5.6 Common access resources and the threat to sustainability

Common access resources and environmental sustainability

Common access resources and market failure

The meaning of common access resources

- Describe, using examples, common access resources.

Environmental problems can be studied by examining a special category of resources known as common access resources. **Common access resources** are resources that are not owned by anyone, do not have a price and are available for anyone to use without payment. Examples include clean air, lakes, rivers, fish in the open seas, wildlife, hunting grounds, forests, biodiversity, the fertility of the soil that occurs in nature, open grazing land, the ozone layer, the stable global climate, and many more.

Why common access resources are a type of market failure

- Explain that lack of a pricing mechanism for common access resources means that these goods may be overused/depleted/degraded as a result of activities of producers and consumers who do not pay for the resources they use, and that this poses a threat to sustainability.

Common access resources differ from any other kind of resource or good, because they possess a special combination of characteristics: they are rivalrous and non-excludable (page 119).

A good is *rivalrous* when its use by some people reduces availability for others. Most goods, including common access resources, are rivalrous. If we use up clean air, there is less left over for use by others; when we catch fish in the open sea, there are fewer fish left over for others to catch; if we destroy the stability of the global climate, it will not be available for use by future generations.

A good is *non-excludable* when it is not possible to exclude anyone from using it. Most goods and resources are excludable, because they have a price. However, open access resources differ because *they have no price and anyone can use them without payment*; therefore they are non-excludable.

(Common access resources are like private goods in that they are rivalrous, and they are like public goods in that they are non-excludable.)

The rivalry and non-excludability characteristics of common access resources pose serious threats to the environment. Rivalry means that consumption by some reduces availability for others. Non-excludability means that consumers and producers use them abundantly and often overuse them *because they have no price*.

There is no end to examples of overuse of common access. When factories, homes or cars use fossil fuels that emit pollutants into the atmosphere or into oceans, rivers and lakes, they 'overuse' a portion of these natural resources without paying for them. Some of these activities result in ozone depletion, with harmful effects on life from the sun's radiation; they 'overuse' part of the ozone layer. They also give rise to global warming, with possibly devastating effects on agriculture, health and ecosystems; this involves 'overusing' the benefits provided by a stable global climate. When fish are overfished, the fishing industry uses up an excessive amount of the global stock of fish and possibly disrupts the marine ecosystem. Similarly, when forests are cleared to create land for use in agriculture or for the sale of timber by the lumber industry, there are huge consequences in terms of loss of biodiversity and threats to wildlife and the ozone layer. Land is being overgrazed because of excessive grazing; arable land is lost because of soil erosion and salinisation; wildlife is endangered because of the destruction of natural habitats due to the encroachment of settlers and agriculture. *In all these cases, common access resources are used without payment, leading to serious environmental degradation and depletion.*

Sustainability and common access resources

- Describe sustainability.

The meaning of sustainability

Sustainability refers to the ability of something to be maintained or preserved over time. It can be explained in terms of the joint preservation of the environment and the economy: for the environment it refers to environmental preservation (lack of destruction); for the economy it refers to the preservation of humankind's ability to provide goods and services to satisfy needs and wants into the future.

The problem of sustainability arises because of conflicts between environmental and economic goals. Economic goals involve efforts to increase the quantities of output produced and consumed;

focusing on economic goals while disregarding the environment may result in its irreversible destruction. Environmental goals involve the preservation of the environment; but focusing on environmental goals while disregarding the economy may result in humankind's inability to satisfy needs and wants.

The important question, then, is how to strike a balance between environmental and economic goals, so that both can be satisfied into the future. The answer to this question is provided by the concept of *sustainable development* (introduced briefly in Chapter 1, page 14), defined as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'.[6] This means that societies should pursue economic growth *that does not deplete or degrade natural resources*, so that future generations will not have fewer or lower-quality natural resources to satisfy their own needs.

Sustainability refers to maintaining the ability of the environment and the economy to continue to produce and satisfy needs and wants into the future; sustainability depends crucially on preservation of the environment over time.

The maximum sustainable yield of common access resources (supplementary material)

A simple example shown in Figure 5.15(a) illustrates the meaning of sustainable resource use. Fish in the open seas are a common access resource that anyone has access to without payment. The horizontal axis measures the number of fishing boats, and the vertical axis measures the quantity of fish caught in tonnes. The first, second and third boats each catch 4 tonnes; therefore, in this range of 'constant average yield' (yield refers to the amount of output), the three boats together catch 12 tonnes, or 4 tonnes each on average.

