EXPLORING SUSTAINABLE DEVELOPMENT

Geographical Perspectives

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The Role of Spatial Scale and Spatial Interactions in Sustainable Development

Alan Grainger

Introduction

The spatial dimension of sustainable development has so far been rather neglected (Niu et al, 1993; Van den Bergh, 1996). For geographers, who have a particular interest in the analysis of spatial phenomena, this is both a crucial gap and an area in which they can make a significant contribution to improving our general understanding of sustainable development. It is beyond the scope of this chapter to cover all spatial aspects of sustainable development, so the focus here is on the role of spatial scale and spatial interactions. This seems highly appropriate, as much previous research has concentrated on studying sustainable development at a particular level of the spatial scale, such as the local or national, while ignoring interactions within and between these levels.

The chapter addresses sustainable development as a theoretical concept rather than a political ideal (see Chapter 1). However, it takes both a descriptive approach, by assessing the sustainability of development in the real world in relation to an ideal sustainable path, and a prescriptive approach, by examining the various strategies which are, or could be, used to make development more sustainable. A key broad underlying question is whether existing theories, largely conceived from an aspatial perspective, have limitations when applied spatially.

The development of a society is regarded here as sustainable if overall human welfare does not decline (Pearce, 1991), and this can occur if a society follows an ideal development path that optimizes the balance between economic, social and environmental change. In practice, actual development paths never coincide with the ideal, but the closer the two paths are, the greater the sustainability of development. Characterizing the ideal path is difficult, but various alternative conditions have been proposed (see Chapter 1). The primary analytical framework for this chapter is provided by the Very Weak Condition of environmental economics theory (see Table 3.1). This is the only condition that encompasses, and differentiates between, the economic, social and environmental dimensions of development, and it can be used to evaluate relationships between the spatial distributions of Natural Capital and Human and Man-Made Capital. The other Constant Capital Conditions are referred to, as appropriate, together with conditions proposed by ecological economists.

The chapter has four main parts, addressing key generic questions on the role of spatial scale identified by Gibson et al (1998). Part one compares the merits of different types of spatial scale and finds a socio-political scale to be most useful in this context. Part two examines whether sustainable development is a meaningful concept at all levels on that scale, from the global to the household. Part three assesses the extent to which the sustainability of development in a spatial unit at a particular level is determined by internal processes, and how much it is influenced by interactions with other units, for example, through trade and pollutant transfers. Part four looks at how the sustainability of development in a spatial unit at one level depends on patterns at other levels and interactions between them. This leads to a discussion of the role of uneven development and international conventions in sustainable development and the merits of participatory strategies.

Table 3.1 The Constant Capital Conditions for sustainable development

1	Very Weak: there is no reduction in the stock of Total Capital. The value of depleted Natural Capital does not exceed the value of the rise in Human and Man-Made Capital derived from it.
2	Weak: there is no reduction in the stock of Critical Natural Capital.
3	Strong: there is no reduction in the total stock of Natural Capital.

Structuring Global Space

Scales, levels and hierarchies

Sustainable development was devised with two global goals in mind: protecting the global environment by safeguarding the world's remaining pristine ecosystems; and increasing international equity by reducing inequalities within and between countries. To assess the overall effectiveness of actions intended to achieve these goals we need a scale to divide the planet into manageable segments. A *scale* was defined by Gibson et al (1998) as 'the dimension used to measure a phenomenon'. It encompasses the range of variation in a phenomenon and is usually divided for convenience into a hierarchy of discrete gradations, or *levels*.

Each level on a spatial scale provides an alternative picture of the world, dividing it into a large number of individual *spatial units*. At the national level, for example, these comprise some 190 countries. The lower the level on the scale, the greater the number of spatial units.

Geographical scale was defined by Delaney and Leitner (1997) as 'the nested hierarchy of bounded spaces of differing size'. In nested hierarchies the bounded spaces (or spatial units) at one level contain others at lower levels. If the hierarchies are constitutive, on the other hand, as is common in social hierarchies, then the properties of spatial units at one level help to determine the properties of units at higher levels (Mayr, 1982). Whether this is true for sustainable development is examined below.

Ecological scales

Of the various scales that could be used for this analysis, an ecological scale seems at first glance to have many attractions. It typically starts at the global level with the entire biosphere, and then proceeds through the levels of biome-type (a major type of global ecosystem), biome (a continental ecosystem type), landscape, ecosystem, community, population and organism (see Figure 3.1) (McTaggart, 1993).

The advantage of using such a scale is that it could help to identify critical limits to the depletion of biological wealth, from major biome-types, such as tropical rain forest, at the global level, down to the diversity of individual species, such as the teak tree, *Tectona grandis*. This would be particularly useful for monitoring trends in Critical Natural Capital, required to sustain the functioning of the biosphere (see Chapter 1). In the World Conservation Strategy (IUCN, 1980) the remaining distributions of the different biomes, landscapes and ecosystem types were mapped by rarity, richness and threat, forming the basis for a global network containing representative examples of each.

Monitoring the overall sustainability of development would be difficult, however, for three reasons:

1. Measuring change over time in a particular biome, such as tropical rain forest in Asia, would require the coordinated monitoring of trends in Natural Capital in many dispersed locations. Even with the help of sampling, this would be a huge undertaking.
2. Integrating development and environmental change would be hampered by data limitations. Global data on the potential and actual spatial distributions of ecosystems are limited in both quantity and accuracy. Moreover, environmental boundaries and societal boundaries do not necessarily coincide: for example, the huge natural region of the Amazon Basin is divided between eight countries. Ecological scales also tend to be structured around the distribution of renewable resources, whereas development patterns are also influenced by the distribution of non-renewable resources and the economics of their exploitation.
3. Even if all patches of a particular biome in each country could be identified and mapped, the socio-economic processes determining the sustainability of each patch would only partly originate inside its boundaries. So while, in principle, compliance with the Very Strong and Strong conditions could be monitored in a sophisticated way on an ecological scale, some of the key factors affecting compliance, such as the forces driving deforestation, would originate in other biomes. This would make integrated analysis of human–environment interactions difficult, if not impossible.

Social science scales

The main alternative is a social science scale. Scales used by geographers and political scientists, for instance, typically divide global space into a hierarchy of levels that starts with groupings of states (including both supranational regions and the international community) and moves down through the state, region, locality (city, town and village) to the household (see Figure 3.2) (Gibson et al, 1998). Although the

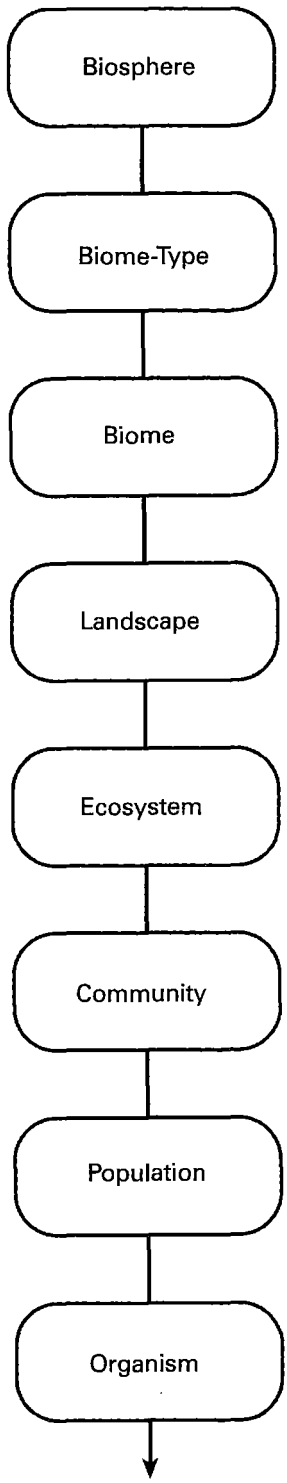

Figure 3.1 An ecological scale

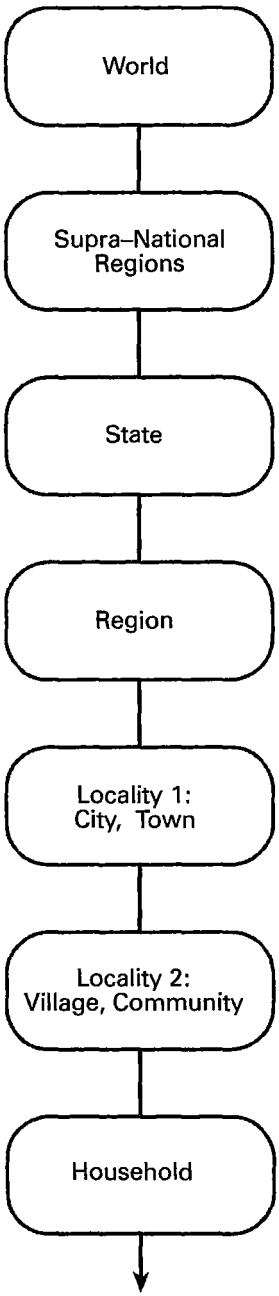

Figure 3.2 A social science scale

distributions of individual spatial units at each of these levels do not necessarily coincide with the distribution of Natural Capital, they are not totally divorced from it. Many national and sub-national boundaries have been chosen to follow natural features, such as mountains, rivers and coasts, and some even have an ecological

significance. In Indonesia, for example, different types of rhinoceros are native to the islands of Java and Sumatra. An integrated analysis of human–environment relationships is helped by the cultural and legal homogeneity of individual spatial units, but the major advantage of using this type of scale is the abundance of social, economic and environmental data collected within the framework of political boundaries. This makes the comparison of changes in all these dimensions of development within a single territory far more practical than with an ecological scale. While a social science scale is by no means perfect, it seems the most pragmatic choice for present purposes.

Principal levels in a socio-political hierarchy

Spatial units at each level on a social science scale have their own distinctive characteristics and links with spatial units at other levels. These are now reviewed in order to decide which level provides the best reference point for analysis.

National level

States are sovereign territories with the freedom to order affairs inside their own borders. They are sometimes referred to as 'nation-states', though this strictly refers to countries populated by a single national group. The national level has many advantages for undertaking a generalized assessment of sustainable development. For while uneven development is common within states, national economic space is still relatively homogeneous, owing to the adoption of common currencies, laws and institutions (Radice, 1984). Governments have the authority to enforce this homogeneity, and a survey by the UK Environment Agency found that the need to comply with government regulations provided the main incentive for 80 per cent of British companies to raise their environmental performance (Gallagher, 1997).

