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Environmental problems from an economic perspective

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6.1 Introduction

Many people think that it is the way the economy operates that gives rise to environmental problems – this even being the root cause of the environmental crisis facing the planet. *Economics* is frequently perceived as being at odds with *ecology* and *the environment*. However, are there ways in which economics can assist in the solution of such problems? This chapter sets out to examine the potential contribution of economics to understanding environmental problems and resolving the environmental crisis.

The chapter begins with a brief description of what economics is about (section 6.2). It then looks at the economic functions of the environment and examines the relevance of the laws of thermodynamics (section 6.3). It goes on to outline how economists have traditionally looked at natural resources and the environment (section 6.4). It then discusses the interrelationship between economic systems and ecosystems (section 6.5) and considers the property and access arguments of ‘the tragedy of the commons’ (section 6.6). Finally it makes some concluding comments on international environmental policies (section 6.7).

6.2 What is economics? Some economic concepts

Economics can be viewed in two ways – in terms of scarcity or material welfare. It can study how choices are made between alternatives in the allocation of scarce resources to fulfil human aims and objectives. It may also examine individual and social action to obtain and use resources to meet material needs and thereby achieve human well-being.

Traditional economics deals with production and consumption. Labour, capital, and natural resources are used in the production process to ensure a sufficient supply of goods and services which can be bought by consumers on markets. On the other hand,

there are collective goods such as an army, dikes, roads, infrastructure and education which are provided by the government or by other authorities. Economic goods are scarce, as scarce production factors are used to produce private as well as collective goods. This brings us to one of the most difficult topics in economics, the problem of *value* and *price*, which is particularly important in relation to nature and the environment. Natural resources may have a market price, as, for instance, coal, natural gas, iron ore, and land. However, in many cases, natural resources do not have a price. A country may not have a shortage of water, but the quality of that water is a different matter. Surface waters may be more or less polluted and not suitable for drinking purposes. As long as sufficient water of good quality is available, water does not have a price, but when pollution becomes significant, drinking water will have a price.

Markets and market forces

In most parts of the world, the economic context is one governed by market forces. This term needs to be defined strictly. Market forces come into being, at the level of the whole economy, when the majority of decisions made at the level of individual firms and consumers take place in markets, and there is no one determining the collective consequences. Market forces are thus the overall sum of many millions of separate individual parts.

It is important also to distinguish between *markets* and *market forces*. Market forces are a macroeconomic phenomenon, at the level of the economy as a whole. Markets by contrast are a microeconomic mechanism, operating at the level of individual products, businesses and households. They are defined by the existence of a number of suppliers and purchasers free to choose with whom they trade, where changes in price mediate between supply and demand. Markets can be and are regulated by government intervention, for example through taxes and laws: there are no completely 'free' markets. But even where markets are regulated, market forces can still operate. They do so whenever the overall result of individual decisions made in markets is unplanned. Regulation of markets *may* be designed to plan the overall outcome, but this is not usually the case. In most cases market-regulating laws are introduced simply to prevent certain microlevel occurrences, such as exploitation of workers or consumers. In the case of taxes the purpose is generally to raise revenue for the government.

This is what happens in most sectors of the economy, on both national and international scales. The overall allocation of resources and commodities (energy, raw materials, money, labour, goods and services, wastes) is not planned by a single agency. It is left, rather, to the undetermined, combined result of many different agents' decisions. These decisions are made privately; that is, without reference to others' similar decisions, on the basis of each agent's own interests. In general it is impossible for individual economic agents to take into account the wider effects of their actions, which cannot be known. Added together, market forces thus generate an overall result which no one has determined. This is the 'invisible hand' which Adam Smith argued brought general prosperity.

Source: Jacobs (1991), pp. 23–5.

However, it could not be argued that drinking water only has economic significance when it has a price resulting from pollution. Even before pollution, it is a significant resource in the process of production and consumption. It can be concluded from this example that price is not always a useful indicator of economic scarcity and significance.

As the majority of natural resources do not have a price, a general impression has arisen that nature and the environment are outside the realm of economics. It must be stressed that this is a myopic view. It is not the price which conveys economic significance; this is found in the scarcity of the good and in its possible use in the process of production and consumption. It is irrelevant, from an economic point of view, whether this scarcity has been translated into prices or not. Nevertheless, economics is often associated with prices and not with scarcity. This is based on a long tradition in neoclassical theory, in which the market was and is the focus of interest.

As the supply of particular resources and commodities increases, so their price will tend to fall; this is the simple relationship between supply and demand, as determined by markets and market forces (see Box 1). However, the price of goods may be influenced by other factors including, for example, who controls the resources, the extent of competition between producers of goods, and government intervention in, or regulation of, the market. The combination of all the economic decisions of individuals (that is, unplanned by government or other central agency) brings about the allocation of resources and commodities and – it is argued – general prosperity.

In market economies, increasing production and consumption of goods and services has generally been regarded as ‘a good thing’ – demonstrating the material well-being

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GDP and GNP

Gross domestic product (GDP) is the total value in money terms of all the production in a country in one year. It is measured in three different ways (which should all end up with the same total): through adding the value of the goods and services produced, through adding the expenditure on them, and through adding the incomes received from producing them. Production where no money changes hands – such as unpaid domestic work – is therefore excluded from GDP. Money changing hands where there is no production – such as gifts – is also excluded.

Gross national product (GNP) is GDP plus rents, interest, profits, and dividends flowing into a country from abroad, minus rents, interest, profits, and dividends paid out to people in other countries. GNP therefore measures the total income received by the inhabitants of a country. GNP depends on where the owners are located; GDP depends on where the economic activity is located. In a country with a lot of foreign investment in it but very little investment by its inhabitants in other countries, there will be a net outflow of ‘property income’ (rents, interest, profits, and dividends). This will result in a GNP much lower than its GDP.

GDP or GNP per capita, i.e. per head or per person, is GDP or GNP divided by the total population of the country. This gives a figure often described as measuring the ‘average standard of living’.

Source: Anderson (1991), pp. 19–20.

Types of resources

Non-renewable resources are those which (in a human time-scale) cannot be regenerated by natural processes: fossil fuels (coal, oil, gas), minerals and other materials. Fossil fuels can of course be 'regenerated', but only over a period of several million years. Non-renewables are therefore ultimately in fixed supply: all use depletes the total stock.

Renewable resources are those which, through natural regeneration processes, can continue in supply despite being 'used' by humankind. Plants and animals, of course, reproduce and regrow. But clean air and fresh water are also renewable: the elements oxygen, hydrogen, carbon and nitrogen (among others) are constantly recycled by living organisms in processes such as photosynthesis, respiration, nitrogen fixing and decay.

Continuing resources, by contrast, are inexhaustible. They are those sources of energy the supply of which is unaffected by human activity. They are often called 'renewable', but this is not strictly accurate. The two principal original sources of continuing energy are the sun, which generates solar radiation and wind energy, and gravity, which generates tidal and wave energy and hydropower (though this, dependent on water, is also partly renewable). Some geothermal energy (heat from the Earth's crust) is also a type of continuing resource.

Source: Jacobs (1991), pp. 3–4.

of both individuals and society as a whole. In economic terms, these benefits are reflected in measures (or *indicators*) of *growth*, known as gross domestic product (GDP) or gross national product (GNP) (see Box 2).

6.3 Economic functions of the environment and the laws of thermodynamics

Before we begin to look at the development of economic thinking in relation to natural resources and the environment, it is important to consider what kind of *economic functions* are served by the environment, because all of human economic activity depends on the natural environment.

'The biosphere performs three principal functions for the economic activities of humankind' (Jacobs, 1991, pp. 3–5). Jacobs identifies these as provision of *resources*, assimilation of *waste products*, and provision of various *environmental services* (amenities and 'life-support' services). There are three main types of resources: *non-renewable*, *renewable*, and *continuing* (see Box 3).

Jacobs clearly explains how the 'economic functions of the environment are related in quite specific ways, by the first two *laws of thermodynamics*' (see Box 4).

Having established the important implications for environmental policy of the laws of thermodynamics, Jacobs contrasts two models of the economy, the diagrams reproduced here as Figures 6.1 and 6.2.