When a fourth boat goes out to sea, it brings back only 3 tonnes of fish; this translates into a smaller quantity of fish caught by each boat on average. The four boats together have caught 15 tonnes, or an average of 3.75 tonnes ($= \frac{15}{4}$) instead of 4 tonnes. When the fifth boat is added, the five boats catch 17 tonnes, and the average catch falls further to 3.4 tonnes ($= \frac{17}{5}$). With the sixth boat, the total is only 19 tonnes or 3.2 tonnes for each boat on average. This is the range of 'decreasing average yield', meaning that each boat that goes out brings back a smaller amount of fish than the previous one.

What happens if a seventh boat goes out? The total amount of fish caught by the seven boats together (17 tonnes) is *less* than what was caught by 6 boats (18 tonnes). As the graph indicates, in this range of 'absolutely decreasing yield', as more and more boats go fishing, the total amount of fish they bring back becomes less and less.

This example illustrates that the fish were plentiful for the first three boats, but with the addition of the fourth, fishing became more difficult because it began to put pressure on the supply of fish in the ocean.

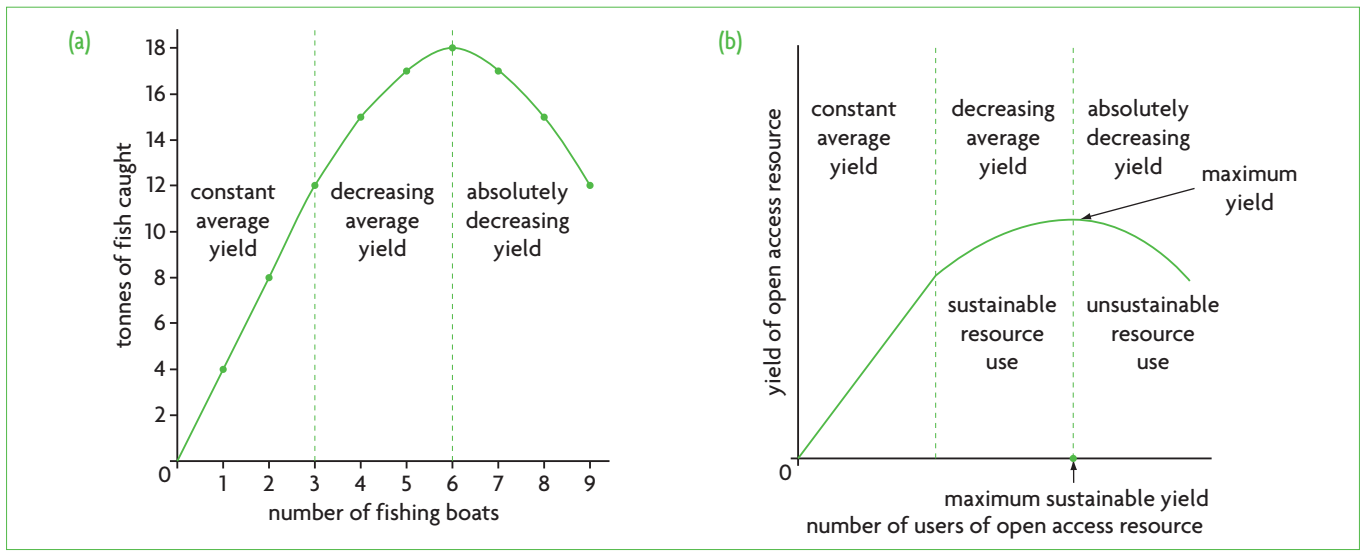

Figure 5.15 Illustrating sustainable and unsustainable resource use

[6] Brundtland Commission (World Commission on Environment and Development) (1987) *Our Common Future*, Oxford University Press.

As the supply of fish was more and more depleted, it became increasingly difficult to catch fish, so the average quantity of fish brought back fell with the addition of each boat. Finally, with the addition of the seventh boat, the fish supply was *overused*; the fish population was no longer able to reproduce itself, and therefore the quantity of fish in the ocean began to drop.

Figure 5.15(b) shows that the point of maximum yield of a common access resource is the resource's *maximum sustainable yield*. *This is the maximum use that can be made of the resource that is also sustainable, in that the resource can reproduce itself.* All points to the left of the maximum sustainable yield indicate sustainable levels of use; points to the right indicate unsustainable use, meaning that the resource is being depleted or degraded. The further to the right, the greater the resource depletion or degradation. In the real world, many open access resources are used unsustainably, i.e. to the right of their maximum sustainable yield.

Note that while it is an easy matter to discuss the maximum sustainable yield of a resource in theoretical terms as we have done here, it is very difficult in practice to determine what this actually is for any resource.