National borders are, by definition, internationally recognized; compilations of international statistics on social characteristics, economic activity and environmental quality all use the state as the basic spatial unit; and international action on the environment requires voluntary cooperation between the governments of sovereign states. Claims that economic globalization has severely diminished the sovereignty of individual countries (see, for example, Ohmae, 1995) are widely contested (Dicken, 2003). Whatever the truth of this, social, economic and environmental characteristics still vary widely between states. This, and the need of governments to meet their international obligations to monitor sustainable development, provide a strong justification for using the state as the basic building block for analysis in this chapter. States can, in turn, be aggregated into supranational regions and divided into sub-national regions and smaller spatial units. Each is now discussed in turn.

Supranational level

There are three main types of supranational regions. The tightest groupings of states, such as the European Union (EU), are bound by treaty and pool some of their sovereignty so their economic, social and environmental standards can converge. Weaker groupings, for example, the North American Free Trade Agreement (NAFTA) and the Association of Southeast Asian Nations (ASEAN), are also bound by treaty, but their actions have less cohesion. They also tend to be committed to acting together in just one sphere, such as trade, or to voluntarily consult with one another or

collaborate in a number of areas. This contrasts with more tightly regulated multifunctional groupings, such as the EU. In the third type, continental regions, states are grouped by virtue of contiguity alone, and regional social, economic and environmental trends are the simple sum of those in the states they comprise.

International level

States also join together in larger groupings, some of which are global in scale. The most inclusive global grouping is the United Nations Organization. Others, such as the Food and Agriculture Organization (FAO) and other specialized United Nations (UN) agencies are smaller, either because some states choose not to be members or because membership is restricted. Large numbers of states also join together to implement specific international environmental regimes, such as the Framework Convention on Climate Change (FCCC) (see Chapters 11 and 12).

Sub-national level

Below the national level, two main kinds of regional divisions may be found within countries: geographical regions and political/administrative regions. A geographical region, such as the Great Plains of North America, is 'any area with distinct and internally consistent patterns of physical features or human development which give it a meaningful unity and distinguish it from surrounding areas' (Goodall, 1987). Analysing human–environment relationships in these regions is facilitated by their relative environmental, cultural and/or economic homogeneity. Some regions span the broader catchment areas on which urban areas depend for labour and raw materials. Yet regional boundaries are often subjectively defined (Haggett, 2001) and may overlap with those of other regions, preventing the construction of a comprehensive nested spatial hierarchy.

States are often divided into political regions for statistical or administrative purposes. These have varying degrees of autonomy depending upon the administrative system of individual states. In federal states, such as the USA, regions are the next major level of administration below the national government. In unitary states, however, regions may have little or no power or autonomy. Thailand, for example, is divided into seven regions, but they have no administrative role. The distribution of power between the levels of a political hierarchy may, however, change over time. For example, in the late 1990s the British Government devolved a degree of administrative and legal authority to Scotland, Wales and Northern Ireland. As yet, however, there has been no equivalent process in England and the nine Regional Development Agencies established in 1999 have no significant authority.

Local level

The local level is the lowest level in the spatial hierarchy with well-defined boundaries. The spatial unit at this level is, for convenience, called a locality, even though it refers to a settlement that may range in size from a village to a metropolitan conurbation, and even small towns can be divided into multiple 'localities'. Almost half of the world's population live in cities, which are concentrations of Man-Made Capital, Human Capital, but regrettably also of low Environmental Quality. Given their global importance, they are a major focus of sustainable development research (Gibbs, 1994; May et al, 1996; see also Chapters 5 and 6 in this volume). The limited

size and well-defined administrative boundaries of cities can be deceptive, since many of those who work within an urban core commute daily from other settlements within a wider 'contact zone'. The 'city region' which encompasses this zone is a well-established geographical concept (Haggett, 2001), though the actual urban footprint may be even larger when sources of natural resources supplies and the sinks where waste is deposited are also included (see Chapter 5).

Household level

Households have key roles as producers and consumers, and so are important units of analysis for assessing the sustainability of development at higher levels. They may be more meaningful units for assessing human pressures on the environment than the individual person, for even if population stabilizes, the number of households may continue to grow and with it demand for houses, cars etc. Indeed, 4.4 million new households are expected to be formed in the UK between 1991 and 2016 (DoE, 1995).

In developing countries, where labour is still predominantly agricultural, the household is an important spatial unit, because for a significant proportion of the farming population, it can be equated with the 'family farm', consisting of a homestead and a collection of fields. This general model is applicable even in short-rotation shifting cultivation in the tropics, characterized by a fixed homestead and a variety of plots farmed and fallowed in rotation (Grainger, 1993).

As countries become more developed the household is better described as a social unit than as a fixed spatial unit. At any point in time it occupies a particular territory, but the location of this territory can shift markedly, as household members change the location of their external activities to sustain their livelihoods. Since the overall territory associated with each household at any time can be divided into sub-territories at different locations, household territories are not mutually exclusive, as with spatial units higher up the spatial scale.

Firms

Firms do not constitute a specific level on the spatial scale, but they are included here as they are crucial actors in development and influence the spatial distribution of sustainable development. Many are still based in one location, and of these the largest have an impact on the environment equivalent to a large town. Where they locate their facilities influences the travel patterns of workers, and the networks by which raw materials and finished goods are transported. At the other extreme, transnational corporations have production facilities and sales outlets in multiple locations all over the world (Berry et al, 1999). Although, in principle, they are obliged to comply with the laws of the states within which they operate, such corporations extend managerial control across international boundaries and integrate national economies into their international operations (Gilpin, 1987).

Achieving Sustainable Development at Different Levels

Many researchers have tended to focus their studies of sustainable development on a single level of the spatial scale. National and city studies are particularly popular. In

principle, each spatial unit at a particular level of the scale should have its own development path. But is it meaningful to talk about sustainable development at every level of the scale? In the context of the Constant Capital Conditions (see Table 3.1) this depends upon whether typical spatial units at each level contain all the types of capital, and the economic and environmental processes linking them, that are needed to satisfy a particular condition. This is not inevitable, since Human and Man-Made Capital, and the various components of Natural Capital, are distributed heterogeneously over the surface of the planet.

Supranational, national and regional levels

Most spatial units at supranational and national levels are large enough to contain sufficient stocks of Natural Capital and Human and Man-Made Capital to have the potential to comply with the Strong and Very Weak Constant Capital Conditions. However, the heterogeneous distribution of Natural Capital has left some countries and sub-national regions better endowed than others.

The situation is more complicated for Critical Natural Capital (see Chapter 1). The stipulation in the Weak Condition that this should not decline is less meaningful below the global level since some countries have little or no Critical Natural Capital within their territories, as strictly defined in global terms. In highly developed countries, in which little of the original cover of natural ecosystems remains unmodified, some types of ecosystems may be quite limited in extent. But when considered together with corresponding stocks in other countries the overall effect of this deficiency may not be significant at the global level. On the other hand, in those countries which do contain significant proportions of Critical Natural Capital, this may be concentrated in particular sub-national regions, such as Amazonia in the case of Brazil. Consequently, if an attempt were made to enforce the Very Weak and Weak Conditions together at global level then a relatively small number of countries would be obliged to conserve a large proportion of their territories, so that the whole of humanity could benefit from the continued operation of the biosphere.

Although most countries have sufficient Natural Capital to comply with the Strong Condition in principle, in practice compliance may not be feasible since this condition was not originally formulated in a spatial or developmental context. To meet the condition and prevent a decline in Natural Capital, any Non-Renewable Resource Capital that is lost in the course of development must be offset by a rise in Renewable Resource Capital, and existing Renewable Resource Capital must be managed in a perfectly sustainable way. Past experience, however, suggests that the general sustainability of renewable resource management only increases gradually as a country becomes more developed. Moreover, while countries are highly dependent upon renewable resources in the early phases of their development, they subsequently make increasing use of more energy-intensive non-renewable resources, and the contribution of renewable resources to overall energy consumption only becomes significant again at an advanced phase of development. Consequently, compliance with the Strong Condition should only be expected in countries that are still in an early phase of development or are highly developed. Compliance could, however, be achieved if the temporal scale were extended. For example, highly developed countries could establish new renewable resource stocks today in order to compensate

for non-renewable resources stocks lost long ago. Compliance could also occur at a higher level on the spatial scale, since the total expansion of renewable resources in all countries could offset the total depletion of non-renewable resources in the same year.

Localities

The potential to satisfy conditions for sustainable development becomes more difficult to determine in localities and households, where spatial units lack the full range of capital stocks and processes. Most of the Resource Capital transformed in large cities comes from outside since local stocks are invariably non-existent or depleted. This alone would be sufficient to make an area unsustainable in some approaches to sustainable development – for example, the Environmental Space (Buitenkamp et al, 1992; Schmidt-Bleek, 1992) and Ecological Footprint methods (Wackernagel and Rees, 1996), discussed below. Both are based on the ideal carrying capacity condition of ecological economics in which the scale of the human economy must not exceed the planet's ultimate carrying capacity (Daly, 1999). In countries that have reached the post-industrial phase of their development, service industries account for a larger proportion of gross national product (GNP) and employment than manufacturing. In this context, the local absence of Resource Capital is less important and overall trends in Natural Capital in large cities will be dominated by the Environmental Quality component. The level of the latter will typically be quite low, reflecting pollutants emitted by manufacturing industry, vehicles, power stations and domestic waste disposal. It is probably unrealistic to think of cities ever satisfying the Strong Constant Capital Condition, yet they could satisfy the Very Weak Condition if the huge annual increment in Human and Man-Made Capital outweighs in value the reduction in Natural Capital caused by the environmental degradation associated with economic activity. Urban environmental problems are discussed in more detail in Chapters 5 and 6.