The relevance of the laws of thermodynamics

The laws of thermodynamics are the physical rules which govern the behaviour of matter and energy. The *first law* is very simple. It states that matter and energy cannot be either destroyed or created. There is a fixed total, which is always conserved in some form or another. This law has a rather profound bearing on economics, because it calls into question what exactly economic activity does. Clearly, for all the effort that goes into production, nothing 'new' is actually created. All that happens is the *transformation* of materials and energy from one state into another. Every quantity of resources which enters the economic process must emerge at the end as the same quantity of waste. The *quantitative* relationship between the first two environmental functions (provision of resources and assimilation of waste products) is therefore straightforward. The more resources are used, the more wastes need to be assimilated. Resource depletion and pollution are essentially the same problem, two sides of one coin.

But the relationship has a *qualitative* dimension to it as well. The transformation of resources into wastes follows a specific path dictated by the *second law* of thermodynamics or 'entropy law'. Entropy can be understood as a measure of the 'disorderedness' or 'unavailability' of matter or energy. Thus a lump of coal has low entropy; it is concentrated in form and the energy it contains is available for use. But once the coal is burnt it has high entropy, becoming dissipated as heat and carbon dioxide, neither of which is available for use. The example illustrates the workings of the second law, which states that (so long as there are no external sources of energy) entropy always increases. Entropy is thus indeed a way of defining resources and wastes: the former have low entropy, the latter high entropy. In turn economic activity may be thought of as a process by which low entropy materials are converted into high entropy ones, while useful services are derived from them en route.

It is here, however, that the third function of the environment (the performance of environmental services) enters the picture. For it is not quite true that entropy always increases. Note that the second law only insists on this if there are no external sources of energy. This is of course the case with respect to the universe as a whole. But it isn't so for the Earth. On the contrary, the biosphere is powered by a continuous flow of energy from the sun. And this enables the flow of entropy within the biosphere to be reversed. This 'circular' activity is made possible and carried out by the performance of environmental life-support services.

The three economic functions of the environment are therefore clearly linked. Resources and wastes are ultimately the same quantities. They differ only in entropic value; but high entropy is constantly being converted back into low entropy through the life support services which the environment performs.

It will be apparent that these connections increase the complexity of the environmental crisis. It might be thought possible, for example, to reduce the problem of resource depletion if wastes could be recycled faster or more efficiently. But the damage being done to life-support services actually reduces the ability of the environment to assimilate wastes and recycle them; an increasing quantity simply gets stored as pollution. More recycling could be done by the economy but the entropy law tells us that this can only be done if additional energy is applied, which, if it comes from fossil fuels, only adds to the pollution problem.

Source: Jacobs (1991), pp. 11-13.

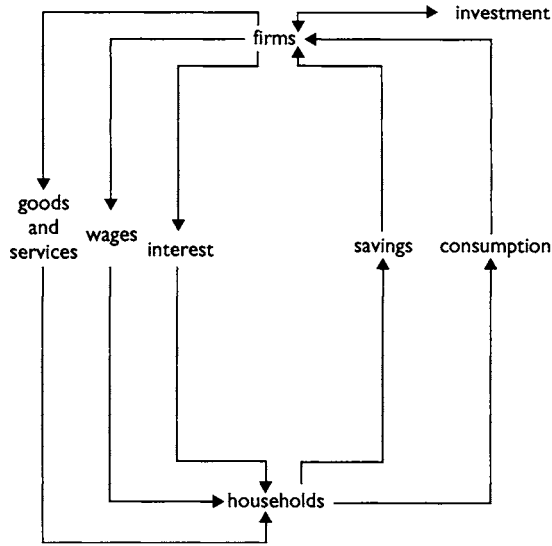


Fig. 6.1 The orthodox model of the economy. Source: Jacobs (1991), p.13

Figure 6.1 shows the traditional view of the economy as a circular flow of money. This ignores the physical environment, matter, wastes and energy, which physical description is illustrated in Figure 6.2. The latter integrates the environment into the view of the economy.

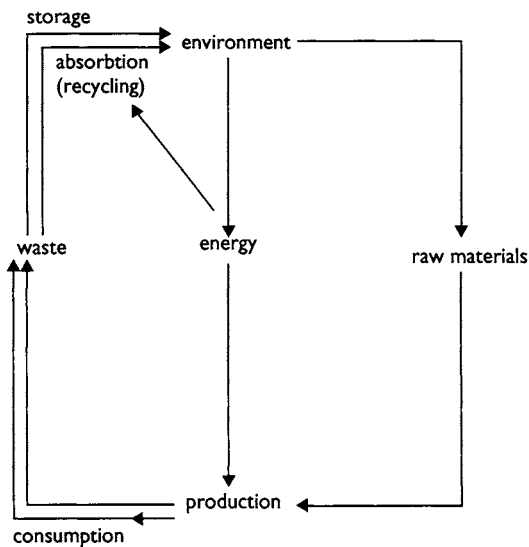


Fig. 6.2 A simple thermodynamic model of the economy. Source: Jacobs (1991), p.14

6.4 Economic theory, natural resources and the environment

In traditional economics, natural resources are only dealt with to the extent that they are traded on a market. The deterioration of Nature and the pollution of the environment are outside the scope of economics as long as these phenomena cannot be defined in terms of prices. Traditionally, therefore, economic growth has been defined as an increase in production and/or consumption, without any attention being paid to the disruption of Nature and the environment (see Box 5).

Environmental problems and property rights

Prices cannot be seen as given facts. They are closely related to the definition of *property rights* with regard to natural resources. If the property right to a natural resource is not well defined, the resource can be used by many economic actors. A lack of property rights to natural resources will result in these resources not having a price and overexploitation will often be the consequence. Society can control the use of natural resources either by means of prices or by a system of regulations.

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Natural resources and ecosystems

Economics has a long tradition of distinguishing between the production factors of labour, capital and natural resources (either Nature or land). Labour and capital have received abundant attention, but this cannot be said for natural resources. This chapter uses a broad definition of *natural resources*, which is not restricted to natural resources bought and sold on the market. Furthermore, natural resources are taken into consideration insofar as they are important in the process of production and consumption. Thus, deposits of minerals and fossil fuels in the Earth's crust are natural resources, but the fertility of the soil, the attractiveness of landscapes for recreational activities, the biodegradation capacity of certain ecosystems, the energy of the sun, as well as the generating capacity to form new living organisms can also be defined as natural resources relevant for humanity. Furthermore, pollution may be absorbed or buffered by certain mechanisms within the ecosystem; these absorption capacities are natural resources as well.

The term *ecosystem* is used with reference to the great variety of living organisms and the abiotic forces which influence them. Ecosystems can be defined at different geographical levels, for example, rivers, oceans, the Alps or the globe. Ecosystems include flows of materials such as oxygen, water, and nutrients. The term *ecocycle* or *ecological cycle* is used to describe these flows. Both ecosystems and ecocycles are used in the production process. Beyond a certain level of disruption, however, they can no longer be used in the economic system. This level is known as the *carrying capacity* of the ecosystem. It is the maximum level of utilisation which allows a lasting use of natural resources.

This problem of the definition of property rights and an appropriate use of natural resources has international implications. Many environmental problems, such as the greenhouse effect and the hole in the ozone layer, have to be seen in a global context. Global problems can only be solved by global measures. Many environmental problems are transboundary; the costs of environmental pollution are off-loaded by one country onto another. The benefits of a polluting production process go to the producers of the product, located in the polluting country. In the case of transboundary pollution, the costs related to the pollution are shifted to adjacent countries. This type of problem makes an international approach unavoidable.

The off-loading of the costs of pollution on others is not restricted to geographical shifts. Many environmental costs are off-loaded onto future generations. In a market economy, however, only current market forces can influence the outcome of the market. Future generations cannot play a role in the process of reallocation of scarce resources.

Current proposals for solving environmental problems with the help of economic concepts are generally based on economic theories which were developed a considerable time ago. Hence, it is necessary to look at these early theories to see whether they are still relevant in the context of finding economic solutions to environmental problems.

