optimality : At an optimal allocation, society's welfare is maximised.

Pareto Improvement : It is defined as a change where at least one person benefits, and nobody loses.

Pigouvian Fee : It is an emission fee exactly equal to the aggregate marginal damage by emissions when evaluated at the efficient level of pollution.

Point and Non Point Sources of Pollution : Pollutants enter the water environment from two main types of sources: point source and non point sources. A point source is a single, identifiable source of pollution, such as a pipe or a drain. Industrial wastes are commonly discharged to rivers and the sea in this way. Non-point sources of pollution (also termed 'diffuse' pollution refer to such impacts which occur over a wide area and are not easily attributed to a single source. For instance, in farming areas non-point sources of pollution include pesticides, fertilizers, animal manure and soil washed into streams in rainfall run-off.

Policy : A purposive course of action followed by an actor (or set of actors)to deal with a problem or matter of concern.

Pollution Fees : The payment paid by the polluter to a regulatory body per unit of pollution emitted.

Pollution Halo : FDI brings new and cleaner technology that reduces pollution level in developing countries. Such FDI diffuses advanced technologies, upgrades managerial skills and practices creating *pollution halos* in developing economies.

Pollution Haven Effect : This is a weaker version of PHH which predicts the movement of FDI in response to environmental regulation and net pollution of developed country declines.

Pollution Haven Hypothesis (PHH) : Predicts that removal of trade barriers between developed (high income) and less developed (low income) countries results in pollution intensive production moving to low income countries with relatively low environmental regulation.

Porter Hypothesis : Asserts that stricter environmental standards spur innovations that enhance the character of competitiveness, and hence, right kinds of environmental policies will help the economies in the long run.

Positive Economics : The use of economics to describe the world. It is a value-neutral analysis.

Private Goods : Goods that are both rival and excludable.

Produced Assets : Produced assets are those which are generated by mankind by using natural and other resources and technology.

Public Goods : Goods that are non-rival and non-excludable. Such goods are typically not provided at the efficient level by private markets.

Revealed Preference Method : Under this method, preferences for environmental goods and services are inferred from observed behaviour in actual markets. For this purpose, markets closely related to the environmental goods are chosen.

Stated Preference Method : Under this method, individuals are directly asked to state their willingness to pay for the particular environmental good (e.g. contingent valuation method).

Steady State Strategy of Development : A zero rate of growth, argued by the Club of Rome, to cope with the 'finiteness of environmental resources' which would eventually prevent economic growth.

Stock Pollutant : Pollutants towards which the environment has low absorptive capacity are called stock pollutants (e.g. persistent organic pollutants such as PCBs, non-biodegradable plastics, and heavy metals). Stock pollutants accumulate in the environment over time. The damage they cause increases as more pollutant is emitted and persists as the pollutant accumulates. Stock pollutants can create a burden for future generations, by passing on the damage that persists well after the 'benefits' received from incurring that damage are forgotten.

Strong Sustainability : The concept argues for the conservation of

natural resources and environmental quality, at least in its minimum amounts. The concept assumes that environmental processes are irreversible and hence manufactured and human capital are not substitutes of natural capital.

Subsidies : Subsidies refer to what the public authority pays a polluter for every ton of emission reduced from a bench mark level.

Sustainable Development : Economic progress that meets the needs of the current generation without compromising the needs of the future generations.

Tradable Permit : Allows polluter to buy and sell the right to pollute. Pollution control is expressed by holding the number of emission permits.

Tragedy of Commons : This is a term used in social science to describe a situation in a shared-resource system where individual users acting independently as per their own self-interest behave contrary to the common good of all users by depleting or spoiling that resource through their collective action. The concept became widely known owing to an article written by the American ecologist and philosopher Garrett Hardin in 1968. In the modern economic context, commons is taken to mean any shared and unregulated resource such as atmosphere, oceans, rivers, fish stocks, or even an office refrigerator.

It is argued that the very term 'tragedy of Commons' is a misnomer since 'the commons' refers to land resources with rights jointly owned by members of a community with no individual outside the community having any access to the resource. However, the term is now used in social sciences and economics for describing a problem where all individuals have equal and open access to a resource. Thus, 'tragedy of open access regimes' or simply 'the open access problem' are more apt terms.

Upcycling and Recycling : Upcycling can take place in perpetuity (i.e. forever) while recycling mainly delays the final disposal of waste material.

Use Value : Value that comes from the actual usage of the environmental good.

Waste Sink : The service provided by the environment wherein it acts as a receptacle of residuals generated by human activity.

Weak Sustainability : Refers to the maintenance of total capital stock in a non-declining manner. It assumes that manufactured and human capital are perfect substitutes of natural capital consumed in production process and that they can be aggregated in the same units.

Welfare Economics : The branch of economic theory which investigates the nature of the policy recommendations that the economist is entitled to make.

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