As the size of settlements declines, sustainable development, as understood within the framework of the Constant Capital Conditions, becomes progressively less meaningful. Not only are stocks of Resource Capital lacking, but so too are the processes that transform it into Human and Man-Made Capital. In well-established rural communities in developed countries, for example, stocks of Resource Capital, in the form of natural ecosystems, are relatively static; Environmental Quality declines as a result of agricultural pollution and the extension of settlements; the farming population gains its income from growing crops (assumed here to be a form of Man-Made Capital, although opinions differ on this); and many other livelihoods are based on employment in nearby towns and cities. However, these limits to the spatial resolution with which sustainable development may be assessed are more a reflection of the limitations of the Constant Capital Conditions than of the idea of sustainable development itself.

Households

The Constant Capital Conditions are also only partly relevant at the lowest level on the scale as many households lack stocks of Resource Capital. Nevertheless, Environmental Quality is of great importance to households. For example, the interior

environments of many homes in developing countries are of poor quality because of smoke pollution from wood fires, a lack of piped drinking water and inadequate sanitation. This encourages the spread of disease and reduces the quality of life (McGranahan, 1993). As countries develop, more households are connected to water supply and sewerage networks. This raises the quality of life but also creates new problems, including groundwater depletion and river pollution.

At the household level, the primary concern is with the sustainability of livelihoods, rather than with the sustainability of development as a whole. Carney (1998) defines a livelihood as comprising 'the capabilities, assets (including both material and social resources) and activities required for a means of living'. To sustain their own livelihoods, households exploit material assets in various locations and substitute one asset or activity for another. According to Scoones (1998): 'Sustainable livelihoods are achieved through access to a range of resources (natural, economic, human and social capitals) which are combined in the pursuit of different livelihood strategies (agricultural intensification or extensification, livelihood diversification and migration)'. However, there is still no theoretical framework to explain how households choose their optimum combination of resources (Carney, 1999).

Implications for sustainable development strategies

Sustainable development, as understood in terms of compliance with the Constant Capital Conditions, is therefore a meaningful concept from the global level to the sub-national regional level, but is not universally applicable below this. Three implications follow from this. First, countries are not equal in their potential to satisfy the Constant Capital Conditions because of differences in their initial endowment of Natural Capital and their present phase of development. Second, even if cities, towns and households cannot develop sustainably themselves, they can still make an important contribution to strategies intended to increase the sustainability of development at higher spatial levels. Rees (1995) called cities 'nodes of pure consumption, the entropic black holes of industrial society', but argued that because of their high resource use and environmental impacts, improving how they function could significantly increase global sustainability. So while a 'sustainable city' may only ever be a highly efficient machine for metabolizing the various types of capital (see Chapter 5), it can provide a wide spectrum of benefits to higher spatial levels. Third, the limitations of the Very Weak Condition at lower levels on the spatial scale suggest that there may be scope for another method or condition that is more universally applicable.

Sustainable Development in Open Economies

The Constant Capital Conditions were originally devised to apply to the planet as a whole, and so implicitly assume that each spatial unit functions as a closed economy. But while Spaceship Earth is a closed system, individual spatial units at other spatial levels are not. Instead, they are best described as open economies, and trends in their Natural Capital and Total Capital are influenced by transfers to and from other spatial

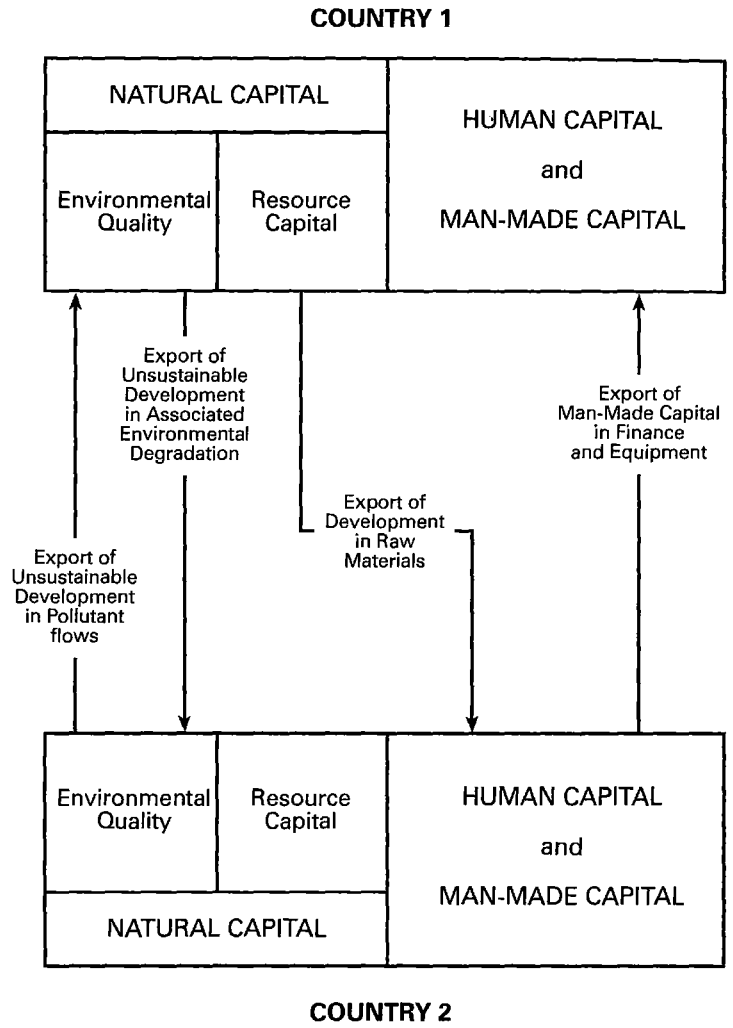

Figure 3.3 Sustainable development of open economies

units, through flows of goods, financial capital, pollutants and other environmental disbenefits (see Figure 3.3). This section examines, within the framework of the Very Weak Condition, how transfers between spatial units on the same level of the spatial scale influence the sustainability of their development. We look first at the effects of flows in natural resources, then at flows of the environmental quality associated with their exploitation, and finally at strategies to correct for inequities in these flows. This provides a test of the ability of the Very Weak Condition to explain actual patterns of development, and of its compatibility with political economy theories.

Exporting development

International trade plays a vital role in human development by compensating for the heterogeneous distributions of natural resources and the products derived from them. Reserves of tin, aluminium, copper and iron, for example, are concentrated in the US, Canada, South Africa, Australia and the states of the former USSR. More than half of all global oil reserves are found in the Middle East. Renewable resources are more highly dispersed but differ greatly in quality from place to place. For example, softwoods, such as pine, which are crucial for manufacturing paper, account for a large proportion of all wood reserves in Europe and North America but are not extensive in tropical countries, which therefore need to import pulp and paper. Patterns of natural heterogeneity are exacerbated by spatial bias in past exploitation since reserves in some areas have been more economically attractive to exploit than others, owing to their superior quality, species content, extraction costs and proximity to markets. The UK, for example, has largely depleted its economically extractable reserves of iron ore and coal and so now has to rely upon imports to meet most of its requirements.

According to classical and neo-classical trade laws, the whole world should benefit from free trade, though the laws do not predict how the benefits are divided (Berry et al, 1999). In reality, this is far from equitable. All countries gain from being able to specialize in advantageous economic activities, but some benefit more than others and this affects the ability of individual states to comply with the Very Weak Condition.

Many developing countries are far richer in Natural Capital than in Man-Made Capital, and rely on exports of a limited range of natural resources for much of their foreign currency earnings and national income. As most of these resources are exported in a raw or partially processed state, prices tend to be low and variable. Much of the value added therefore accrues to the developed countries which process them. According to Dependency Theory, the Core of the world economy (ie the industrialized world) extracts the surplus value of the productive activities of developing countries of the Periphery, so by engaging in trade the latter *export their development* (Frank, 1969). In the terminology of sustainable development this means that they export potential Human and Man-Made Capital. Consequently, the amount of Human and Man-Made Capital which accumulates in the country where Resource Capital is exploited is only a fraction of the total, undermining its ability to satisfy the Very Weak Condition.

Developed countries also benefit from low labour costs in developing countries, which keep raw material prices low. This is explained partly by the lower living costs in developing countries, and partly by the fact that workers do not have the same safeguards in terms of working conditions, social security and health services as are standard in developed countries. In this respect, exporting development also means exporting commodities and products that are produced at the expense of the social welfare of workers in developing countries. Continuing to rely upon the exports of primary commodities will perpetuate this, as insufficient capital is generated to invest in better working and living conditions.

Capital transfers within countries are often inequitable too, leading to a pattern of uneven economic development, discussed below. Commercial centres typically benefit from resource extraction at the expense of resource-producing regions, undermining

the potential to satisfy the Very Weak Condition at regional level. For example, Nigeria's leading oil production area, the Delta Region, has historically received little of the wealth created by exploiting its resources and has also suffered substantial land and water pollution from leaking pipelines. This has led to unrest and violence. However, the situation could change following the Nigerian government's decision to include in its 2000 Budget a 'derivation principle', under which states will receive at least 13 per cent of revenues generated locally (Wallis, 1999).

Trade in sustainable development

Importing sustainable development

Inequity in trade is exacerbated by the impact which exploiting Natural Capital in developing countries has on local people and environments. Mining and logging, for example, often degrade the environment, and if the costs of this are not fully paid – as is often the case – then Environmental Quality is effectively transferred to those countries which ultimately consume the resource. Environmental laws are generally weaker and less well enforced in developing countries than in their developed counterparts. As a result, there is considerable variation in the sustainability of renewable resource management, and hence in the ability to comply with the third of the Daly Principles, which states that renewable resources should not be harvested at rates that exceed their regenerative capacity (see Chapter 1). Developed countries therefore buy resources and products more cheaply than would be the case if they were produced at home, in line with tougher domestic legislation (Satterthwaite, 1997).

So besides importing development by processing raw materials from overseas, developed countries also *import sustainable development* by not paying the full environmental costs of resource extraction. In the language of Dependency Theory, this adds an 'environmental surplus' to the economic surplus that the 'Core' expropriates from the 'Periphery'. Environmental degradation is also likely to occur if resources are processed in developing countries, again reflecting less stringent environmental regulations. According to Robins and Trisoglio (1995), shifting 'energy- and resource-intensive industries to the developing world . . . [has, in effect, displaced] . . . the environmental problems of production'.

Exporting unsustainable development

When one spatial unit exports pollution to another, thus reducing the latter's Environmental Quality, it effectively *exports unsustainable development*. Many countries release excessive levels of pollutants into the atmosphere, rivers and oceans, damaging the environment elsewhere. Emissions of sulphur and nitrogen oxides from coal-burning power stations in the UK, for example, have long been blamed for the acid deposition that damages forests and lakes in Scandinavia.