The increasing relevance of markets

Factory production on a mass scale started during the Industrial Revolution. This method of production was accompanied by environmental problems different from those in previous periods. The growing influence of the production processes of the Industrial Revolution increased the importance of the quantitative aspects of the market, a situation accompanied by social changes. The production of goods assumed an increasingly industrial character, which meant that the necessity of trading these goods on international markets also increased.

The Industrial Revolution had a profound influence on economic theories. Production increasingly focused on the relevance of international markets, resulting in increased competition. Labourers worked in factories which were owned by capitalist entrepreneurs. Working conditions in these factories were poor, commonly leading to health problems among workers. Wages were low and many workers lived in unfortunate circumstances. It could therefore be argued that environmental problems in this period centred around the working conditions in the factories and the residential areas around these factories. Marx saw this development as an inherent characteristic of capitalist production, with the labourer being exploited by the capitalist. Although Marx was fully aware of the relevance of natural resources for the production of goods, he did not analyse the relationship between natural resources and other production factors. He concentrated on the relationship between labour and capital. In doing so, he excluded natural resources from his analysis.

The same can be said of the theories of Ricardo, a theorist who lived in the early 1800s, when industrialisation was becoming increasingly relevant. Ricardo was a well-known classical economist in this period and he defined Nature as a fixed asset in his models. This meant that in his models an increase in production could never be

accompanied by a decrease in the availability of natural resources. Marx's later use of the Ricardian model partially explains why Marx also ignored this topic. It should not be overlooked, however, that natural resources were considered inexhaustible in this period. The use of these resources was low compared to their supply, so that their relevance could be ignored in the analysis of fundamental economic relationships.

The problem of natural resources

In the same period, the concept of *value* in economic theory changed (see Box 6). Classical economists were still of the opinion that the exchange value of a good was determined in an objective way by the number of labour hours necessary for producing that good. More or less simultaneous, but independent, publications by Menger (1868), Jevons (1874) and Walras (1874) heralded a break with these paradigms. These authors were of the opinion that the exchange value of a good could be derived from the satisfaction of the needs of the individual consumer (in other words, the exchange value related to the 'utility' of the commodity – see Box 6).

It was Malthus who drew attention to the importance of the restricted availability of natural resources. He argued that population increases by geometrical progression, but that the total level of 'subsistence' (for our purposes, natural resources) could only increase by arithmetical progression – i.e. by a lower amount than population. Consequently, in his view, a shortage in the total level of natural resources was inevitable and starvation of the human population would be the result. Limiting the number of children born seemed to him to be the solution. However, neoclassical

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The concept of value

In economics value means either value in use or value in exchange. The theory of value and the theory of distribution together form the theory of price. The theory of distribution deals with the determination of the prices of the factors of production; the theory of value deals with the determination of the prices of consumer goods.

The price of a commodity may be defined as its value in terms of money. The theory of value is therefore concerned with the relative prices or exchange values of commodities. Since goods are demanded because they have the power to satisfy human wants, they also have value in use. Water is valuable not because of the price it commands but because it has 'utility', the power to satisfy a human want.

Value in use is not an intrinsic quality of a commodity but rather its capacity to satisfy a human want. For a commodity to have exchange value it must have utility (or more strictly, it must give the promise of utility so that it is desired), and it must be capable of being exchanged.

Value in exchange expresses the amount of one commodity that can be exchanged for another

Source: *Everyman's Dictionary of Economics*.

economists disagreed with Malthus' concept of the shortfall of natural resources. Marshall, for instance, stated quite explicitly (1925, p. 180) that technical developments had proved that Malthus' earlier arguments had been wrong. The result was that no attention was paid to the fact that these highly acclaimed technical developments were based on the large-scale use of non-renewable resources, i.e. resources with a *stock* character, such as iron ore and coal, which can be depleted. Before the Industrial Revolution, the actual use of natural resources was nearly exclusively based on renewable (or – in the case of wind energy, which derives from solar power – continuing) resources, i.e. resources with a *flow* character, which are in principle inexhaustible, such as muscle power, wind energy, wood and wool. Since the Industrial Revolution, the wealth of humanity has been based to an ever-increasing degree on the use of non-renewable resources – resources with a stock character.

This has had two closely related effects. Firstly, one should be aware of the fact that ores and fossil fuels are only available in the Earth's crust in limited quantities. Eventually, these stocks will be exhausted. Secondly, these materials will, after their use in human production and consumption processes, be discharged into ecological cycles, as is the case with metals and alloys, fumes, and synthetics. Such materials are not natural components of the prevalent ecological cycles, at least not in such large quantities. The result is the disruption and, in the worst case, destruction of ecological



Plate 6.1 Exploitation of non-renewable resources: mining bauxite ore (Billiton), Surinam. Photo: Ron Giling/Lineair

The problem of sustainable development

It is often claimed that sustainable development is inconsistent with neoclassical theories because, with modern-day high levels of production, resource depletion, and pollution, a traditional neoclassical approach would, in the long run, fail to take account of the need for sustainability. The neoclassical approach assumes that substitution of resources and technical development will lead to increased economic accessibility and efficiency of use of natural resources, so that sustainable development is assumed to be the result of the market process. It is now known, however, that this essential assumption in neoclassical analysis will not hold in the long run. It can, therefore, be concluded that sustainable development requires a strict policy implemented by national and international authorities.

cycles. In other words: the Industrial Revolution marks the transition from a more or less closed system of production and consumption to an open economic system characterised by an increasing use of natural resources with a stock character, which are then discharged as alien and poisonous materials into the ecological cycles following production and consumption. This dramatic shift did not, however, significantly influence economic theories in this period (see Box 7).

Externalities

Marshall (1925) was the first to introduce the concept of the *external* effect or external economy. He illustrated the idea with the example of an expanding company which creates beneficial effects for other companies in the region such as training for the labour force, stimulating a growing labour supply or attracting other supplying companies. The existing companies receive these *benefits* as if they were free, since no effort, sacrifice or expenditure is required on their part.

Surprisingly, Marshall did not elaborate on the possible external *costs* of an activity. It was Pigou (1952) who first paid serious attention to environmental problems. For this purpose he introduced the concept of *negative external effect* (see Box 8). This is the cost imposed by one activity on others for which no compensation is paid. Thus, the emission of smoke by factories causes negative externalities: 'For this smoke in large towns inflicts a heavy uncharged loss on the community, in injury to buildings and vegetables, expenses for washing clothes and cleaning rooms, expenses for the provision of artificial light, and in many other ways' (Pigou, 1952, p. 184). It should not be overlooked that Pigou was dealing with problems which had been described by Marx as an exploitation of labourers by capitalists. Pigou's externality was a sideline in neoclassical reasoning; the exploitation of labour by the interests of capital was the core of Marx's theories. Basically, however, both authors were discussing the same types of problem.

In Pigou's line of thought, externalities were part of the difference between the social and the private cost price of goods and services. For example, if heavy metals are discharged into a river following production, the discharging producer transfers part of

Negative externalities

One of the examples of externalities given by Pigou is that of a train which uses coal as a fuel. Such trains produce sparks, which can cause fires along the railway. If a forest or a house is burned down by these sparks, this is a negative externality caused by the railway company to the owner of the forest or the house. In such an example there is one clearly identifiable economic agent causing the effects, while the victims are, likewise, limited and well defined.

his production costs to society (in this case, the costs of restoring the river to its former condition). If there is sufficient competition, the price to the customer will be too low, since the costs of purification of the river water have not been incorporated in the price. Thus, as we have noted earlier, market prices do not reflect actual scarcity, as the increase in scarcity of clean river water is not part of the equation.

According to Pigou (1952, p.192), it is the task of the government to achieve a transfer of externalities to the buyers. He proposed *taxing* the creators of *negative* externalities (such as the producers of polluted waste water) and *subsidising* the creators of *positive* externalities. A government tax on the release of polluting



Plate 6.2 External effects of economic activities: outflow from an aluminium factory in Delfzijl, The Netherlands. Photo: Mark Edwards/Lineair

substances into surface water would have the effect of making polluters pay a higher price for pollution; the polluter would pay for the negative externalities – the negative effects of pollution. This would result in increased costs for the polluting industries, a lower level of pollution, and decreased costs for the victims of pollution. This is often called an *internalisation* of societal costs by the polluting economic agent. Negative externalities are no longer transferred to society.