Sustainable resource use means that resources are used at a rate that allows them to reproduce themselves, so that they do not become degraded or depleted.

Test your understanding 5.8

1 Provide examples of common access resources, making reference to their overuse.

2 **(a)** Define common access resources using the concepts of rivalry and excludability. **(b)** How does the non-excludability of these resources relate to their lack of a price? **(c)** Why does the lack of a price pose a threat to the environment?

3 How are common access resources related to market failure?

4 Explain the concept of sustainability.

5 **(a)** In discussions of open access resources, there is an emphasis on their *overuse* rather than their *use*. Why? **(b)** Explain why cutting down a small amount of forest over an extended period of time may be consistent with the concept of environmental sustainability.

Distinguishing between the 'pollution of affluence' and the 'pollution of poverty'

- Explain, using negative production externalities diagrams, that economic activity requiring the use of fossil fuels to satisfy demand poses a threat to sustainability.
- Explain that the existence of poverty in economically less developed countries creates negative externalities through over-exploitation of land for agriculture, and that this poses a threat to sustainability.

We often think of environmental degradation as the by-product of production and consumption activities resulting from increasing quantities of output produced and consumed (economic growth). This type of environmental damage has been termed 'pollution of affluence' and arises mainly from industrial production and high-income consumption patterns that involve the heavy use of fossil fuels (such as oil), using up open access resources like clean air, rivers, lakes, and so on, and leading to climate change.

However, there is another type of very important environmental damage, which occurs mainly in developing countries, and which arises from production and consumption activities that are due to poverty. This second type of environmental damage has been termed 'pollution of poverty', and is due to economic activities pursued by very poor people in an effort to survive.

High-income production and consumption based on fossil fuels as a threat to sustainability

In section 5.3 we studied negative production and consumption externalities, which show how societies are worse off when production or consumption activities give rise to external costs. The concept of negative externalities can be used to illustrate the problem of overuse of common access resources and its effects on sustainability. The overuse of common access resources and their depletion/degradation are the external costs of industrial production and high-income consumption activities, both based on use of fossil fuels. In the negative production externality of Figure 5.2 (page 103), the difference between the *MPC* and *MSC* curves can be interpreted as the social cost arising from the cement factory's overuse of clean air, water, sea life and ozone layer on account of its dependence on fossil fuels; it can also be interpreted as the cost to society of causing global warming (destroying the stability of the global climate). The burning of fossil fuels creates external costs in terms of overuse of common access resources.

If it were possible to make the cement factory pay for the overuse of these resources, the producer would not necessarily stop its polluting activities entirely, and would not stop *using* common access resources. However, it would stop *overusing* them, thus leading to a sustainable use of common access resources.

Figure 5.2 can be used to illustrate the overuse of any common access resource as a negative production externality. For example, if the *MPC* curve represents the private costs of a fishing firm that fishes in the open seas, the external costs could be depletion of the stock of fish, and environmental damage due to disruption of the marine ecosystem, or the common access resources that the fishing firm has overused but not paid for.

Overuse of common access resources can also be seen to result from negative consumption externalities, shown in Figure 5.6 (page 108). Take the demand for heating oil, represented by the demand curve *MPB*. The overuse of clean air (the common access resource) is the external cost that causes the marginal social benefit curve (*MSB*) to lie below the *MPB* curve.

Poverty as a threat to sustainability

According to the Brundtland Report, which coined the term 'sustainable development' (page 14), poverty is the most important cause of environmental destruction, due to the overexploitation by poor people of their scarce environmental resources. Poor people lack modern agricultural inputs, and being too poor to buy inputs that preserve the soil's fertility, they deplete the soil's natural minerals, making soils less productive. Poor people usually have higher birth rates and higher population growth, creating pressures for them to open up new lands for agriculture. With suitable agricultural land becoming increasingly scarce, they cut down forests (deforestation) in search of new farmland, they move to fragile lands in mountains and hills, causing soil erosion, and they overgraze animals on pasture lands, depleting the nutrients there as well. Lacking modern energy sources, they also cut down forests to obtain firewood. Poor people have limited abilities to borrow to finance the purchase of inputs, and this works against their ability to make improvements in sanitation, irrigation, improved agricultural inputs and land improvements, which would reverse or reduce these types of environmental degradation (see Chapter 17).

The production and consumption activities of very poor people that endanger the environment and sustainability can also be interpreted as negative externalities involving overuse of common access resources. In Figure 5.2, the *MPC* curve may be a farmer's private costs of farming, with the difference between the *MPC* and *MSC* curves representing overuse of forests that have been cleared for agriculture, or the overuse of soil leading to depletion of nutrients.