Transfers of Environmental Quality also occur within a country. The quality of urban environments in developed countries has greatly improved in recent decades; but much urban waste is deposited far outside city boundaries. Sewage is a leading source of river pollution in the UK (Environment Agency, 2001), and the impacts of urban air pollution are more widespread than previously thought, with high levels of hydrocarbons, nitrogen oxides and carbon monoxide being transported from urban to

rural atmospheres (Weybourne Atmospheric Observatory, 1994). Each city's 'ecological footprint' (see p. 66) (Wackernagel and Rees, 1996) is therefore quite large and can even be regional in scale (Berry, 1990). Vancouver's footprint, for example, is estimated to be 20 times its legal area, and that of London 125 times (Jopling and Girardet, 1996; Wackernagel and Rees, 1996).

Monitoring sustainable development in open economies

Using the Very Weak Condition

As virtually all units at sub-global levels on the spatial scale are open economies, it is therefore vital to correct for these inflows and outflows if reliable estimates are to be made of the sustainability of development of a given area. To comply with the Very Weak Condition the value of the rise in Human and Man-Made Capital should be greater than, or equal to, the fall in Natural Capital from which it is derived, or:

$$\partial HMMC \geq \partial NC \tag{3.1}$$

where ∂HMMC is the increment in Human and Man-Made Capital, and ∂NC the increment in Natural Capital, consisting of the sum of changes in Resource Capital (RC) and Environmental Quality (EQ). Transposing this equation, we arrive at an equivalent expression, which states that the difference between the two changes should be greater than zero:

$$\partial HMMC - \partial NC \geq 0 \tag{3.2}$$

Pearce and Atkinson (1993) devised the Genuine Savings Index to test for compliance with this rule. The net rise in Human and Man-Made Capital is calculated by deducting from each country's gross annual saving (S) – after adjustment for net foreign borrowing – the amount that must be invested to offset the depreciation of Human and Man-Made Capital (∂K_m). The Genuine Savings Index Z is then calculated as the difference between Net Saving and the depreciation of Natural Capital (∂K_n). Z is 'normalized' by dividing all terms by the country's annual income Y:

$$Z = [S/Y - (\partial K_m)/Y] - (\partial K_n)/Y \tag{3.3}$$

According to the Very Weak Condition, development is sustainable if Net Saving exceeds the depreciation of Natural Capital (ie if Z is greater than or equal to zero). Pearce and Atkinson (1993) found that countries as diverse as Japan (Z=17), Costa Rica (Z=15), The Netherlands (Z=14), Brazil (Z=3) and the USA (Z=2) were apparently developing sustainably during the 1980s. Other countries, such as Indonesia (Z=−2), Nigeria (Z=−5) and Mali (Z=−14), were not.

However, the above test assumes that each country is a closed economy. In open economies the decline in Natural Capital in each spatial unit should only be compared with the rise in Human and Man-Made Capital associated with exploiting Natural Capital within that unit. This means removing from the comparison any rise in Human and Man-Made Capital associated with processing imported Natural Capital.

The Environmental Quality associated with imported Natural Capital should also be deducted.

International trade statistics could be used to adjust for the value added by imports of Resource Capital at national level, though this would be complicated given the number of intermediate processing stages that can separate the raw material source from the destination of the finished product. Lack of data would make it more difficult to estimate the associated reduction in Environmental Quality. If corrections are only made for the effective transfer of Human and Man-Made Capital from importing country to processing country then this will only adjust for the import of development, *not* sustainable development. Transfers of Environmental Quality must also be incorporated to achieve the latter. Further corrections are needed for the unsustainable development exported by industrialized countries through their pollutant emissions.

Most developing countries will probably not satisfy the Very Weak Condition since much of the rise in Human and Man-Made Capital associated with the depletion of their Natural Capital accumulates in countries to which they export the latter. Equally, the apparent ability of many developed countries to satisfy the condition would be reduced if these transfers were fully accounted for, as a significant proportion of their annual rise in Human and Man-Made Capital would be excluded and the negative Environmental Quality exported as pollutants would be included. Making corrections for sub-national regions and localities would be more difficult because at these levels the flows are more complex and data are unavailable.

This form of adjustment has three limitations. First, correcting for flows of Resource Capital and Environmental Quality for all countries would remove a significant amount of the annual global increment of Human and Man-Made Capital from consideration. Second, to achieve perfect monitoring it would be necessary to follow each individual material export from source to market, which would be a massive undertaking. Third, compliance with the Very Weak Condition does not necessarily ensure the rise in social welfare that is fundamental to economic development because the condition is based on the sum of Human and Man-Made Capital, whereas economic development is concerned with the equity with which a country's total income is distributed. Human and Man-Made Capital would have to be disaggregated to monitor properly the export of development. Such difficulties associated with using the Very Weak Condition for monitoring sustainable development reflect its 'incremental comparison' approach, in which changes in Natural Capital are compared directly with changes in Human and Man-Made Capital. Monitoring would be made easier if a new method could be devised under which changes in the three dimensions of development could be monitored separately.

A first attempt to monitor the sustainability of development in open economies was made by Proops et al (1999), who adapted the Genuine Savings Index to allow for trade. They found that oil-exporting countries in the Middle East now appeared to be developing sustainably (ie $Z \geqslant 0$), while estimates made on the assumption that they were closed economies suggested they were unsustainable. In contrast, assessment of developed countries and African developing countries shifted from sustainable to unsustainable when modelled as open economies. Unfortunately, these estimates only gave approximate measures of the export of development, as defined above, not the export of sustainable development. This is because they only corrected the ∂K_n term in Equation 3.3 for trade in non-renewable resources, and ignored transfers of

renewable resources and environmental quality. Furthermore, for ease of calculation, they compared the annual saving in a country only with the decline in Non-Renewable Resource Capital used in that country. So any exported Resource Capital was added to the balance sheet of the importing country and treated as though it had been extracted domestically. This is why the ∂K_n term fell in oil exporting countries (thereby raising Z) and rose in oil importing countries (reducing Z). This is a different method to that suggested above, and it raises questions not only about its partiality, but also about its reliability, because it does not truly reflect the decline in Resource Capital in the country where the stocks are held.

Using ecological economics conditions and indicators

The feasibility and relevance of using the ideal carrying capacity condition of ecological economics to monitor the sustainability of development at national and sub-national levels are even more questionable. This condition, under which humanity should not exceed its ultimate carrying capacity, is entirely reasonable at the global level, although even this upper limit is difficult to estimate given the rapid changes in demand for natural resources and in the technological sophistication with which this can be met. But the heterogeneous distributions of both natural resources and demand for them, and the complex patterns of trade which have developed to compensate for this, undermine its use at sub-global levels. Trade and technology combine to free many areas from the limitations imposed by their immediate physical environments.

Currently available indicators based on this ideal condition, such as the Environmental Space and Ecological Footprint methods, are too limited in scope to determine full compliance with it. The dependence of cities and developed countries upon importing large quantities of resources for processing, with all the consequences discussed above, is widely assumed to be encompassed by the Ecological Footprint method. Unfortunately, this fails to match the image conveyed by its name as it uses land area as a proxy for all Natural Capital. It may well illustrate external dependence, but this is not very relevant as an accounting practice, as it merely states that countries which demand more than the global mean area per capita to satisfy their resource needs are unsustainable (Wackernagel and Rees, 1996). The Environmental Space method is a modest improvement, regarding as unsustainable any country or spatial unit where resource use per capita exceeds the global mean (Buitenkamp et al, 1992; Schmidt-Bleek, 1992). But both methods are simplistic (Moffatt, 1996) and ignore how trade compensates for the heterogeneous global distribution of natural resources. Similar criticisms apply to the idea of the self-reliant 'bio-region' proposed by Register (1987). International trade has been a reality for most countries for hundreds of years and global interdependence continues to increase. Self-sufficiency is not essential to achieve sustainable development.

Strategies to compensate for trade in development and sustainable development

The inequities of trade and development are ameliorated partly by the actions of individuals and firms, and partly by government intervention to promote economic development and sustainable development. In practice, the two sets of strategies are linked in various ways.

Compensation by capitalists

Capital always has a tendency to search for and exploit profitable opportunities, so poorly developed or declining regions with high unemployment and low labour costs are potentially attractive to entrepreneurial capitalists. American and Japanese firms have, in recent decades, established manufacturing plants in developing Latin American and Asian states for this very reason. The same principle also applies to developed countries, where the injection of capital into depressed regions, such as north-east England, may partly offset the effects of previous capital withdrawals. In both types of countries, such capital investment may also be an attempt to gain access to new markets. On the other hand, in today's globalized economy all plants owned by transnational corporations, in particular, are vulnerable to closure as capital can be shifted elsewhere at short notice.

Financial assistance to depressed regions

The decisions of capitalists to locate new facilities in depressed regions in developed countries are often catalysed by state financial aid. Within the EU, the value of subsidies for expanding productive Man-Made Capital in depressed regions varies from country to country: for example, UK aid, under its Regional Selective Assistance scheme, is only one fifth of the EU average (Groom, 1998). Aid is limited by the European Commission to avoid anti-competitive practices, and in the late 1990s the Commission asked member states to focus regional assistance more closely on areas most in need of help and reduce the maximum proportion of the population which could receive it (Tucker, 1997). These restrictions may also be justified in view of the questionable long-term effectiveness of regional development schemes.

Aid is also given from three EU Structural Funds on condition that it is matched by funds from within the country. The European Regional Development Fund accounts for one third of the total EU budget and aims to secure 'balanced economic and social development' across member states. However, its focus on social and economic regeneration means that it is only used to fund environmental protection and regeneration if this can be directly linked to economic development (DoE, 1994).

Linking environment and development in overseas aid programmes

Over the last 50 years developed countries have also given financial aid to developing countries to facilitate their development and reduce the North–South gap. Increasingly, however, the terms of such assistance differ from those of internal aid programmes in linking environment and development by imposing conditions to curb the negative environmental impacts of development projects. Protests about the large-scale destruction of the Amazon rain forest resulting from highway construction partly funded by the World Bank were a major cause of this shift in policy. Some types of projects are now completely ineligible for aid from some countries: for example, the US government will not fund the construction of hydroelectric dams. This type of pressure does not curb a state's sovereign right to undertake any actions it chooses that may deplete resources or degrade environments, but it does limit its access to particular sources of overseas capital for this purpose.