During the first part of the 20th century, discussion of the problem of externalities took place on the periphery of economic science. Two World Wars, the stagnation of production, and the large numbers of unemployed people commanded most of the attention in this period. Externalities were regarded in the literature as theoretical and without any practical significance. Blaug (1978, p. 404) states that there was ‘a common tendency in the interwar literature to regard external economies as economic curiosa’.

After the Second World War, attention in society was primarily directed at the restoration of production capacity, which had been severely damaged during the war in Europe. Furthermore, the prevention of mass unemployment, a common phenomenon in the 1930s, was given high priority. Special attention was given to the publications of authors such as Keynes, which dealt with serious societal problems in the field of unemployment. The growth of production and the maintenance of a high level of employment were the primary aims of society. The aim of maximising the growth of production was also spurred on by the onset of the Cold War. Both Western and Eastern Europe used the growth of production as a strategy with both political and military significance. In this social climate, there was no demand for a discussion about environmental problems since it was thought this could only hamper the growth of production. Questions about environmental problems were marginalised in terms of social importance and discussion.

The acceleration of industrial production which took place in the course of the 1960s, combined with a rapidly changing social climate, led to a fundamental change in these opinions. The increasing growth of production was accompanied by serious environmental problems; eventually, these were perceived by large sections of the population. Air pollution increasingly became a common occurrence. Smog in the Dutch Rijnmond area, the German Ruhrgebiet, London and the British Midlands was the unpleasant side effect of sunny weather. Swimming in lakes and rivers became more and more hazardous. Certain species of flowers and animals decreased in numbers, owing to increasing pollution and intensive farming techniques. In spite of the construction of more and more highways, there was a steady increase in traffic congestion. Industrial and resort areas were being constructed on a massive scale. The rise of the petrochemical industry was phenomenal, increasing the potential for large-scale disasters. In short, a situation arose in which damage to the environment was viewed by many people as an everyday phenomenon. At the end of the 1960s, these developments led to increased scientific interest in environmental problems.

Externalities revisited

Confronted with these problems, economists with a neoclassical background based their thinking on the concept of externalities introduced by Pigou. The concept allowed situations of inconvenience to be satisfactorily described. However, it was not very

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Intergenerational effect

Using Pigou's definition, the future exhaustion of fossil resources can be defined as a negative externality which is off-loaded by the present generation on future generations, as these resources are used up in current production and consumption processes.

useful for analysing the problems of exhaustion of resources, as the inconvenience in these cases is not restricted to specific individuals. Exhaustion affects everyone, making it a collective evil or, when prevention of it is the starting point, a collective good. It is significant that the exhaustion of nearly all natural resources is not an *acute* phenomenon. It is future generations in particular who will be the victims of the present excessive use of natural resources. As we do not know the preferences of future generations, the concept of externality loses its meaning. Indeed, all present productive and consumptive actions would be regarded as a collection of externalities. Although future generations are not involved in any of the present market transactions, they will suffer the influences of these transactions on their own potential to produce and to consume. It was for this reason that neoclassical economists initially saw the environmental problem only as one of pollution, and more complex problems such as the exhaustion of natural resources were not taken into account (see Box 9).

Towards the end of the 1960s, increasing numbers of economists began to investigate environmental problems. The Pigovian tradition was a dominant influence in their efforts. The neoclassical tradition, in which economic information can only be found through the market, is a very well-established paradigm in current economics, so the vast majority of the economists confronted with environmental problems after the Second World War began by looking for solutions from within this paradigm (see Box 10).

One of the most remarkable publications was Mishan's polemical book *The Costs of Economic Growth* (1967). Mishan wanted to demonstrate that an increase in production would be accompanied by a decrease in welfare, as a result of the more than

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Environmental economics

Most of the academic work done in environmental economics may be described as an attempt to incorporate the environment into the conventional or neoclassical framework of economic analysis. The environment is perceived as a set of commodities (goods and services) valued, like other goods and services, by individuals in society. But because environmental commodities are usually available free (that is, at zero price), this value generally goes unrecognised. The result is that they get overused, leading to environmental degradation. To bring the environment into the economic calculus, prices or monetary values therefore need to be assigned to the various goods and services it provides.

Source: Jacobs (1991), p. xv.

proportional increase in the number of negative externalities. He claimed that it is absurd that the right to pollute is stronger than the right to live in a sound environment in our society. To solve this problem, he proposed the protection of amenity rights, backed by the criminal justice system. In this system, contrary to present rules, a potential polluting producer would buy pollution rights. The price would depend on the value attributed to amenity. If the costs of the required pollution rights are prohibitive, due to a high priority for a clean environment, the planned production will be too expensive. One could conclude that society does not wish to give priority to these polluting products but to the environmental quality that would be sacrificed.

This approach does not solve the problem. Mishan recognised that in most cases it would not be possible to *quantify* negative externalities – that is, express these effects in money terms. Firstly, because of the diffuse character of many negative externalities, they are not concentrated in time or place. Secondly, many negative externalities have more than one cause, which makes it very difficult, and in many cases impossible, to relate a particular negative effect to discrete economic activities. Finally, Mishan expected that effects which could not be quantified would in many cases be more important than those which could easily be quantified. In essence, Mishan provided arguments to show that a calculation of polluting costs to the victims was far from easy and, in many cases, completely impossible.

Hueting (1980) elaborated this problem in further detail. He paid special attention to the way in which the gross national product (GNP) is defined. Hueting argued that the calculation of the GNP is incorrect when environmental matters are taken into account. It includes much expenditure which is only incurred to remedy environmental problems. If, for example, the government constructs purification plants to clean up surface water, the costs will increase the GNP, because the cost of a purification plant can be quantified; it is a normal economic good. Since the GNP is often regarded as an indicator of welfare, an increase in its level due to higher environmental costs would be interpreted as a rise in income and welfare. We can therefore conclude that GNP figures provide incorrect information. According to Hueting, a correction has to be introduced for all costs which are incurred in neutralising negative environmental effects resulting from productive or consumptive activities. This type of criticism was an attack on the concept of GNP accounting, which assumed that all types of production would have the same effect on economic welfare. National statistical offices in Western countries were disinclined to develop methods to correct GNP accounting.

The argument resurfaced at the end of the 1980s, this time receiving broader support. However, attempts to correct national income accounting are far from easy. The point is that the environment does not have a market price, which means that all calculations of this type are accompanied by a number of subjective decisions (see Box 11).

Hueting also addressed the Pigovian problem of constructing an optimal point of pollution, that is, the point at which marginal costs of pollution are equal to marginal benefits from pollution prevention. Hueting elaborated on this topic by focusing on water pollution by organic materials and argued that in practice it will be impossible to find an optimal point of pollution. Firstly, it is particularly difficult to calculate the damage of polluted water because of the absence of a market for environmental damages. Secondly, the value consumers will attach to clean water is difficult to calculate and furthermore, how to express the level of preference of consumers for clean water in

The example of acid rain

A striking example of the problematic relationship between economic activities and environmental pollution, as well as a good example of a negative external effect, is the large-scale deterioration of forests as a result of acid rain. One of the most important causes of acid rain is the emission of large quantities of sulphur dioxide. Some 20 years ago, the first measures were taken in Europe to reduce the harmful effects of sulphur dioxide. These measures included the changeover to natural gas and nuclear energy and the construction of tall chimneys on factories. At first these measures appeared to be adequate, because air pollution in urban areas and industrial regions did decrease. However, the tall chimneys only dispersed the acidifying substances over larger areas of Europe. Acid deposition beyond the industrial areas increased rapidly, damaging forests particularly in Central Europe and Scandinavia. The acidification of ecosystems could probably have been foreseen. Biologists had warned at an early stage that tall chimneys would at best merely shift the problem elsewhere. Society, however, was easily able to dismiss these warnings as exaggerations, because it was not known for certain what the effects on Nature would be.