The threat to sustainability lies in the *increased scale of economic activities around the world*, which may be due to economic growth based on the use of fossil fuels; or it may be due to the increasing numbers of very poor people who engage in environmentally destructive activities in an effort to survive.

Whereas the pollution of poverty occurs mainly in developing countries, this is not to say that developing countries are not guilty of creating some 'pollution of affluence'. Increasingly, the pollution of affluence arises also in developing countries that grow by engaging in industrial production and consumption activities without regard for the environment.

A note on renewable and non-renewable resources, and sustainability

Non-renewable resources are those resources that do not last indefinitely, because they have a finite supply (they need tens of thousands or millions of years to reproduce themselves). Examples include metals, minerals and fossil fuels, such as oil, natural gas and coal. Many of these resources, with the exception of fossil fuels, do not get destroyed through their use, and so through effective recycling could be made to last indefinitely. By contrast, fossil fuels are destroyed when used, and moreover have devastating effects on the earth's atmosphere, the global climate and the ozone layer.

Renewable resources are those resources that can last indefinitely if they are managed properly (not overused), because they are reproduced over relatively short periods of time by natural processes. Examples include forests, wildlife, fish, biomass, water resources, geothermal power, soil fertility and biodiversity. The idea of sustainable resource use applies mainly to *renewable resources*, because given appropriate management, these resources can be made to last forever. On the other hand, through mismanagement or overuse, these resources become depleted and degraded, indicating unsustainability.

The idea of sustainable resource use does not apply to non-renewable resources like fossil fuels. If resources are non-renewable, they could be used sustainably only if they were not used at all. On the other hand, as we have seen, the idea of sustainability is relevant to fossil fuels when referring to the negative externalities that are created by their use.

Test your understanding 5.9

1 Discuss the impacts of production and consumption activities on the environment, making a distinction between the roles played by growth based on fossil fuels and by poverty.

2 Using diagrams, show what kinds of market failures are particularly relevant to analysing environmental problems.

Government responses to threats to sustainability

♦ Evaluate, using diagrams, possible government responses to threats to sustainability, including legislation, carbon taxes, cap and trade schemes, and funding for clean technologies.

This section should be studied in connection with the material presented on pages 106–8 (on negative production externalities) and 111–12 (on negative consumption externalities).

Legislation

Legislation (laws and regulations) intended to limit threats to sustainability typically involve emissions standards, quotas, licences, permits or outright restrictions. Examples include:

- restrictions on emissions from cars
- requirements for cars to use catalytic converters to reduce air pollution
- restrictions on emissions from factories and industrial production
- requirements for steel mills and electricity generating plants to install smokestack scrubbers to reduce emissions
- banning the use of harmful substances (e.g. asbestos)
- restrictions regarding hunting seasons and hunting areas
- issuing licences or permits for particular activities (such as hunting)
- prohibiting construction (such as housing) or industry or agriculture in protected areas
- restrictions on the quantity of logging
- restrictions in the form of quotas for fishing (maximum permissible quantity of fish that can be caught) or in the form of the size of shipping fleets, or total bans for specific areas or specific times of the year
- establishment of protected areas for the protection of biodiversity and endangered ecosystems.

Regulations and restrictions have the advantage that they are simple to put into effect and oversee. In most of the examples above, they can be quite effective, such as in the case of restricting car emissions, banning the use of harmful substances, restrictions on hunting, logging and fishing, and establishment of protected areas. In the case of emissions of industrial production, they avoid the technical difficulties that arise in the use of market-based solutions and force polluters to cut emissions (see page 107).

However, they also face limitations. In the case of emissions of pollutants, they do not offer incentives to reduce emissions, to increase energy efficiency and to switch to alternative fuels; and they cannot distinguish between high- and low-cost polluters, which would limit the overall cost of reducing pollution (for more information, see page 108). They also involve costs of monitoring and supervision to detect possible violations.

Overall, the effectiveness of legislation must be assessed in relation to the particular use for which it is intended, as it can be more effective in some situations than in others.

Carbon taxes versus cap and trade schemes

Perhaps the single most pressing and complex threat to the global ecosystem is global warming, caused by emissions of greenhouse gases, the most important of which is carbon dioxide. When we speak of the contribution of greenhouse gases to global warming, we refer to those gases emitted by manmade processes, and specifically by the burning of fossil fuels (oil, coal and natural gas). Whereas it is known with a reasonable degree of certainty that manmade greenhouse gases cause global warming, there is tremendous uncertainty in calculating the precise contribution of each of these to increases in global temperatures.