This linkage could be further extended as part of international programmes to mitigate global climate change (see Chapter 11). For if developing countries were

obliged to protect extensive wilderness areas as carbon stores this could ring-fence a significant proportion of their territories from settlement and resource extraction, thereby reducing their overall development potential. This could further widen the North–South gap, primarily for the benefit of developed countries whose prolonged greenhouse gas emissions have been the major cause of climate change. To prevent such inequity developed countries would be under an obligation to compensate developing countries for potential development income lost as a result of large-scale conservation (Grainger, 1997).

Migration as a compensation mechanism

In the absence of external assistance, households will make their own responses to uneven development to sustain their livelihoods. The simplest strategy is to migrate from declining or stagnant regions in search of better lifestyles in areas with growing economies. Thus, three of the UK's most depressed sub-regions, Merseyside, Tyne and Wear, and Clydeside, all experienced net out-migration in the 1990s (Groom, 1999d). Some migrants may remit part of their earnings to sustain family members who remain at home.

Rural–urban migration is common in the developing world, but it is not without its problems. If too many people leave rural areas then agricultural sustainability can decline, with the risk of adverse environmental impacts. Urban areas also experience 'migration overload' if insufficient new jobs are generated to meet demand from migrants. Some unemployed migrants may return to rural areas, clearing forests to grow food, thus causing environmental damage. In Indonesia and Brazil, the state has previously assisted large-scale migration from overcrowded areas to new settlements in under-populated rural districts, but such schemes have rarely been successful (Grainger, 1993).

In developed countries, technological advances now mean that people living in deprived peripheral regions may not have to resort to physical migration to compensate for locational disadvantages. For example, 13,000 information technology (IT) jobs have been created in recent years in the Highlands and Islands region of Scotland. Half of all new jobs in the region in 1999 were linked to either IT or telecommunications, although the North Sea oil industry is still a major source of employment. These two sectors, in particular, have contributed to a 20 per cent net rise in regional population between 1960 and the late 1990s, reversing the continuous depopulation suffered since the 1840s (Nicholson, 2000).

Transfers of political pressures between spatial units

People directly affected by what they perceive to be the socially or environmental harmful activities of transnational corporations often feel powerless to influence them, because the headquarters of these firms are so far away and national governments seem unwilling or unable to regulate their activities. But during the last ten years another type of compensatory mechanism has evolved in which non-governmental organizations (NGOs) from abroad help local people by reducing the constraints imposed by distance and international boundaries on transmitting pressures to major corporations.

Transferring protests between developing and developed countries

In one of these mechanisms, NGOs based in the headquarters country of a transnational corporation act as proxy pressure groups for NGOs from the developing country where the impacts occur. Transnational corporations are often alleged to apply lower environmental, labour and human rights standards to their operations in developing countries than they do in developed countries. For example, Royal Dutch Shell has extracted oil in Ogoniland, part of Nigeria's main oil-producing Delta Region, since the 1960s, but in doing so it has caused considerable environmental pollution. In 1990 an indigenous political group, the Movement for the Survival of the Ogoni People (MOSOP), began to campaign for self-determination and for compensation for lost earnings and the pollution created by oil extraction. Protests became so violent that Shell left the area in 1993, though it continued to operate elsewhere in the region. Ken Saro-Wiwa and nine other leading MOSOP members were put on trial for their role in these protests, and in November 1995 they were executed. Shell became the object of protests, both directly and via the media, from human rights groups and other NGOs in the UK and abroad for not demanding that the government halt the executions. Shell's reputation was badly damaged when organizations that had previously held it in high esteem, such as the Royal Geographical Society, disassociated themselves from its conduct in Nigeria. The board of Shell felt obliged to respond to these pressures by presenting a report on its environmental performance in Nigeria to its 1997 Annual General Meeting, and by rewriting its statement of general business principles to recognize its duty to support human rights, care for the environment and show commitment to sustainable development (Mortished, 1997). Shell is still rebuilding relations with the Ogoni people, and has funded community and environmental projects in the area. This expenditure, however, equates to only a fraction of the billions of US dollars in compensation and royalties that local people have demanded (Corzine, 2000).

Transferring protests between developed countries

NGOs may also use pressures in one developed country to force firms to take action in another. Greenpeace campaigned for ten years against MacMillan Bloedel (now part of Weyerhaeuser Corporation) for using the traditional clearfelling practice to manage its forests in the Canadian province of British Columbia. MacMillan Bloedel ignored the protests until in 1998 Greenpeace persuaded the UK do-it-yourself (DIY) stores B&Q and Do It All to boycott all timber from British Columbia. Only when the Canadian firm came under pressure from British consumers did it agree to switch to variable retention logging, which leaves 30–70 per cent of timber behind in the forest after harvest (Alden, 1998).

A different instance arose in February 1995 after Shell was given permission by the UK government to dispose of its disused Brent Spar oil platform, situated in the British sector of the North Sea oil field, by dumping it in deep water in the Atlantic Ocean. Greenpeace protested against this decision, twice occupying the rig, and launched a boycott of Shell petrol in Germany, Denmark and The Netherlands. Two petrol stations were firebombed and shots were fired at another. After ten days of this boycott, German Chancellor Helmut Kohl unsuccessfully requested that UK Prime Minister John Major withdraw authorization for the dumping. However, on 20 June

Shell's main board decided to abandon the plan. Significantly, Shell's policy shift was triggered not by protests within the UK, but by Shell Germany's concern about the damage to its reputation and profits: petrol sales had fallen by 10–20 per cent. Protests were greatest in Germany because its environmental movement was stronger than in the UK (*Wall Street Journal*, 1995). Not only did they influence a regulatory decision in another country; they also succeeded in overturning an environmental impact assessment made before the original proposal was submitted for government approval. John Cridland, Environment Director of the Confederation of British Industry, the leading employers' organization, complained that: 'We have latched the whole of our environmental policy on sound science and risk assessment leading to a balanced cost-benefit analysis. It is very worrying if it can be derailed by special interest groups' (Lascelles, 1995).

Imposing conditions on trade between developing and developed countries

NGOs have pressed for some time for environmental and social conditions to be imposed upon goods in world trade. Initially, in the 1980s the World Wide Fund for Nature (WWF) and other NGOs began to campaign for the governments of developed countries to ban imports of wood from tropical forests that were not managed sustainably. They did not win the necessary political support, but they were successful in establishing certification schemes that identify goods produced in environmentally sound ways. Some measure of cooperation has also been secured from retailers, often reflecting consumer pressure. Hence, WWF and leading retailers such as DIY chain B&Q helped to establish the Forest Stewardship Council (FSC) in 1990. The FSC's accreditation identifies whether timber comes from sustainably managed forests. B&Q agreed that by 2000 it would buy timber only from FSC approved sources (B&Q, 1997). This initiative has led to the extension of certification to forests in developed countries. The Statement of Forest Principles agreed at the 1992 UN Conference on Environment and Development (UNCED), and the commitments made by temperate countries in the Second International Tropical Timber Agreement, have placed the sustainable management of all forests within a common international framework.

Policy implications

It appears from this discussion that the sustainability of development of an open economy can be evaluated within the framework of the Very Weak Condition in a way that is compatible with the key principles of Dependency Theory.

Developing countries will continue to export their development to developed countries until they become more industrialized. This requires that developed countries allow greater access to imports from their developing counterparts. As yet, few such concessions have been forthcoming. However, if developing states did secure greater market access then it might lead in the short- to medium-term to greater environmental degradation in these countries, since manufacturing processes would not initially be as environmentally friendly as in the global North. This would add to the existing import of sustainable development by developed countries, mainly through the environmental degradation caused by extracting primary commodities.

One way to reduce the present import of sustainable development by developed countries would be to impose uniform global standards on social welfare and environmental quality in all countries. If perfectly implemented, this would require developed countries to pay fair prices for goods purchased from developing countries, so the latter could ensure proper working standards and minimize environmental degradation when natural resources are extracted and processed. However, compliance with these standards would in practice be limited, since the 'globalist' approach is at odds with the apparent link, referred to earlier, between the level of economic development of developing countries, their living and working conditions, and the sustainability of their resource and environmental management. The approach would further strengthen the environmental component of globalization, which is ironic, as NGOs appear to be having more success than governments in combating the harmful effects of economic globalization by curbing the activities of transnational corporations.

An alternative 'gradualist' approach would not judge all countries by the same standard, but instead judge each country by reference to the standard expected at its particular level of development. This is consistent with the principle of differentiated obligations, currently employed in implementing international environmental regimes. Adopting this approach would mean that developed countries would continue to import sustainable development from developing countries for some time to come. On the other hand, the social and environmental performance of developing countries would be expected to improve in line with an agreed trajectory linked to their rate of development. If developed countries wished to achieve faster progress then they would need to provide sufficient funding to strengthen domestic monitoring and regulatory institutions in developing countries.

At the heart of the dispute between the globalist and gradualist approaches is a fundamental difference of opinion over the meaning of sustainable development. The globalist approach effectively ignores the changes that occur in the course of economic development, assumes that all countries have the same capabilities, and equates sustainable development with joint international action on a broad range of social and environmental issues. The gradualist approach, on the other hand, assumes that every country has its own unique development path. As it develops, the welfare and capabilities of its people increase and so too should its sustainability of development.

No strategy that flies in the face of reality is likely to succeed, however strong are the political pressures from the developed countries that promote it. Since the uniform standards that characterize a globalist approach are strongly opposed by developing countries they are unlikely to be put into practice. It would therefore seem pragmatic for developed countries to adopt a gradualist approach, accept that levels of social welfare and environmental management in developing countries will be lower than their own, and assist them to improve their performance at a rate commensurate with their pace of economic development. Developed countries should also pay greater attention to integrating the economic, social and environmental dimensions of their own development, in particular, by including environmental factors in the provision of financial aid to depressed regions.