Source: Dietz and Van der Straaten (1992).

monetary terms? Thirdly, a comparable difficulty is the level of the government's responsibility for clean water. How high is the priority given by the government to clean water and how can it be measured? This brought Huetting to the following conclusion: 'The crucial question "What is Nature worth to us?" cannot be answered by means of the instruments available to us. But in my opinion the study has shown that at the same time another question remains unanswered, namely "What is the worth of goods that are produced and consumed at the expense of the environment?" For when the value of the environment cannot be determined in the conflict between production and environment, the market price of produced goods may no longer be accepted as an indicator of the economic value of these goods' (Huetting, 1980).

Here, Huetting touches upon a fundamental shortcoming of the neoclassical approach. The fixation on priced forms of scarcity, that is, scarcity which arises from the interaction of market supply and demand, excludes unpriced forms of scarcity (see Box 12).

Shortcoming of conventional environmental economics

Conventional environmental economics, we might conclude, is useless as an instrument of environmental management, because the concept of 'externalities' merely hides the inability to put a value on social costs that are shifted to other social groups or to future generations.

Source: Martinez-Alier (1990), p. xiv.

Ecological economics

The problems of measuring externalities give rise to doubts about the possibility of constructing an optimal point of pollution on the basis of Pigovian principles. Recently, some economists have concentrated on the paradigm of ecological economics, in which the *economic system* is seen as a part of a wider system: *the ecosystem*. The challenge of this approach for environmental economists is to elaborate the relationship between the economic system and the ecosystem.

Several authors had already dealt with these problems in the course of the 1970s and 1980s. Boulding (1966), for instance, argued that current economic theories and policies were using natural resources as if they were infinite and inexhaustible. He came to the conclusion that such an approach was strongly related to the American tradition of the frontier state. He defined this type of economy as a *cowboy economy*, using the environment as an infinite entity. In his opinion, natural resources should be used as in a *spaceship economy*, in which resources and the sink function of the environment can only be used up to a certain level. Daly (1977) argued that traditional economic theories failed to cope with problems of absolute scarcity. Scarcity in neoclassical analysis is only a relative issue: some goods and resources are more scarce than others. However, current environmental problems have to do with an absolute scarcity. Hence, it is necessary to consider the concept of the *steady state*, in which natural resources are used only to a certain level.

More recently, Daly has focused on the problem of how to define the limits which Nature and the environment impose on economic activities (Daly, 1991) (see Box 13).

13

Optimal allocation of resources

The term 'scale' is shorthand for 'the physical scale or size of the human presence in the ecosystem, as measured by population times per capita resource use'. Optimal allocation of a given scale of resource flow within the economy is one thing (a microeconomic problem). The optimal scale of the economy as a whole relative to the ecosystem is an entirely different problem (a micro-macro problem). The microallocation problem is analogous to that of the optimal distribution of a given amount of weight within a ship: once the best relative distribution of weight has been determined, there is still the question of the absolute amount of weight the ship is able to carry. This optimal scale of load is recognised in the maritime institution of the Plimsoll mark. When the waterline hits the Plimsoll mark, the ship is full; it has reached its safe carrying capacity. Of course, if the weight is poorly distributed, the waterline will touch the Plimsoll mark sooner. But eventually, as the absolute load is increased, the waterline will reach the Plimsoll mark even for a ship whose load is optimally distributed. Even optimally loaded ships will sink under too much weight – although they may sink optimally! It should be clear that optimal allocation and optimal scale are quite distinct problems. The major task of environmental macroeconomics is to design an economic institution analogous to the Plimsoll mark to keep the weight, the absolute scale, of the economy from sinking our biospheric ark.

Source: Daly (1991), p. 35.

Other authors using the ecological economic paradigm still hold the opinion that the problems of valuing Nature and the environment can be considerably decreased by means of further research in this area. For example, Pearce (who is, in fact, an environmental economist, more closely associated with the neoclassical school) argues:

‘Empirical work on evaluation remains limited, even in the developed world Its importance for the development process is that the revealed economic values for environmental conservation and environmentally improving projects and policies have frequently been found to be large. Valuation demonstrates that there is an economic case for protecting the environment, in addition to any ethical case. Valuation can assist the process of decision-making. In so doing it offers the potential of more cost-efficient public choices, so that limited public income is spent to the best advantage’ (Pearce, 1993, pp. 93–4).

Pearce’s argument is, of course, correct. Collective decisions should be based on as much economic information as possible. However, it is clear that the Plimsoll mark metaphor used by Daly (see Box 13) cannot be determined by this type of information. The shortcomings of traditional approaches are too significant to make such an approach successful when major environmental problems come up for discussion. Moreover, our understanding of ecological systems is imperfect, to say the least, and our lack of knowledge and uncertainty raise further questions about the attempts to internalise externalities. The next section discusses a model of thinking which is relevant for an improved insight into these complicated problems.

6.5 Economics and sustainable development

Our discussion so far has led us to a preliminary conclusion, namely, that two related economic and environmental problems have to be solved. Firstly, economic theories pay insufficient attention to the complexity of the relationship between the system of production and consumption on the one hand and the environment on the other. An adequate analysis in economic terms of the relationship between the economic system and the ecosystem is needed.

Secondly, it is often argued that the core of the difficulties is in the concept of negative externalities. Although the neoclassical principle of including the social costs of environmental damage in the calculations of economic agents seems straightforward enough, there are many obstacles to such a process. In the first place, the relationship between the emissions and the level of damages in the ecosystem is not clear. For instance, what is the contribution of the emissions of acidifying substances in The Netherlands to the death of trees in the German Black Forest? These types of calculations are almost impossible. Even if it were possible, there is the problem of the great number of Dutch polluters. In the Pigovian approach, there is only one polluter and one victim, and calculations are not so difficult. Such an assumption, however, is far removed from the complex reality of modern societies, with large numbers of polluters and many people suffering from pollution. This makes political choices immensely difficult. Responsibilities must be defined if we are to find a solution.

In trying to internalise negative externalities, complications also arise in the

ecosystem itself. In the Pigovian approach, the ecosystem is defined in a straightforward manner, while in reality it may be quite complex. In many cases, for instance, it involves thresholds: pollution becomes apparent only after it reaches a certain level. Another complication is caused by the rather common synergistic effects of pollution. The combined effects of different emissions may cause a higher level of damage than would be expected from the individual effects of the different pollutants. Finally, there are many uncertainties in the functioning of the ecosystem itself. If, for instance, the economic relevance of the greenhouse effect were to be evaluated, the conclusion would be that this does not fit the framework of a Pigovian approach, due to future uncertainties. The interests of future generations, which are relevant to the greenhouse effect, cannot be taken into account in the case of the internalisation of external effects. This leads to the conclusion that the Pigovian approach of internalisation is interesting from an analytical point of view, as it provides insights into the relationship between pollution and costs, but it does not provide us with real tools for solving the problem of external costs. The main reasons are the absence of a market for environmental goods, the complexity of the functioning of the ecosystem and the absence of future generations in the calculations. In order to come to terms with these problems, it is necessary to develop a line of reasoning which might yield better tools for reaching a solution. In this section, a simple model is presented which takes into account the consequences of the shortcomings of the neoclassical approach.

The problems mentioned above played an important role in the Brundtland Commission report (WCED, 1987). The Commission was aware of the shortcomings of a traditional economic approach, and proposed the concept of *sustainable development* as an absolute necessity for solving problems in this field. They defined sustainable development as development in which the use of natural resources to meet the needs of the current generation would not frustrate the ability of future generations to meet their own needs. Natural resources are seen as capital which has to be maintained by current and other generations. In broad terms, this approach was accepted by many governments and environmental economists. In the next paragraphs, this concept will be elaborated on in connection with economic theory.

Sustainable development in economic analysis

The model in Figure 6.3 separates the system of production and consumption from the ecological system, and applies concepts which are commonly used in the description of the functioning of ecosystems. These concepts appear in the righthand section of the model, which outlines the ecosystem insofar as it is relevant to the process of production and consumption. The lefthand section of the figure outlines the system of production and consumption. This includes the economic decisions of economic agents involving ecological considerations, decisions which will have a negative effect on natural resources.