Two measures under discussion in the global community that can be taken to deal with the problem of carbon dioxide emissions are carbon taxes and cap and trade schemes.

Carbon taxes

The *carbon tax*, introduced on page 106, is a method to reduce emissions of carbon dioxide, emitted when fossil fuels are burned. The carbon tax aims at taxing the use of fossil fuels in accordance with the amount of carbon each one emits. Therefore, *fuels that emit more carbon are taxed at a higher rate than those emitting less carbon.*

Since the tax varies with carbon emissions, fossil fuel users face the incentive to switch to fuels that emit less carbon, or even no carbon (non-fossil fuel energy sources). Figure 5.5(b) (page 105) shows how the external costs become smaller as a result of using less polluting fuels, and how as a result the optimum quantity of the good produced increases.

Some countries have introduced carbon taxes (for example, Denmark, Finland, France, Ireland, Netherlands, Poland, Sweden), as well as some states in Canada and the United States, while in others the carbon tax is hotly debated together with cap and trade schemes.

Cap and trade schemes

Cap and trade schemes refer to *tradable permits*, discussed on page 106 and illustrated in Figure 5.5(c). Such schemes impose a cap (a maximum amount) on the total amount of carbon dioxide that can be released by producers into the atmosphere. Permits to release carbon dioxide are distributed to producers, and the permits can be bought and sold in a market. Cap and trade schemes may be set up within a country; or within a group of countries such as the European Union Emissions Trading System (EU ETS; see page 130); or globally, such as the Kyoto Protocol (see page 129).

Evaluating carbon taxes and cap and trade schemes

As market-based methods to reduce emissions, both carbon taxes and cap and trade schemes provide incentives to firms to switch to less polluting forms of energy. However, they differ in how they attempt to do this. Carbon taxes fix the price of the pollutant in the form of a tax on carbon and allow the quantity of carbon emitted to vary, depending on how firms respond to the tax; cap and trade schemes fix the quantity of the permissible pollutant, and allow its price to vary, depending on supply and demand.

Most economists prefer carbon taxes to cap and trade schemes for a variety of reasons:

- **Carbon taxes make energy prices more predictable.** Fossil fuel prices in global markets fluctuate according to demand and supply. Under cap and trade schemes, the price of fossil fuels might fluctuate even more due to fluctuations in the price of carbon. By contrast, since carbon taxes fix the price of carbon emissions, the price of fossil fuels is likely to be relatively more predictable. Price predictability is important for businesses that need to plan their costs ahead of time.
- **Carbon taxes are easier to design and implement.** Cap and trade schemes are difficult to design and implement as they involve complicated decisions such as setting the cap at the right level and distributing the permits among all interested users. Carbon taxes may be simpler to design and use.
- **Carbon taxes can be applied to all users of fossil fuels.** Cap and trade scheme proposals often target one particular industry, or small group of industries. Carbon taxes can be applied to all users of fossil fuels, including all producers and consumers.
- **Carbon taxes do not offer opportunities for manipulation by governments and interest groups.** Politicians often prefer cap and trade schemes to carbon taxes, and it is believed that this may be because it is easy to manipulate the distribution of permits for the benefit of preferred groups and supporters, without affecting the impacts on the environment (because of the cap). Carbon taxes do not allow for such manipulation.
- **Carbon taxes do not require as much monitoring for enforcement.** Cap and trade schemes require monitoring of emissions, otherwise firms may try to cheat by emitting more pollutants than they are permitted. Carbon taxes are easier to monitor as they only involve payment of a tax depending on the type and quantity of fossil fuels purchased.
- **Cap and trade schemes face strong political pressures to set the cap too high.** If the cap on pollutants is set too high, it would have a very limited or no impact on reducing carbon emissions.
- **Carbon taxes are less likely to be used to restrict competition between firms.** A possible disadvantage of tradable permits over taxes is that some firms could buy up more tradable permits than they actually need, thus driving up their price, in an effort to keep new firms from entering the market (as a result restricting competition).

There are also some arguments against carbon taxes and in favour of cap and trade schemes:

- **Carbon taxes may be too low.** Governments may be unwilling to set carbon taxes high enough for these to provide the necessary incentives for users to switch to less polluting energy sources.
- **Carbon taxes cannot target a particular level of carbon reduction.** Since carbon taxes cannot fix (or cap) the permissible level of carbon emissions, they lead to uncertain carbon-reducing outcomes. Cap and trade schemes work by fixing the total amount of the permissible carbon emissions.
- **Carbon taxes are regressive.** A regressive tax is one where the tax as a fraction of income is higher for low-income earners than it is for

higher-income earners, and go against the principle of equity (see Chapter 11, pages 313–4). A carbon tax on a firm is an indirect tax whose burden (incidence) falls on both producers and consumers (see page 74). Therefore, consumers would also be affected, and lower-income consumers would be affected proportionately more than higher-income consumers.