Interaction between Different Spatial Levels

Assessments of the sustainability of development at discrete levels on the spatial scale are, of course, rather arbitrary, as environmental phenomena often overlap various levels. A large number of households emitting carbon dioxide from their cars, for example, can help to change global climate; and deforestation in the Asian regional tropical rain forest biome contributes to a decline in the global tropical rain forest biome-type. There is insufficient space here to discuss all of the interactions between different levels on the spatial scale which affect the sustainability of development, so this section focuses on just two main types. First, influences 'from above' in which, for example, agreements at supranational and global levels impose constraints on national development paths and promote convergence between groups of countries. Second, influences 'from below' in which the sustainability of national development is affected by development patterns and activities in regions and localities. This category also includes influences on national policy-makers from groups and individuals at lower spatial levels who engage in 'bottom-up' participatory consultation and decision-making in an attempt to counter the failure of 'top-down' planning. The Very Weak Condition again provides the basic framework for analysis but the main focus is on how state intervention conditions economic and environmental processes in response to pressures from a wide range of interest groups and policy actors.

Influences from above

Every state has its own unique development path, which is a response to economic, social, environmental and political conditions both within and outside its territory. However, the size of the spread between the paths of individual countries can be reduced when groups of countries agree to work together for common ends.

Promoting regional convergence in environmental performance

When countries belonging to supranational regional groupings agree to conform to common environmental standards, this imposes constraints on their economic activities that should cause their environmental performance gradually to converge over time. Generally, the tighter the grouping the faster the convergence should be. The cohesiveness of the EU is such that Ohmae (1993) termed it a 'region state'. In practice, however, most member states do not necessarily adhere strictly to directives from the European Commission and while the Commission can take action against defaulting states in the European Court of Justice, the latter had no power to enforce its verdicts until recently. This, together with continuing differences in policy between countries, means that EU member states still vary greatly in their environmental performance. The UK, for example, has one of the lowest rates of domestic waste reuse in Europe – 15 per cent compared with 70 per cent in The Netherlands (DTI, 1998) – though it is trying to raise this to conform with EU common minimum standards.

Such 'top-down' influences raise questions about the role of the democratic process in improving environmental performance. The interests of Capital and Labour have traditionally dominated formulation of government economic policies. Environmental

policy tends gradually to expand in scope and effectiveness as: (a) public awareness of the environment increases; (b) environmental interest groups become relatively more powerful; and (c) levels of democracy and pluralism advance to enable such groups to increase their influence over policy-makers. The imposition of centralized directives from the European Commission on all EU countries is an admirable attempt to speed up this evolutionary process, but it could be counterproductive if its circumvention of the democratic process alienates domestic support for such measures.

Other groupings of states commit themselves to less stringent or more specific standards than the EU. For example, members of the UN Economic Commission for Europe, which includes Western Europe, Scandinavia and Eastern European countries, have since 1979 collaborated to cut gaseous emissions that cause transborder air pollution and acid deposition. The North American Free Trade Agreement (NAFTA) contains some environmental safeguards, but enforcement is poorer than in the EU and so convergence is slower. For example, considerable pollution is generated by the concentration of industries situated in the free trade zone on the Mexican side of the US border, attracted by the economic advantages of operating there. As the Mexican government gives highest priority to the contribution made by the zone to the national economy, it chooses not to enforce its own environmental laws strongly, and is not pressed by its partners to do any better. Mexico's level of economic development is greatly inferior to that of the USA and Canada, and clearly the members of NAFTA have decided that there are limits to the amount of mutual convergence that they can achieve in such conditions.

Weak regional regimes, which are not binding on those that sign them, have even less chance of success than groupings bound by treaty. For example, all of the states surrounding the Mediterranean, except Albania, committed themselves in the Mediterranean Action Plan of 1975 to 'take all appropriate steps to prevent, abate and combat pollution in the Mediterranean Sea area and protect and improve the marine environment in the area'. In 1985 they went further and agreed to realize a specific list of improvements within ten years. But both the original and revised plans were voluntary and the states did not realize either of them, giving a higher priority to economic development instead (F Pearce, 1995).

Promoting global convergence in environmental performance

States are also constrained by the global agreements which they sign, particularly the strong environmental regimes which are binding on signatories (see Chapter 12). Parties to the Framework Convention on Climate Change (FCCC), and its subsequent protocols, for example, have committed themselves to limiting their emissions of greenhouse gases, and this, in turn, will affect their national trends in Natural Capital and Human and Man-Made Capital. Developing countries are often allowed to proceed more slowly in complying with strong regimes, in line with the principle of differentiated obligations – which recognizes that they are less able to afford to improve their environmental performance than developed countries – and with the 'gradualist' approach mentioned above.

Since the mid 1990s, attempts have been made to extend international environmental commitments beyond the confines of purely environmental regimes such as the FCCC. Proposals have been made, for example, to limit the import of sustainable

development by adding environmental conditions to international trade agreements under the auspices of the World Trade Organization (WTO). These conditions would reduce the environmental impacts associated with the extraction of raw materials or the manufacture of goods exported from developing countries (Costanza, 1994; Williams, 1999b). No agreement on this issue was reached in the abortive Seattle round of trade talks in 1999 or in the follow-up meetings in Doha in 2001 and Cancun in 2003, but the topic is likely to be raised again in future talks (see Chapter 12). However, such proposals, referred to earlier in this chapter as stemming from a globalist approach, seek to apply the same conditions to developing and developed countries. This completely ignores evidence that the sustainability of resource management and the level of environmental quality initially falls in the course of development and only improves when societies have become highly developed – a relationship portrayed in the Environmental Kuznets Curve (Cole et al, 1997). Achieving more sustainable development will depend upon a growing awareness that convergence is feasible but uniformity is impossible.

Influences from below: patterns of development at lower levels

Even though a particular spatial unit is undergoing economic development not all the smaller sub-units which it comprises may be developing equally rapidly. Some may be stagnating or even in recession, perpetuating the uneven pattern of development found in most countries in which levels of income, social welfare and Human and Man-Made Capital are preferentially concentrated in some regions. The sustainability of development is often uneven too, since environmental management is better in some spatial units than others. Is such unevenness inevitable, and to what extent does it constrain the performance of the entire state or other spatial units?

Uneven economic development

Inequitable transfers of capital between regions, of the kind mentioned above, contribute to uneven development within countries. To provide some structure to complex regional mosaics in developed countries, Williams (1987) distinguished between wealthy 'rapid accumulation' regions, which now account for the majority of economic activity, and poorer 'slow accumulation' regions, which include the 'rust-belt' areas found in most developed countries, such as South Yorkshire in the UK and Michigan in the USA. Many of the latter used to be economically thriving, often as centres of mining or manufacturing, but fell into decline as economic activity shifted to other regions. Man-Made Capital became obsolete, and thousands of households unable or unwilling to search for new jobs elsewhere were left in poverty, usually in an environment degraded by decades of resource extraction and waste dumping.

Marxist economic geographers, such as Harvey (1985), explain uneven development as an inevitable consequence of the accumulation of capital and the crises to which this is subject:

> The process of accumulation must be understood as inherently spatial because it depends on labour power which, in the short term at least, is place bound ... Capitalist development has to negotiate a knife edge path between preserving the

> values of past capitalist investments . . . and destroying them in order to open up fresh geographical space for accumulation.

As a country becomes more developed it is normal for the government to intervene to ensure that the rise in overall economic activity is matched by greater equity in the distribution of national income. Yet development is still uneven in many developed countries today, and this raises two questions. First, how much unevenness is compatible with a highly developed society? Second, could a limited degree of unevenness be acceptable in principle and yet be politically and morally unacceptable in practice? There is still, for example, a vigorous debate about the reality of the so-called 'North–South divide' within England. According to Townshend and Gordon (1999), data from the 1991 National Census reveals that:

> England remains a nation of immense social and economic differences . . . Problems of unemployment, poverty and ill health are concentrated in the major cities, the depressed industrial north, and in the forgotten corners of England. By contrast, areas of affluence and privilege are found in the extended suburban South-East. . . . Divisions of wealth between rich and poor seem to be getting more marked.

This is supported by another study of variation between English regions, which used a synthetic Competitiveness Index, based on indicators of average earnings, business density, unemployment, the number of knowledge-based businesses, economic activity and gross domestic product (GDP) per head (Huggins, 2000). This found that relative to a UK average of 100, the north-east was the least competitive region with a score of 89, while London was the most competitive, with a score of 116.

However, development in the UK as a whole is far more even than in other European countries. Compared with a 47 per cent difference between the GDP per capita of the UK's richest and poorest regions, expressed as a percentage of the EU mean, the difference for Italy is 93 per cent. Travers (1997) counters traditional concerns about the UK's North–South divide, claiming that it has the smallest inter-regional variation of any large European country: 'The myth of a UK with uniquely poor and rich regions is very powerful. The UK has, doubtless by accident, achieved a degree of regional equality of which it can be proud.' While inter-regional differences are important, they may be a distraction from even greater disparities within regions. In the English region of Yorkshire and Humberside, for example, the GDP per capita for North Yorkshire in 1994 was 99 per cent of the EU average, compared with 91 per cent for West Yorkshire and only 74 per cent for South Yorkshire (Eurostat, 1995).

Generalizing about the role of unevenness in development is difficult. It might be expected to decline as a country becomes more developed, but no straightforward pattern is evident. For example, regional differences in GDP per capita in the UK, as measured by the Coefficient of Variation, were declining until 1976, but then increased dramatically from 1976 to 1989 before falling again with the onset of the recession in 1990 (Dunford, 1997). There is also no consensus as to how wide a variation in regional development is consistent with a country being called 'developed'. A pragmatic limit of 75 per cent of the EU mean GDP per capita is currently used to identify regions

that merit assistance through EU programmes, but a more rigorous assessment would be valuable, based on detailed research into the mechanisms of development.

Uneven sustainable development

The sustainability of development also often appears to be unevenly distributed among the regions of a country, within a region or even inside a city. Consider a typical country that has reached the middle to late phases of its development. Human and Man-Made Capital will tend to be concentrated in various core regions, and Natural Capital in poorer regions in the geographical and economic periphery. However, for such a country to comply with the Strong Condition or the Very Weak Condition in future, it would have to retain most if not all of its existing stocks of Natural Capital. So the regions in which Natural Capital is now concentrated could not be allowed to develop further, as this would inevitably reduce their Natural Capital. This might be politically unacceptable.