In ecological science, ecocycles are used to describe ecosystems. If the environment is disrupted, it can be ascertained at which point in the cycles the polluting substances are transported and where they decompose or accumulate. The way in which information and energy are transported in an ecosystem is also relevant. The energy in Figure 6.3 comes from the sun. The main problem in Figure 6.3 is how the information

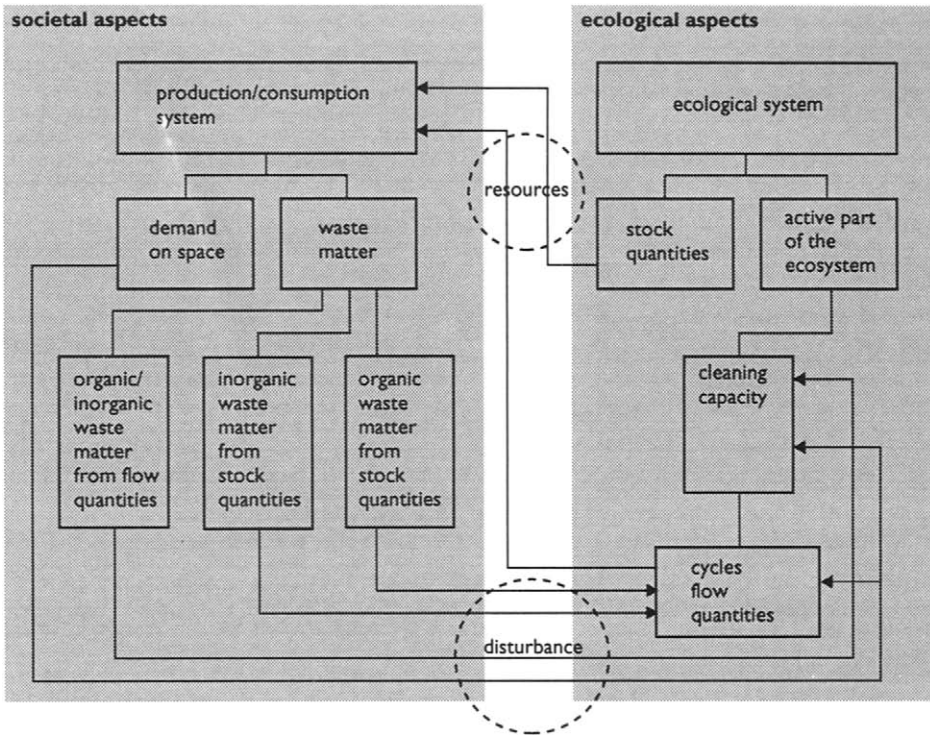


Fig. 6.3 A model of the relationship between the economic system and the ecosystem

which is available in the ecological system can play a role in the system of production and consumption. As was concluded above, the price mechanism cannot work in this respect. The information which is necessary to achieve an optimal allocation of unpriced natural resources will not reach the economic agents. This does not imply that consumers, producers and the government are not informed about environmental disruption. That may or may not be the case. The point is that this information does not reach them through the price mechanism. This leads to a situation in which economic agents acting in a market in which production factors, goods, and services are priced do not have the relevant economic information about the disruption of unpriced natural resources which are, nevertheless, relevant for production and consumption. It is necessary to obtain other types of information, which can help us to make decisions in the allocation of unpriced natural resources. This is only possible if data about the functioning of the ecological system are included. This is a central point in the construction of Figure 6.3.

The model of Figure 6.3 distinguishes between *stocks* and *flows*. It describes the effects of human production and consumption on the ecological system. A system of human production and consumption is based, among other things, on the need to use natural resources from the ecological cycles – the active part of the ecosystem. Such natural resources are, in theory, inexhaustible and therefore go on flowing forever. Around the beginning of the 19th century, however, the large-scale exploitation of fossil natural resources began. But resources such as oil, coal and iron ore are

exhaustible; they are defined as stock quantities in Figure 6.3. The fossil part of the ecosystem is hardly, if at all, affected by the flow of waste products originating from the economic system. Pollution of the environment occurs in that part of the ecological system involving cycles, which can be disturbed by the discharge of waste products.

There is a great difference between the dumping of organic materials and the dumping of inorganic and synthetic materials into the ecocycles. Organic materials are normal elements of functioning ecocycles, while inorganic and synthetic substances are foreign to them. These foreign substances include the waste products from fossil resources. If dumped into the ecocycles, even in low concentrations, they cause disturbances, because no mechanisms are available to process or decompose these waste products. On the other hand, the dumping of decomposable organic matter does not necessarily disturb the ecocycles. Such matter is already part and parcel of the ecocycles and can be decomposed by bacteria in the normal way. However, if too much decomposable organic matter is dumped into, for example, surface water, the water's self-cleaning capacity may be overtaxed to the extent that only stinking, rotting and deoxygenised expanses of water remain. The pollution from fossil matter is worse than pollution from organic, decomposable matter. Whereas the latter occurs locally and may be neutralised after a time, pollution from undecomposable stock matter is irreversible. It is almost impossible to restore the cycle in this case. Substances foreign to ecocycles accumulate, with long-term effects for the environment over a large area. Thus, when heavy metals are discharged into the surface water, the flora and the fauna will be seriously affected. Heavy metals do not disappear when the organisms die, but accumulate in the ecocycles.

One category of effects on Nature from human activity has not so far been dealt with: the use of land. Yet this use seriously violates the ecocycles. The process began as soon as people settled in one place, took up agriculture and began to change the natural vegetation. In Europe, this has reached the point where virtually none of the original vegetation is left. Modifications of the vegetation do not necessarily lead to unacceptable changes in the ecocycles, but they do interfere with the cyclical process. Further pressure on the natural vegetation from the construction of houses and factories and of roads and other infrastructural elements has seriously affected the ecosystem. Its effect is different from that of the discharge of waste products, however, in that it threatens the functioning of ecocycles much more rapidly and directly, without complicated intermediary processes. For instance, ecocycles may be changed if natural woodland is turned into arable land or cleared for the purpose of road construction.

Stocks are, in principle, exhaustible. They are the raw materials and supplies of fossil energy which are embedded in the Earth's crust. They are exploited and used in the production process, after which the residuals are released into the environment, leading to disruption of the ecocycles. Arrows in Figure 6.3, starting from the stocks, indicate the route these substances take during the process of being used as a resource, and the release of the residuals as pollutants.

If the goal is ecologically sustainable development, then it is a prerequisite that the ecosystem should be used in such a way that its working will not itself be irreversibly damaged. To a certain extent, this is difficult to achieve. The discharge of materials not natural to the environment and extracted from the stocks should be minimalised or

preferably stopped altogether. The discharges of waste products from flows contain materials which are natural to the environment. This does not alter the fact, however, that overloading of the carrying capacity of ecocycles may cause the local or regional disruption of ecosystems. It has been firmly established that the use of space by humanity eventually leads to a disruption of ecosystems.

The speed at which stocks will be exhausted can be considerably reduced by the large-scale introduction of mineral and synthetic recycling. It is impossible, however, to recycle all materials. Some of the materials are 'lost' during the processes of production, consumption and recycling; these materials are discharged into the ecosystem. Technological development should be directed at decreasing the percentage of materials 'lost'. Of course, the best solution would be to switch to renewable or continuing resources. Such resources can be extracted from the ecocycles (using ecologically sound methods) without disrupting them. The same is true of the extraction and use of energy. Fossil stocks of oil, natural gas and coal will sooner or later become exhausted; conversion to the use of energy from flows is inevitable in the long run.

Conversion towards sustainability

A process of conversion to ecologically acceptable methods of production will have a considerable influence on many social relations. Sustainable development will pose a threat to well-established interests as the market process has led to a situation which is far from sustainable. This situation is not the result of the actions of a limited number of individuals. The environmental crisis is, in essence, the result of a spontaneous development of the market. It cannot be expected, however, that reduction of the environmental disruptions will also be a spontaneous process. Such a reduction will only be possible through the introduction of strict environmental policies.