- **Carbon taxes must be adjusted for inflation.** During periods of inflation (a rising price level), the market will automatically result in rising prices of tradable permits according to supply and demand, which is an advantage. In the case of carbon taxes, an upward adjustment would have to be decided on by the government (or international body), which could be politically and administratively more difficult.

Theory of knowledge

The ethical dimensions of sustainability and preserving the global climate

In Chapter 1, page 14, we saw that solutions to the problem of sustainability face major technical difficulties due to uncertainties and incomplete knowledge of social and natural scientists regarding the complex relationships between environmental, economic, social and institutional variables. These kinds of technical difficulties are also responsible for the uncertainties surrounding both regulatory and market-based economic policies to address environmental externalities discussed in the present chapter.

Over and above the technical difficulties, the problem of sustainability faces major ethical issues of fairness and justice, relating to intergenerational equity (running from generation to generation), as well as equity across nations and social groups within nations of the present generation.

In the area of climate change alone, important issues include (a) how will the burden of having to make sacrifices in the present be distributed among countries; (b) how will the impacts of climate change be evaluated; and (c) how will intergenerational equity be accounted for?[7]

To determine the distribution of sacrifices, a possible ethical principle that can be used is 'the polluter pays' principle, according to which the sacrifice is distributed according to how much each country contributes to climate change. In one variant of this principle, it would be necessary to take into account cumulative (historical) contributions to greenhouse gas emissions. This would place an extra burden on the developed countries of today, which over time, have contributed far more to emissions than developing countries. As a counterargument, opponents refer to 'excusable ignorance', meaning it should not be necessary to pay for past emissions if these were made without knowledge of their effects on the global climate. According to a different ethical principle, the past would be ignored and future emissions rights would be distributed to all countries on a *per capita* basis.

On the second issue, concerning evaluation of impacts of climate change, one approach involves welfare analysis. This has given rise to disagreements about how to calculate welfare and add it up across individuals in the present as well as in the future. Another approach focuses on human rights as the basis for evaluating impacts, such as the rights to food, water and shelter, which may be threatened by climate change.

Intergenerational equity, the third issue, is closely related to the evaluation of impacts of climate change, as these must account for impacts not only on the present generation but future generations as well.

These kinds of questions clearly belong to the normative realm of thought. Given the technical difficulties as well, it is no wonder that there are broad disagreements over sustainability, and no easy solutions appear on the horizon.

[7] The World Bank (2009) *World Development Report 2010: Development and Climate Change.*

Thinking points

- What do you think should be the role of science and social science in providing answers to these kinds of questions?
- To what extent do you think market forces can be relied upon, if at all, to deal with problems of environmental sustainability?
- Market economies are based upon human behaviour motivated by rational self-interest (see page 11). To what extent do you think this self-interest is the root cause of the environmental problems that beset the human race today? (See also the Theory of knowledge feature on page 131.)
- Given that, historically, economically more developed countries have been mainly responsible for today's environmental problems, do you agree with the view that economically less developed countries should simply ignore calls for them to limit their growth rates to prevent further global warming?

Funding for clean technologies

The need for clean technologies

Clean technologies aim toward a more responsible and productive use of natural resources, which also reduce negative environmental impacts. They include wind power, solar energy, biofuels, geothermal energy, nuclear power, energy storage (such as the development of fuel cells), fuel efficiency (less waste in use of energy), recycling and many more.

Many of these technologies are already available to reduce carbon emissions, including using more efficient use of fossil fuels (avoiding waste in their use), and the use of low- or no-emission power-generation methods, such as wind power and solar power. However, the very large potentials of these two approaches are nowhere close to being realised, mainly because there are not enough appropriate policies in place that would promote their greater use. These policies include the kinds of regulatory and market-based policies that we have discussed above. In addition, they involve a more rational use of subsidies (to be discussed below).

But even if these already existing technologies were more widely used, it is believed that they are nowhere close to enough to bring carbon emissions to acceptable levels. This means there is an urgent need for the development of new technologies that can be adopted by countries around the world on a large scale to prevent unacceptable increases in global temperatures.