Contrary to the assumption underlying the Very Weak Condition, some areas have 'developed' but are now poor not only in Natural Capital but also in Human and Man-Made Capital. These include 'slow accumulation' regions, which used to be centres of industry but are now economically and socially depressed, and environmentally degraded. Similar conditions are found at the local level in inner cities and former mining communities. For example, mortality amongst infants aged less than one year is 7.3 deaths per 1000 live births in Inner London, but only 5.5 in suburban Outer London. According to Jacobsen (2001), Inner London is 'a southern European city in a northern European shell ... Areas of extreme poverty with poor health outlook exist cheek by jowl with great affluence.' Moreover, low-income groups in inner cities often live near areas of low environmental quality, such as industrial sites, refuse dumps and polluted canals (McGranahan et al, 1996). Current environmental economics theory takes no account of such spatial patterns, and there does not seem to be any way to modify it to encompass these cases within a sustainable development framework.

Planning for sustainable development

Interactions between different levels on the spatial scale pose two main challenges to planners. First, how to reduce the unevenness of development and sustainable development without undermining the sustainability of national development? Second, how to increase information flows between different levels to improve implementation of policies which, by common consent, are beneficial to the entire country? The failure of traditional 'top-down' planning methods has led to widespread adoption of 'bottom-up', participatory approaches to planning. Unfortunately, total reliance on such approaches can undermine the coherence of national policies, and it can also lead to problems as a result of the unequal distribution of political power in a country.

How unevenness complicates planning for sustainable development

The development of peripheral regions

Deciding whether or not to develop peripheral regions in developing countries may put planners imbued with the sustainable development paradigm into a quandary.

The inhabitants of such regions tend to be poorer on average than those in the metropolitan core, so there is a strong ethical case to improve their mean incomes. However, conventional development strategies tend to promote agricultural expansion or resource exploitation, which are likely to remove forest and other natural vegetation and generally degrade the environment. So while people might benefit economically and socially from such initiatives, the quality of their environment would probably decline. Even if the rise in Human and Man-Made Capital within the region did exceed the loss of Natural Capital, because peripheral regions usually contain a large proportion of a country's Natural Capital the loss could cause a significant reduction in the Resource Capital and Environmental Quality of the country as a whole, and so undermine its sustainability of development.

Critics argue that attempts to 'develop' peripheral regions are rarely undertaken with the improvement of local livelihoods as the main priority, and that most of the benefits from expanding logging, mining and plantations usually accrue to outsiders. As Atkinson shows in Chapter 10, resource-rich circumpolar regions have, in the past, received little of the Human and Man-Made Capital generated by exploiting their resources. The experience of Nigeria's Delta Region, referred to above, provides another potent example, showing how popular dissatisfaction with uneven sustainable development can lead to national political conflict.

Some governments openly state that they favour exploiting resources in peripheral regions for the sake of national economic development, rather than for the good of local people. In 2002, for example, US President George W Bush declared that the overall benefits of further oil exploration in Alaska exceeded the resulting environmental costs. In developing countries which depend heavily upon resource exploitation, the stakes can be far higher. For example, the Ok Tedi copper mine, located in a remote mountainous area of Papua New Guinea, accounts for 10 per cent of the country's GDP and 20 per cent of its exports. Yet its operations have caused serious damage to the local environment, and its owners have had to pay hundreds of millions of dollars to store mine waste and compensate villagers for damage to their water supplies, land and vegetation. The World Bank recommended closing the mine to end environmental degradation, but this created a dilemma for the government, which must balance the environmental benefits of closure against the repercussions for the national economy (World Bank, 1999). In September 2001 the government decided that the mine should stay open, but be run by a new publicly-controlled company operating under strict environmental safeguards.

Identifying sustainable strategies for urban development

A related problem concerns the role of cities in sustainable development. While the vigour of regional development often depends upon urban economic activity, cities must import resources and tend to be both spatial concentrations of pollution and the centres of regional networks of environmental degradation. Consequently, they may never attain sustainable development in their own right on the basis of the Constant Capital Conditions.

One solution to this dilemma is simply to try to keep cities as compact as possible. This has become a favoured model for urban sustainability (Haughton, 1999; see also Chapter 6 in this volume). If a large number of people live and work in a small area then transport and energy demand will be low, offsetting the pollution and social

welfare problems associated with the high population density. Dispersed urban and suburban settlements might be socially and aesthetically more attractive places to live, but they are more dependent upon vehicular transport and less energy efficient (ICLEI, 1993).

Another approach is not to focus on the city, but to assess its sustainability in the context of the region on which it chiefly depends for resources and labour. For example, in 1997 planners in the Hertfordshire town of Stevenage estimated that 65,000 new homes were needed to sustain future local economic growth, but found that only 85 per cent of them could be accommodated within its boundaries. One option for locating the remaining houses was to disperse them throughout the surrounding countryside, which would be to the detriment of rural landscape quality. Another was to concentrate them along an existing major transport corridor, the A1 trunk road, with its associated rail and bus routes. The town council chose the second option because of its lesser landscape impact and the potential to minimize additional fuel use and associated traffic pollution. The UK Department of the Environment, Transport and the Regions (DETR) supported this decision to adopt an integrated regional view of the proposed development. It approved the removal of 2.5 square miles of land from the Green Belt along the A1 corridor, provided that in compensation five times as much land was added to the Green Belt elsewhere in the region.

Rethinking top-down planning

In top-down planning methods, state officials draw up plans at a national level which must be complied with at lower levels by regional and local governments. However, this approach often fails to ensure successful development because the policy is either poorly formulated or poorly implemented, or both. The more removed planners are on the spatial scale from the level at which activities are to be undertaken, the greater the likely differences in perception between planners and local inhabitants. A classic example of a divide between supranational planners and priorities at lower levels occurred in the late 1990s when the European Court of Auditors ordered all EU governments to restrict the width of hedgerows to under 2 metres because it believed that oversized hedgerows were being used to exaggerate field sizes to make fraudulent claims for farm subsidies. At the supranational level financial stringency was perceived to be more important than any associated biodiversity loss. In the face of protests from the Council for the Protection of Rural England and other NGOs, the UK Ministry of Agriculture responded that it was powerless to change the new measure, even though it was accused of applying EU rules too strictly.

By the 1970s, the top-down approach to promoting development in developing countries was recognized as inefficient and ineffective, reflecting numerous failures in many countries. Prominent amongst these was the scheme to build a highway through Brazilian Amazonia and resettle along it large numbers of poor people from overcrowded areas in drought-stricken north-east Brazil. Unfortunately, the route chosen for the Trans-Amazonian Highway by remote government planners was covered almost entirely by infertile soils. Consequently, few people joined the resettlement scheme and many of these eventually returned home when their crops failed (Grainger, 1993).

Reaction to the limitations of the top-down approach has led to growing use of an alternative 'bottom-up', participatory approach, in which people at the spatial level

where development is to occur participate actively in its planning and implementation. In principle, this should ensure a better two-way flow of information between national and sub-national levels. This ought to improve policy formulation by balancing the national government's overview and coordinating role with local people's creativity and knowledge of specific conditions in the area concerned. It should also lead to better implementation of a policy or project because local people will be more enthused about something that they have helped to plan, introduce fewer obstacles in the way of its implementation by government agencies, and may assist in implementing it themselves. In the context of development projects funded from overseas, aid agencies can feel more confident that money devoted to bottom-up projects will improve the living standards of the very poorest, as it is transmitted directly to the specific communities where they are concentrated rather than being diverted to further enrich the elite. Aid will also be used to empower the poor to escape from the poverty trap in which they are confined by national and international power structures.

A bottom-up approach is also often assumed to be good for the environment on the assumption that everybody is keen to conserve their own immediate surroundings. This may be over-optimistic, but local people's knowledge of the natural and cultural environments in which they live is invariably superior to that of external 'experts'. Because of this, and the other reasons given above, Agenda 21, the blueprint for sustainable development agreed at the 1992 UN Conference on Environment and Development, advocated a participatory approach to sustainable development. This inspired the slogan 'Thinking globally, acting locally', and the idea of 'glocalization', in which local action can bypass constraints imposed from a higher level on the spatial scale (Beauregard, 1995).

There is much more to participation, however, than improving links between national and local levels. It is a more generalized philosophy with applications to all forms of planning involving different levels on the spatial scale. As such, it has given rise to strategies in which state planners do not just consult people at lower spatial levels, but also devolve management responsibility to them. The Philippines government, for example, has been taking such an approach to environmental management since the late 1980s.

Problems with participatory planning and management

Experience with these new forms of planning and management is still limited, but is sufficient to show that they do not provide an instant solution to all the problems that have long plagued planning. Nor can they guarantee sustainable development. This sub-section highlights some of the practical problems that have arisen so far. They are instructive in their own right, but also for the light that they shed on interactions between different levels on the spatial scale.

Conflicts between states and regions

In federal states, such as the USA and India, regional governments have legal authority to formulate and implement policies to suit regional needs. Although this is an excellent example of devolved decision-making, it can create obstacles when states attempt to make coherent improvements in the quality of life for the entire country. It is common in such circumstances for the balance of power between the state and

the regions to be strongly contested. Regions that differ in political philosophy from the national government may therefore take a different line on a given topic merely to assert their autonomy, regardless of the social, economic or environmental merits of their actions. In India, for example, state governments are sufficiently powerful to ignore national environmental and social criteria for the construction of hydroelectric dams.

Conflicts can also arise over the sustainable rates of growth of different regions. For example, in 1999, the South-East Regional Planning Conference (SERP) – which represents local councils in the region – wanted to control development by building only 718,000 new homes between 1996 and 2016, believing that anything more would have significant negative environmental and social impacts. The UK Government's Department of the Environment, Transport and the Regions (DETR) thought that it had a better understanding of regional capabilities than local people and favoured a higher total of 860,000. SERP objected to this and the dispute continues (Groom, 1999a).

Limitations on the autonomy of regional authorities

In the UK, where experiments with devolution are still at an early stage, the national government is learning to accept that regional assemblies in Wales and Scotland have the right to adopt different policies. On the other hand, it has heavily restricted the powers of the Regional Development Agencies (RDAs) it has established in England. These are charged with making their regions more competitive by planning economic development and coordinating the regeneration of communities, land and buildings, but their efforts have been frustrated by inadequate powers and finance. So while they can identify the needs of their regions, they cannot meet them. Their joint claim in 2000 for additional funding to meet the unique needs that they had identified was rejected by government, which asserted that 'our strategy is not to set up one region against another' (Groom and Newman, 2000). As the RDAs were established to make their regions more competitive it is difficult to see what else they could be expected to do.