Policies that stimulate sustainable development, however, will not be received with great enthusiasm by the interests which have profited from the present disruption of the environment. Once the ecological limiting conditions for the production and consumption process have been determined, the interests and economic sectors which produce large amounts of pollution will resist the changes which affect them and defend their position. Furthermore, economic sectors may claim that, in addition to creating economic growth and wealth, they also clean up the environment and should therefore not be confronted with strict standards. Well-organised groups of polluting producers such as the petrochemical industry, the transport sector and agriculture may be expected to oppose strict environmental measures or at least to argue for less stringent measures. They do not oppose the aim of sustainable development in general, but the pace at which it is implemented (Dietz and van der Straaten, 1990).

There are, however, limits to the use of ecological space. This implies that all polluting sectors are in competition, each trying to claim a portion of the limited opportunities for pollution. This may well result in a social struggle for the allocation of ecological space to different production and consumption processes. In this social struggle, national authorities will play an important role, as decisions about this allocation will have to be taken on a collective basis. No single instrument can be excluded from the endeavour to attain a situation of sustainable development.

Governments can use taxes, subsidies, controls and regulations to steer the development in the desired direction. Technological development can play an important role in this process of conversion.

The aim of sustainable development implies that limiting conditions for the production and consumption processes should be formulated from an ecological as well as an ethical point of view. With regard to discharges of waste materials from the stocks, the functioning of the ecosystem itself provides the standards enabling us to set a certain level of discharge which is acceptable from an ecological point of view. Such an environmental policy can be implemented with the help of present-day economic instruments. These would ensure that the polluter pays the full costs of damage inflicted on the environment. In economists' terms the polluter is made to internalise the social costs imposed. In our model, the standards originate in the ecological system, the aim being to achieve sustainable development. In this approach, prices and regulations are instruments for the implementation of previously formulated, ecologically desirable ends. Although the price mechanism can play an important role, it is not the same role it has in neoclassical theories.

6.6 Managing the commons

The tragedy of the commons

Figure 6.3 pays particular attention to the collective decision-making process. Other authors have argued that the solving of environmental problems is only possible if the common natural resources are linked to the functioning of the market. In other words: environmental problems can be solved by privatising common property resources. This school of thought was elaborated by Hardin in the article 'The tragedy of the commons' (1968). He is of the opinion that common property resources such as common pasture land or common fishing grounds in the North Sea are overused, resulting in the degradation of that resource, precisely because they can be used by anyone. There is no pressure on the individual to limit use of the common property resource. This results in a situation in which all individuals repeatedly try to increase their yields, and in doing so, degrade the quality and quantity of the common property resource. Hardin's conclusion is clear: common property resources are always overused. The benefit to a private user of overusing such a resource is always greater than the very small marginal damage each potential user suffers from his own overuse. This results in constant overuse, as every user can gain a private benefit by overusing the resource.

Hardin comes to the conclusion that this is the result of a deficient definition of *property rights*, which can only be solved by privatising the common property resource. After privatisation, the positive and negative results of the overuse will both be the responsibility of the user. The benefits as well as the damages resulting from overuse will affect the owner of the property rights. The owner who is also the user will balance these benefits and costs, and will stop overuse. This argument has received a good deal of attention. In the literature one can find numerous arguments based on Hardin's article about the determined overuse of all common property resources. It

should be stated that this approach is completely different from that proposed in the previous section, where it was concluded that a governmental environmental policy was the answer to the environmental disruption of unpriced collective natural resources. Hardin argues that the problem can only be solved by a *privatisation* of *collective* goods.

Open access or common good?

Bromley (1991) made it clear that Hardin's argument ignored the point of *open access*. Hardin assumed that all common property resources have a regime of open access. In many cases of common property there are, however, strict regulations which exclude open access. Thus, according to Bromley, it is not the common property right which creates the problem but a situation of open access. This can be clearly demonstrated by the tropical rainforest in Brazil. These forests were traditionally common property. The Indians living in these forests had built up, in the course of time, an institutional framework guaranteeing sustainable use of these resources. As these forests were taken over by private logging companies, they required private property rights, which can be established in Brazil by applying to the authorities. In the absence of existing private property rights in a particular area, any newcomer can establish such rights. With these private property rights secured, logging could begin in the rainforests, and significant common property resources were destroyed. Here, the establishment of the private property rights led to environmental damage.

On closer consideration, the distinction between externalities and private goods and services based on the intention of the agents is not convincing as a means for understanding environmental problems. If A's paper mill pollutes the river and B becomes ill from drinking the polluted water, conventional theory calls this a negative externality. But if A buys and eats the only bread left at the baker's, as a result of which B goes hungry, no externality is created. The conventional approach to externalities fails to explain why it is any more or less intentional when A eats and B goes hungry than when A produces effluents and B becomes ill.

Externalities point out interdependent relationships between economic agents which in conventional economic theory are seen as 'incidental', that is, as specific and special events. However, as the previous example indicates, there are many situations in which the actions of A affect the well-being of B. Human interdependence relationships are ubiquitous and these relationships constitute the basis of both co-operation and conflict. If two persons are needed to transport the bricks to build a house, they could decide to co-operate. The advantage of co-operation, however, does not mean that a joint effort will be forthcoming. Often, disputes over the distribution of the fruits of joint efforts keep the bricks from being transported at all.

People unavoidably affect each other in situations of scarcity. Scarcity leads to conflict over the control of resources and how this conflict is resolved depends on the structure of property rights in society. Property rights describe the relationship of one person to another with respect to a resource or line of action. As Schmid puts it: 'Rights are the instrumentality by which society controls and orders human interdependence and resolves the question of who gets what' (Schmid, 1987, p.5) .

Internalisation of externalities

In conventional economic theory, externalities are seen as a market failure. Traditionally, *internalisation of externalities* is recommended and it is suggested that internalisation eliminates the externalities concerned. In reality, internalisation procedures do not eliminate externalities. If interests conflict, one or more of the interests must go unmet. Property rights determine which interests prevail, that is, whether A is allowed to affect B or vice versa. Internalisation means a shift in the rights structure. Where formerly the paper mill was allowed to pollute the river, it now either has to pay for effluent discharge, to buy discharge rights (transferable permit) or to install equipment which purifies the effluents before they are discharged. Internalisation reduces the opportunity set (the range of opportunities) of the paper mill, but expands the opportunity set of people living downstream. The interdependence between the paper mill and downstream inhabitants is not diminished, changed or eliminated, nor is the conflict of interests. The change in property rights does not imply that the externality is made internal, it only shifts the externality from one party to the other, that is, the interest of drawing drinking water from the river has been given more weight than the interest of discharging effluents into the river.

In the literature, the impression is created that the establishment of property rights automatically means that the internalisation of externalities can be left to the market. An efficient resource allocation should be independent of the party to whom the property right was given - either the generator or the victim. All that is said to matter is that the parties involved strike an easy bargain in which they agree on the compensation to be given to the rights owner with the aim of reducing the externalities once the rights have been allocated. It should be pointed out that this result hinges on the assumption that internalisation requires no transaction costs, that is, that the gathering of the information needed, the negotiations leading to an agreement and the enforcement of the agreement are without costs. In practice there will always be transaction costs.

In a world with transaction costs, environmental damage is determined primarily by the initial property rights allocation. Mobilising the downstream population to make a bid to encourage an upstream paper mill to reduce its legitimate effluent discharges will result in a more severely polluted river than would be the case if the paper mill had to make a bid to the inhabitants downstream who have the legitimate right to a clean river. Although clearly defined property rights help to solve environmental problems, the most relevant issue is who has the rights and thus who has the effective protection of the state to do as he wishes (Bromley, 1991, p. 35). This, of course, is a political issue: all environmental policies and all definitions of property rights are the result of political processes. Hence, one may conclude that it is this political aspect of environmental problems in particular which is neglected in neoclassical theories. If these theoretical insights are a guide to 'practical' solutions, it is clear that the political barriers will frustrate environmental policies.

6.7 Conclusions: economics and environmental policy

The political context of environmental policy

The above discussion of the privatisation of common resources brings us to the topic of environmental policy as a part of public policy. Environmental policy involves certain measures aimed at achieving a sound environment. It is usually developed in the context of public policy, based on economic theory, which focuses on the level of costs and benefits associated with the implementation of environmental policies.