Funding for clean technologies

It is very important that both private firms and governments be involved in activities leading to innovation and development of low-emissions technologies and environmentally friendly sources of energy. Yet funding for these activities is barely sufficient. According to the World Bank's *World Development Report 2010*:

> '… today's global efforts to innovate and diffuse climate-smart technologies fall far short of what is required for significant mitigation and adaptation in the coming decades. Investment in research, development, demonstration and deployment (RDD&D) is lacking …
>
> Neither public nor private funding of energy-related research is remotely close to the amounts needed for transitioning to a climate-smart world. In absolute terms, global government energy RD&D [research, development and demonstration] budgets have declined since the early 1980s, falling by almost half from 1980 to 2007 …'[8]

Within governments, the priority attached to innovation in energy has been steadily falling over the years. Government spending on energy RD&D as a percentage of government spending on total RD&D fell from over 20% in 1980 to less than 4% in 2007. Private sector spending on energy RD&D, estimated at $40 billion to $60 billion a year, is far greater than public sector (government) spending of about $7 billion a year (2007 figures). However, even within the private sector, spending on energy RD&D is not a high priority, as it represents a mere 0.5% of revenue, compared with 8% of revenue spent on RD&D in the electronics industry and 15% of revenue in the pharmaceutical sector.[9]

Because of the far greater resources at their disposal, developed countries have been playing a leading role in climate-smart technology development. Some developing countries have begun to play a more active role, in 2007 contributing 23% of new investments in energy efficiency and renewable energy compared to 13% in 2004. However, most of these investments were concentrated in three countries only, Brazil, China and India.[10]

Funding for clean technologies clearly has opportunity costs. However, given its urgency governments should make a greater effort to allocate resources to technological innovations in this area, and should also make efforts to promote private sector funding and participation.

Eliminating environmentally harmful subsidies

Subsidies encourage the production and consumption of the subsidised good (see page 81). When environmentally damaging production activities are subsidised, they result in greater production, leading to greater environmental damage. Subsidies to industrial forestry encourage commercial logging, resulting in destruction of forests. Subsidies to production of fossil fuel energy result in a greater amount of fossil fuel production. Consumption subsidies are commonly imposed on fossil fuel energy, agricultural inputs (such as fertilisers and pesticides) and water. Both production and consumption subsidies are often

[8] The World Bank (2009) *World Development Report 2010,* pp. 288 and 292.
[9] The World Bank (2009) *World Development Report 2010.*
[10] The World Bank (2009) *World Development Report 2010.*

the result of 'policy failures', involving the pursuit of a policy for one purpose that creates problems in another area (environmental destruction). Subsidies should therefore be studied for their environmental impacts, and changed or eliminated accordingly.

In the case of fossil fuels, subsidies are often granted to promote the industrial sector by keeping costs down, to promote international competitiveness of industrial products (make them less expensive in international markets through lower costs of production), to support domestic fuel production to ensure adequate domestic supply and to reduce reliance on foreign energy sources (for countries that are fossil fuel producers) and to keep fuel prices down for consumers. The effects of subsidies on fossil fuels are entirely inconsistent with the pursuit of sustainable development.

Figure 5.16 makes an interesting comparison between spending by governments around the world on subsidies to energy and petroleum products, and spending by governments on energy research and development. (These subsidies are concentrated mainly in developing countries, as developed countries have for the most part eliminated energy and petroleum subsidies.) Figure 5.16 shows how governments around the world massively underfund technological innovation in the area of energy.

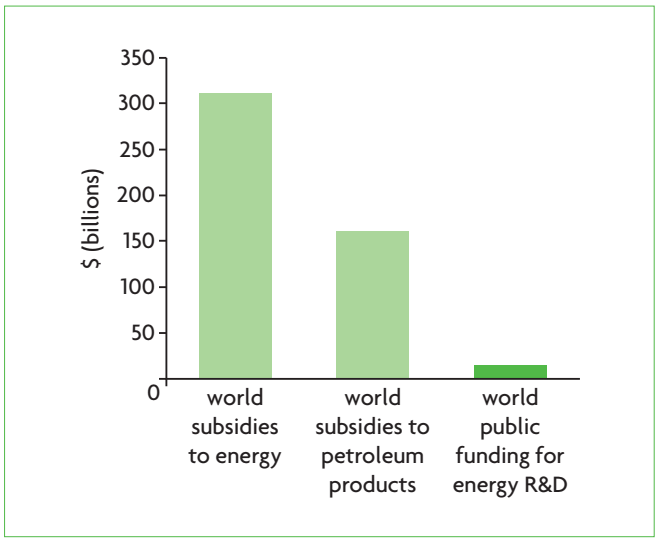

Figure 5.16 World government spending on energy and petroleum subsidies and on energy research and development

Source: The World Bank (2009) *World Development Report 2010: Development and Climate Change*, p. 293.