Each RDA presented a ten-year strategy document to the government in 1999, and these reports reveal interesting differences in regional perceptions of the most desirable goals for future development. The principal aim of the North-east RDA, representing one of England's poorest regions, was, not surprisingly, to develop more in a conventional sense by raising GDP per capita to the UK average from its present value of 80 per cent. The RDA for the richest region, the South-east, might have been expected to give higher priority to the social and environmental dimensions of development. Indeed, it recognized that 'we must release the potential of the region as a whole measured in sustainable economic prosperity, social inclusion and environmental quality'. Yet it still gave top priority to economic growth because it judged itself mainly on international criteria and wanted to move into the 'top ten' of the 77 European regions, as ranked by GDP per capita: it was then ranked 23rd. In contrast, the South-west RDA put more stress on the environment, arguing that it has the highest environmental quality of any region in the country and that 'the natural place for environmental industries is where the quality is good'. It aimed to create 24,000 jobs and £370 million of output in environmental industries, with 12,000 more jobs and £260 million of output in the renewable energy field (Groom, 1999b; 1999c).

Limitations on local autonomy

Local governments are invariably at a greater disadvantage than regional bodies in their relations with national government. This prescribes their freedom of action, making it difficult to implement the idea of 'glocalization'. Since UNCED, there has been considerable local action in the name of sustainable development, including the production of Local Agenda 21 plans, and this compares favourably with the limited action at national level (see Chapter 6). Yet while local councils are supposedly responsible for 'deciding the most sustainable way of meeting the needs of their communities' (Taylor and Parker, 1998), most are unable fully to realize their potential. An Audit Commission (1997) report considered the environmental performance of most UK local councils to be 'patchy'.

One reason for this is that local authorities lack sufficient autonomy to respond to local needs. On matters of housing policy, for instance, councils in the UK must work within national guidelines, and can only release rural land for housing after all other options for building on derelict land and converting offices and other buildings have been exhausted (DETR, 1999c). They are also expected to devise plans to integrate different modes of transport in their areas. Yet national government insists on retaining powers of final approval. While this is supposedly intended to ensure uniformity across the country (DETR, 1998a), in practice the result has often been to delay progress.

Problems with local participation

Participation does not always lead to a desirable outcome for local government. For example, a citizens' group in the American city of Seattle decided, in the spirit of Agenda 21, to devise a set of sustainable development indicators in a participatory manner. The 'Sustainable Seattle' group defined sustainability by a consensus process as a state of 'long-term cultural, economic and environmental health and vitality', and developed a set of 40 indicators to reflect these various different dimensions. It decided not to aggregate them into a single index, or to compare indicator values with benchmark values denoting sustainability levels. Instead, the direction of movement in each indicator was used to show progress towards sustainability (Atkisson, 1996). Unfortunately, the City Council rejected the set of indicators, as it felt obliged to monitor sustainability in terms of compliance with the critical goals in the 'Comprehensive Plan' that is obligatory for all municipalities in the State of Washington. The Sustainable Seattle indicators were not compatible with these regional goals and so council officers had to devise an entirely new set (Brugmann, 1997; City of Seattle, 1996).

Policy implications

States keen to achieve more sustainable development must give careful attention to interactions between different levels on the spatial scale. Promoting convergence between the social and environmental performances of groups of states is to be commended. It must not, however, overwhelm national democracy, or exceed either the capacities of the states involved or their willingness to accept common standards. If any of these conditions are breached, this may prevent effective action or produce results that are not sustainable in the long term. Attempts at regional convergence

between states at a similar phase in their economic development are likely to be far more successful than trying to achieve global convergence by setting uniform standards. This is just one instance of how the uneven distribution of economic development at one spatial level can affect performance at higher levels.

The mechanisms used for implementing sustainable development programmes also need careful scrutiny. Devolved and participatory planning approaches are still in their infancy, and lessons continue to be learned. But if the experiences recounted here are in any way typical they are unlikely to provide a magic solution to planning problems. This is because tensions inevitably arise between politicians, civil servants, groups and individuals at different levels of the spatial scale as a result of differences in perceptions and the need to maintain or increase political power. Expectations in some quarters that they will automatically lead to sustainable development are just as illusory as alternative claims that the key lies solely in international collaboration.

Top-down and bottom-up approaches both have their merits. Top-down planning at national level can ensure overall coherence and a flow of information down the spatial scale, while a bottom-up approach can generate popular enthusiasm, improve relevance to specific problems and ensure a flow of information up the spatial scale. However, neither approach on its own holds the key to success. Without some controlling influences from higher levels on the spatial scale, bottom-up projects could degenerate into a 'free for all'.

Perhaps what is needed is a synthesis of the two approaches, a 'top-and-bottom' approach which combines the best features of both. There may be no need to impose this specifically, as it is likely to develop automatically in most situations where tensions arise between top-down and bottom-up methods. The solution arrived at in each case is unlikely to be theoretically ideal or satisfactory to all, and will be determined by the balance of power between the various groups involved in the issue. On the other hand, it will probably be more acceptable than any solution which might have been reached by using just one of the methods.

Another solution to the contradictions between the two planning approaches is to place more reliance on market mechanisms. In many countries national and local governments are adopting liberalization strategies to improve public services, relying less on public organizations and more on private commercial or non-governmental bodies. In the UK this has led to the privatization of housing estates originally built by local councils for rent to low-income groups. Initially, many houses were sold to their tenants in the 1980s. In the 1990s, faced with the estimated £40 billion cost of refurbishing their remaining housing stock, councils have gradually transferred ownership to housing associations or trusts that can raise the capital (Burns, 2000; Burns and Timmins, 2000). The Asian Development Bank (1997) has likewise suggested that city governments in developing countries should switch from being providers of services, such as water supply and public transport, to being facilitators of services provided by others on a profit-making basis. Some see in this a sign of government failure, but others view it as the next step in the expansion of economic democracy. If it does not reduce social welfare, and it frees public money for spending on other areas, such as environmental management and regeneration, then it could make a positive contribution to sustainable development.

Conclusion

Viewed from a spatial perspective, sustainable development is a far more complicated concept than is commonly assumed. Within the framework of the Very Weak Condition of environmental economics theory, it is not necessarily meaningful at all levels on the spatial scale used here, particularly at the local and household levels, owing to the absence of some capital stocks and the conversion processes which link them.

Examination of the sustainability of development in typical spatial units at different levels of the spatial scale has revealed the need to treat individual units as open economies, rather than in isolation, in order to match real world conditions. At the national level, the Very Weak Condition can be used as a criterion for sustainable development in open economies, provided that national trends in Natural Capital and Human and Man-Made Capital are corrected for inequities associated with the inward and outward flows of raw materials, pollution and other forms of environmental degradation. These result in countries or sub-national regions importing economic development, or importing or exporting sustainable development. This leads in turn to uneven patterns of economic development and sustainable development, both at the global level and within countries, though the effects of inequitable transfers may be ameliorated by various compensation mechanisms, such as migration and state intervention. Making corrections for such transfers at sub-national levels is far more difficult because of the complexity of flows and lack of data.

A new kind of international framework is needed to reduce the incidence of sustainability transfers. However, since development is so uneven at global level it would be inequitable to expect all countries to achieve the same degree of sustainability of development at the same time, as is required by 'globalist' proposals to impose uniform environmental and social standards on world trade. A 'gradualist' approach might be more appropriate. This would assess the sustainability of development, or environmental and social standards, relative to the norm expected for each country's current level of development. This is not yet another ambiguous compromise, like the portrayal of sustainable development in the Brundtland Report (WCED, 1987), but a genuine alternative that could be monitored just as rigorously, provided that acceptable relationships between the rate of increase in social and environmental performance and the level of economic development could be constructed on the basis of theoretical and empirical studies.

Two types of interactions between different levels on the spatial scale were examined here: influences from higher levels and influences from lower levels. Influences from above can lead to limited convergence in the development paths of countries at a similar phase of development. But taking a globalist approach and trying to impose uniform environmental and social standards on all countries, regardless of their level of development, is neither equitable nor advisable. A gradualist approach, typified in the principle of differentiated obligations often employed in international regimes, would be far more equitable to developing countries. No firm conclusions were reached about the relationships between levels of economic development and sustainable development and their spatial unevenness. More in-depth theoretical and empirical studies of these relationships are needed in view of their tremendous importance to international, regional and national planning.

Sustainable development is often mistakenly equated with either successful international collaboration to solve global environmental problems or participatory actions at the local level. The former approach is inadequate because global environmental problems are merely symptoms of unsustainable development at the national level. Consequently, the real solution to global climate change lies in improving the sustainability of development of every country. International agreements can provide an equitable framework for this, but that is all. Nor is participation a magic solution to unsustainable development. It is merely the most popular development strategy today. Experiments in recent years with participation, and devolution of management responsibility to lower levels on the spatial scale, suggest that while these have an important role to play in improving the sustainability of development, they too have their limitations. It was suggested that a combination of top-down and bottom-up approaches might be optimal for implementing programmes because it should achieve the best balance between coherence and enthusiasm, and promote better flows of information in both directions on the spatial scale.

The Very Weak Condition, suitably corrected as necessary, appears from this discussion to provide a reasonable framework for analysing the role of spatial scale and spatial interactions in sustainable development. Other conditions, from environmental economics and ecological economics theories, were not so appropriate. However, the Very Weak Condition did have its limitations, particularly relating to the aggregation of Human and Man-Made Capital and the requirement that changes in this be compared directly with changes in Natural Capital. To provide a more comprehensive and practical explanation of spatial aspects of sustainable development we need a better theoretical model which disaggregates the economic, social and environmental dimensions of development. This would be more flexible than the Very Weak Condition and more suited to monitoring transfers between different countries and other spatial units. It would also allow planners to be far more discriminating when making trade-offs between the three dimensions of development. It is all too easy at present to portray sustainable development as being 'anti-development' and concerned solely with the environment. A three dimensional model would dispel this misconception and reduce current constraints on realizing the potential of sustainable development.