If strict standards are proposed and implemented by a Minister of Environmental Affairs, certain polluting sectors have to take measures which cannot be achieved without incurring extra costs. Polluting industries are often keen to highlight the likely cost to them of proposed environmental measures. The benefits resulting from environmental policies are extremely difficult to assess. In consequence, the costs of environmental measures are often given more attention than the benefits resulting from the implementation of the policy.

This brings us to the distributional effects of environmental policies. Hardin's argument clearly shows that the definition of the property rights of natural resources plays a significant role. The implementation of strict standards and regulations will

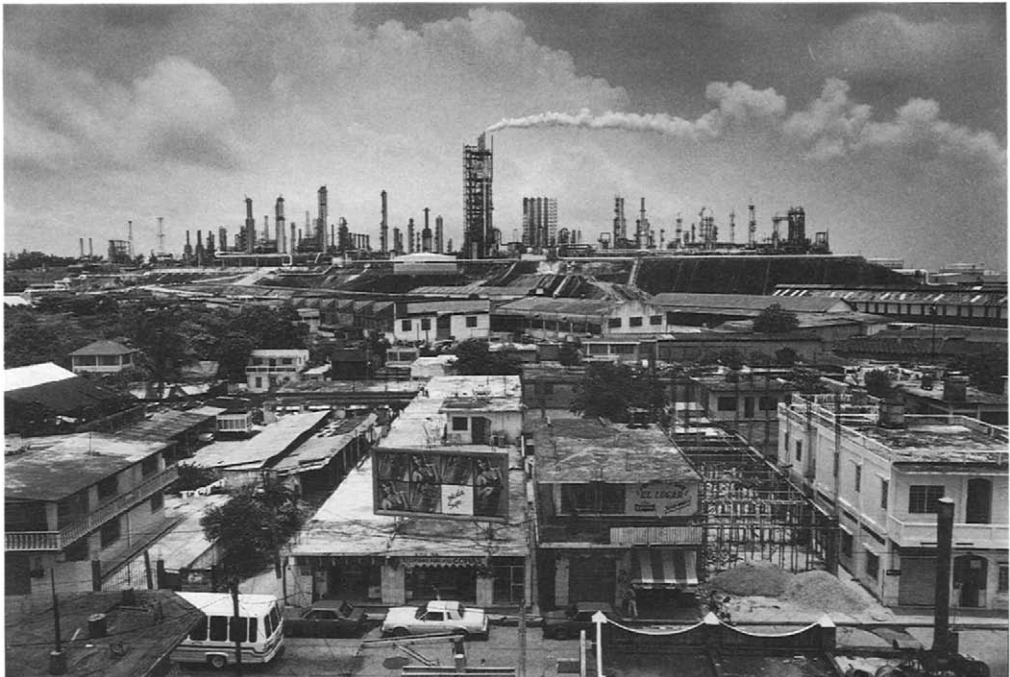


Plate 6.3 Economic industrial development in Minat Itlan, Mexico. Photo: Ron Giling/Linear

cause a change in the definition of property rights. Industries which have polluted rivers for many decades will be confronted with regulations which reduce their opportunities for using the river in this fashion. Of course, these industries will try to neutralise the effects of this implementation of strict standards. Throughout the process of formulating regulations, polluting industries will try to influence policies.

Polluting industries utilise the uncertainties of environmental science. On the other hand, they emphasise the importance of their production, the employment they provide, and their contribution to the balance of payments. All economic interests and sectors use economic arguments in an attempt to influence environmental policies in a direction favourable to themselves. This demonstrates how weak many traditional economic arguments are, since they can be used by any polluter to strengthen his or her position. Many economists argue that the introduction of economic instruments such as levies, subsidies, and taxes will lead to an efficient implementation of environmental measures. It is often overlooked, however, that all such instruments are part and parcel of the institutions of a country. The institutional framework, of which property rights are an important part, should be taken into account when the implementation of environmental measures is discussed. This is particularly true of the problem of the distribution of the costs and benefits resulting from environmental measures.

As long as pollution problems are mainly national, there is a need for a strong national authority. However, environmental problems are becoming increasingly international or global. As a result, all of the difficulties mentioned above are also present on an international scale. This complicates environmental policies considerably. On the one hand, international co-operation in the fighting of environmental problems is absolutely necessary. On the other hand, different countries have different economic interests. Furthermore, polluting sectors are not evenly distributed among countries. Countries have a tendency to protect their polluting industries, in particular when these industries are relatively important economically. We may now draw some conclusions:

- Environmental problems can be defined as economic problems. Costs and benefits of environmental policies are relevant. Economic theory can provide us with insights into the complexity of these relationships.
- Traditional economic theory, which aims to internalise externalities, does not provide real solutions to modern environmental problems. Alternative approaches in which more attention is given to the relationship between the ecosystem and the system of production and consumption will have to be developed.
- The definition of property rights of natural resources plays a crucial role in environmental economics as well as in environmental policies. The implementation of environmental policies is viewed as a change in property rights by polluting industries. They will defend their traditional right to pollute.
- Even if one defines environmental problems as economic problems, the distributional effects of the implementation of environmental policies should not be overlooked. Environmental problems are also traditional political problems – at local, national, and international level.

International environmental policies

Many of the above arguments and discussions dealt with national situations. However, all the problems and complications mentioned above are more serious in an international context. This is mainly caused by the fact that in a national context there is a national authority which is able to implement a legal framework with corresponding sanctions. This is hardly ever the case at an international level. In nearly all cases of international environmental disruption, negotiations are the only way to solve the problem. However, a great deal of negotiation is required in order to persuade polluting countries to curb their pollution. This puts the countries suffering from pollution or environmental disruption in a difficult position.

This was the problem at the United Nations Conference in Rio de Janeiro in 1992, of which the Conventions on Climate Change and Biodiversity were the most tangible results. With regard to the Climate Convention, there was an acrimonious debate between countries such as Brazil and the northern countries. From a global point of view, tropical rainforests are extremely important as a sink for carbon dioxide produced by the burning of fossil fuels, a very high percentage of which occurs in northern countries. Hence, northern countries are of the opinion that these forests have to be protected in order to neutralise the greenhouse effect. There were, however, no well-defined cost-benefit analyses available, owing to the many uncertainties surrounding this topic. The external costs of energy consumption could not be defined and the internalisation of these external costs could not be achieved (see Box 14).

The United States government were not convinced that strict measures would have to be taken to decrease the risk of global warming. This opinion was, of course, related to the high energy consumption in the United States, which it is not willing to give up. Countries with large areas of tropical rainforest, on the other hand, argued that developed countries have been destroying their forests for a long time. It would make no sense to say that the developing countries were the only countries responsible for a

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The value of tropical rainforest

The discussion on debt-for-Nature swaps in Brazil reveals the difficulties in valuation of other externalities. A proposal for buying four billion dollars' worth of the Brazilian debt in order to save the Amazonian rainforest was tentatively launched in early 1989 (*New York Times*, 3 February 1989). This 'generous' offer is paltry in the context of Brazil's total external debt, a nominal value of 115 billion dollars. From another perspective, too, the offer looks mean: under one dollar per inhabitant of the world, once and for all, as the price for preserving the Amazonian rainforest. An annual value of, say, 50 billion dollars could be given to the externalities provided to the rest of humankind by preserving the Amazonian rain forest from private exploitation. However, nobody knows how to give present values to the future benefits of preserving tropical biodiversity.

Source: Martinez-Alier (1990), p.xiv.

global problem. They felt that developed countries should pay them for protecting their tropical rainforests, as these were to be used to solve global problems.

In this debate, the concept of property rights is a crucial one. Who is the owner of the tropical rainforests? Is it the people living in these forests or the state of Brazil or is it the global community of all countries? Indeed, it is the global community which might suffer from the greenhouse effect, but the developed countries have contributed considerably more to this phenomenon than the developing countries. The developing countries, in particular, harbour the global sinks for carbon dioxide, the tropical rainforests. It may be concluded that the distribution of costs and benefits among different countries is the most relevant problem if a policy on the greenhouse effect is to be established.

The United Nations Conference in Rio de Janeiro functioned as a platform for the debate on global environmental problems. However, this debate has only just started, which implies that the establishment of such an institutional framework will still take much time and effort before an acceptable solution is found. The implementation of global environmental policies is just the beginning!