The role of international co-operation

- Explain, using examples, that government responses to threats to sustainability are limited by the global nature of the problems and the lack of ownership of common access resources, and that effective responses require international co-operation.

Policies are made mainly by national governments. However, the overuse of common access resources often has international repercussions, in which case co-operation among governments is crucially important as a method of controlling and preventing negative consequences on certain resources, such as the global climate and the ozone layer. In addition, co-operation among governments is very important for the development and diffusion of new technologies intended to deal with global environmental issues. Co-operation between governments may be global or regional.

For example, the ozone layer has suffered ozone depletion, leading to reduced protection against the sun's ultraviolet radiation. This resulted from human activities involving the production of nitrogen oxides and chlorofluorocarbons (CFCs). The ozone layer is an open access resource. No one owns it, and no one can claim damages for its destruction. The responsibility for its destruction lies with polluting activities within virtually every country, and the consequences of its destruction are felt globally. The same considerations apply to the global climate.

One of most successful examples of international collaboration for the environment is the Montreal Protocol, signed in 1987 and coming into effect in 1989, intended to phase out substances that have caused depletion of the ozone layer. By 2009, all member states of the United Nations had ratified the agreement, and significant progress has been made in the area of phasing out ozone-depleting substances.

Another major (but less successful) international collaborative agreement for the environment is the Kyoto Protocol of 1997–2012. Its objective was to make signatory countries commit themselves to reduce emissions of carbon dioxide and other greenhouse gases over a period of 15 years to slow down the problem of global warming and climate change. It also contained provisions for the development of a market of tradable emissions permits, according to which each participating country was to be assigned certain pollution permits which it would be able to trade (buy and

sell) with other countries. However, the Kyoto Protocol came under a lot of criticism and has not been implemented in full. Many environmental specialists argued that even if it were implemented, the agreed reductions in emissions were too small to have sufficient impact on the problem of global warming. While there have been numerous discussions on a successor agreement to the Kyoto Protocol, nothing concrete has emerged as of summer 2011.

A more successful example of a regional collaborative arrangement is the European Union's cap and trade scheme for carbon, known as the European Union Emissions Trading System (EU ETS), which was initiated in January 2005. The scheme covers the sectors of power and heat generation, oil refineries, metals, pulp and paper, and energy intensive industry. In this system, one permit, or EU Allowance (EUA) permits the holder to release one tonne of carbon dioxide. Each emitter of carbon is allocated EUAs, which are traded in a rapidly growing carbon market.

Test your understanding 5.10

1 Explain some advantages and disadvantages of each of the following policy measures to deal with threats to sustainability: **(a)** legislation, **(b)** carbon taxes, and **(c)** cap and trade schemes.
2 What are some key issues surrounding the debate between carbon taxes versus cap and trade schemes?
3 **(a)** Explain the significance of funding for clean technologies to deal with threats to sustainability. **(b)** What might be some reasons for the underfunding of technological innovations in the development of clean technologies?
4 Using examples, explain under what circumstances international co-operation among governments is essential for the preservation of the environment.

Real world focus

Business leaders in Australia debate carbon taxes versus cap and trade schemes

The head of BHP Billiton (a very large resources company in Australia) suggested that a tax on carbon be imposed in Australia ahead of a global agreement. He argued that this should be done in order to anticipate a global price that would result from an international agreement to limit carbon emissions.

Other business leaders disagreed. They argued that taking action before an international agreement is arrived at would damage Australia's economy and result in a loss of its international competitiveness. Also, some noted that a carbon tax would not have a major impact on carbon emissions. According to one argument, the price elasticity of demand for petrol (gasoline) is low; while a tax may have a short-term effect, people soon get used to the higher price and they go on using what they were using before the tax. Therefore, a cap and trade scheme would be more effective in cutting emissions, though this should only be adopted after a global agreement is reached, since not only a carbon tax but also a cap and trade scheme would negatively affect Australia's competitiveness.

Source: Adapted from Andrew Burrell and Matt Chambers, 'Business leaders condemn Klopper's carbon price call' in *The Australian*, 17 September 2010.

Applying your skills

1 Using a diagram, explain why a carbon tax and a cap and trade scheme would affect Australia's international competitiveness.
2 Using diagrams, explain how **(a)** a carbon tax, and **(b)** a cap and trade scheme can help cut carbon emissions.
3 Evaluate the view of some Australian business leaders that a cap and trade scheme is a better policy than a carbon tax to lower carbon emissions.